Supporting social skills development through a targeted intervention using cooperative videogames in a Special Development School

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Abstract

Students with autism and Down syndrome can experience a range of social-emotional challenges manifesting from differences in social understanding and norms. While there are existing social skills interventions, until now the use of videogames and gamer culture as tools for facilitating the development of these skills has been largely unexplored. In spite of a wealth of research investigating principles of cooperative game design, there is limited reported research that specifically focuses on digital games-based learning for students with social emotional challenges. The research reported here sought to address this gap in the literature.

A design research methodology was used to develop a new social skills intervention that built upon the interest of participants in videogames. Working with the teaching staff and five students at a Special Development School, ten iterative versions of an intervention were planned, implemented and evaluated. Data generated during the implementation of each version were inductively analysed, to investigate the relationships between the social skills performance in the physical and virtual environments, interactions with the teaching staff, and the role of game design in creating the conditions for player interaction. The analysis of this data informed modifications to the social skills being prioritised by this intervention, as well as the methods of instruction used to teach these skills and increase their frequency of performance.

Findings from this study offer insights to both educators and videogame designers. The data led to the identification and refinement of 18 teaching strategies for optimising the acquisition and performance of social skills during cooperative gameplay. Strategies were identified for encouraging participation in group play, supporting students to consider perspectives of

others on fairness, and for assisting students in recognising when to give instructions and share information. In addition to the teaching strategies, 39 game design recommendations for creating the ideal conditions for game-based collaboration were developed. The recommendations relate to leveraging player identity within the team to increase collaboration, specific rules of play that increase interactions between players, the characteristics of level design conducive to social skills performance, and games features that enable all players to be included. These teaching strategies and game design principles provide new understandings of how cooperative multiplayer games can serve as tools for social skills interventions, and how the systems of intervention can be optimised to take advantage of the affordances offered by these tools.

Declaration of originality

This is to certify that:

i. the thesis comprises only my original work towards the PhD, except where indicated in the preface,

ii. due acknowledgement has been made in the text to all other material used,

iii. the thesis is fewer than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.



Matthew Harrison

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Preface

It is important to acknowledge that this thesis contains four illustrations commissioned from Megan McLennan. The purpose of these illustrations is to communicate important features of this study while protecting the privacy of the participants. A comprehensive description of the privacy protections implemented as part of this research project is provided in Section 4.7.4 in *Chapter 4* of this thesis. The author would also like to acknowledge that he received a Research Training Program scholarship offsetting his tuition fees.

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Chapter 1: Introduction

1.1 Statement of purpose

> **"Most people think video games are all about a child staring at a TV with a joystick in his hands. I don't. They should belong to the entire family. I want families to play video games together."**
>
> Shigeru Miyamoto (as quoted in Hall, 2005)

This quote from legendary game designer Shigeru Miyamoto, creator of the Super Mario Bros. and the Legend of Zelda series, articulates his desire to create games that are connective social experiences. For many students with social-emotional challenges, such as those experienced by children with autism, games can provide a structured space for social engagement and meaningful interaction (Ringland, Wolf, Faucett, Dombrowski, & Hayes, 2016). Social engagement and meaningful interaction are at the centre of this research project.

Using a **design research** methodology, this study sought to explore how cooperative videogames could be used to develop social skills for students with social-emotional challenges. This research project involved working with five gaming-enthused student participants, two teaching assistants and a teacher-researcher in a Special Development School (SDS). Ten iterative intervention designs were planned, implemented, evaluated and adjusted in order to develop an intervention that would support the students in acquiring and performing key social skills.

The study sought to optimise the systems of social skill intervention, identifying high priority social skills required for successful collaborative play and effective methods of instruction for

developing these skills. Game design also had an important role, and this study investigated the features of various games that created the optimal conditions for practising the focus social skills. Through the processes of design research, a social skills intervention was developed alongside a set of recommendations for designing multiplayer videogames for use in such interventions.

1.2 Background to the study

At the centre of this research project are three core assumptions that are grounded in current policy, theory and research literature:

1. Some students with disabilities struggle greatly with social communication and interaction resulting in a range of **social skills challenges**. Consequently, they are restricted in their ability to work collaboratively with their peers.
2. Social skills are vital for all students in terms of creating and maintaining healthy relationships, community inclusion, learning and economic participation.
3. Although students might be at different developmental stages in relation to social development, every student can make progress towards developing the social skills required for attaining these outcomes.

All three of these assumptions underpinned the key objective of this study, addressing the students' social skills challenges.

Four of the five student participants were diagnosed with autism, classified in Australia as a social-emotional disability (Australian Government Department of Education and Training [AGDET], 2014). The other student had a diagnosis of Down syndrome, a cognitive disability

(Vičić et al., 2017). Although these primary school-aged students were enrolled in a SDS, they were part of a program that would allow them to transition to a mainstream high school.

One of the defining characteristics of autism is differences in social communication and social interaction (American Psychiatric Association [APA], 2013), yet the manifestations of this characteristic can be wildly divergent. The differences of autism have long been understood to exist on a broad spectrum, with a wide range of social capabilities and behaviours (Wing & Gould, 1979; Wing, Gould, & Gillberg, 2011). Many of these learners can verbally communicate and display average or above average intelligence (Ghaziuddin & Mountain-Kimchi, 2004; Goldsmith & Kelley, 2018).

For the students in this research, the challenges of autism really became apparent in the underdevelopment of the specific social skills and behaviours required for working with their peers, and in their circumscribed interests, or obsessions, with specific items or information (Crooke & Winner, 2017; Klin, Danovitch, Merz, & Volkmar, 2007; Ruzich et al., 2015; Winner, 2007). While the student with Down syndrome faced different social challenges in some respects, the functional outcomes remained very similar to those of his peers with autism. Down syndrome results in communicative challenges, including a significant delay in non-verbal cognitive development, in conjunction with additional, specific deficits in language production and auditory short-term memory in infancy and childhood (Chapman & Hesketh, 2000; Gass, Kennedy, Hastieb, & Wentworth, 2013). These communicative challenges presented barriers for this student in working with his peers. All five students required an intervention to address challenges with social interaction and communication.

While each of the students in this study were unique, many shared a common challenge in reading verbal and non-verbal cues and engaging in social communication and interaction,

particularly in the context of completing collaborative tasks with their peers. At the heart of these challenges were fundamental differences in understanding social skills, the skills required to adapt “effectively to others across contexts” (Winner, 2007, p. ix). A metaphor of climbing a mountain is useful for explaining the experiences of these students in developing social skills. The mountain represents a journey requiring sustained motivation, effort and persistence in the face of numerous challenges. The size and gradient of the ascent is different for every student, but for the participants in this study the journey was decidedly more arduous than would be expected for their age equivalent peers. Despite the difficulties, this learning journey is worthwhile as social skills offer the potential for positive relationships with age equivalent peers (Hehir et al., 2016), a sense of social security (Bellini, 2004; Bellini, Peters, Benner, & Hopf, 2007) and a broader acceptance by society (Attwood, 2016; Vickerstaff, Heriot, Wong, Lopes, & Dossetor, 2007).

The teacher-researcher’s passion for videogames was something shared by the student participants in this study, with both the teacher-researcher and most of the student participants identifying as ‘gamers’. Videogames were introduced initially into the classroom prior to this study as a reward for students and as a way of building positive relationships with and between some of the more passive individuals. Gameplay was a powerful motivator for social participation within this group of student participants. More than just motivating the players to participate in these group interactions, certain designed game mechanics seemed to support students in performing social skills that they were hesitant to use in other contexts. The supporting role of effective game design is represented in Figure 1.1 as a yak, easing the burden of this learning journey through creating supportive and nurturing conditions that encourage the students to practice the performance of the targeted social skills.

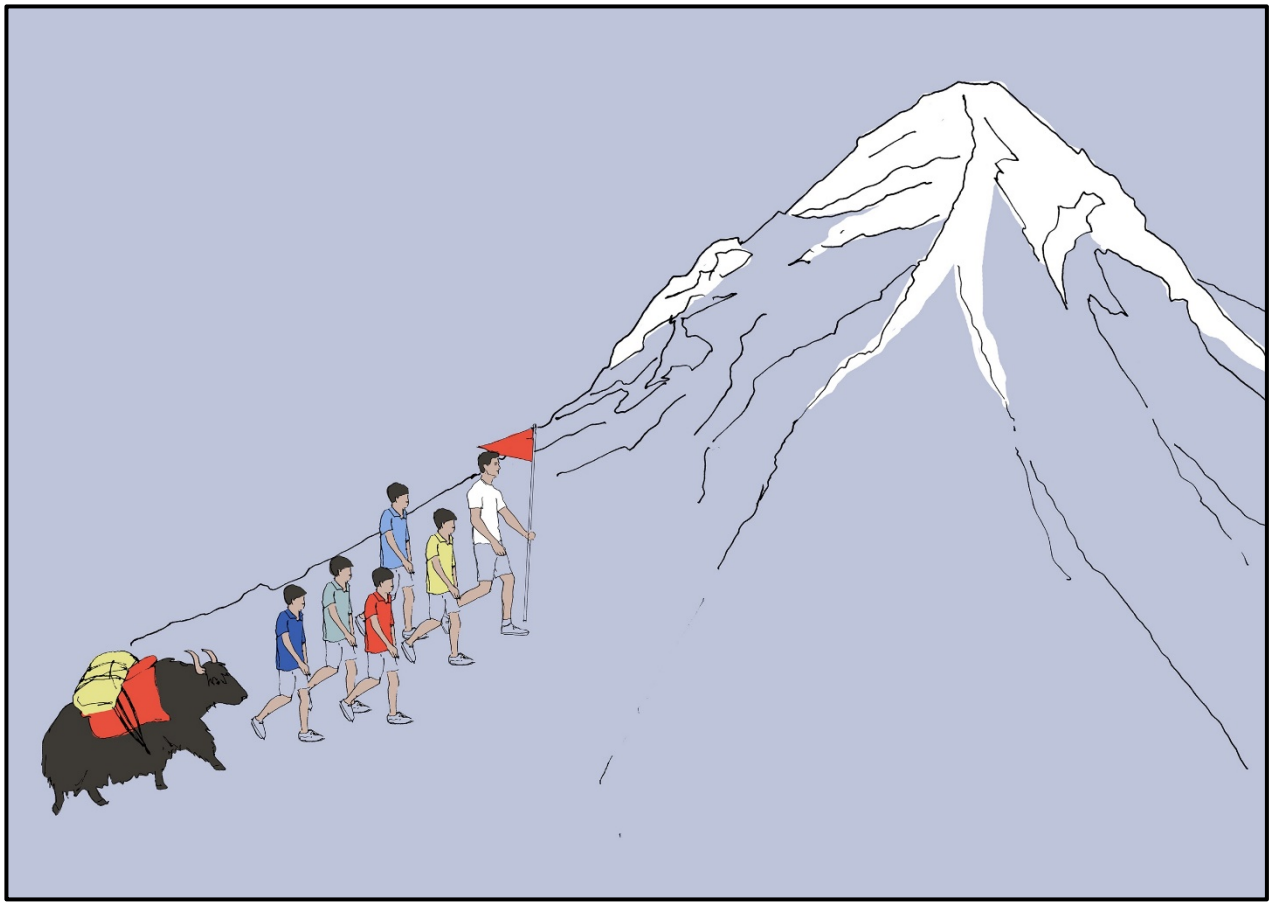


Figure 1.1. A metaphorical depiction of the social challenges faced by the students, and the perceived supports for addressing these challenges.

It should not be surprising that the students and the teacher-researcher shared an interest in videogames, as this reflects shifting attitudes in society. Videogames have become a culturally entrenched form of entertainment. The gross global revenue generated from videogames is estimated at a staggering US$71.3 billion (Takahashi, 2016), which is almost double the total annual earnings of the film industry (Child, 2016). This financial growth correlates with a cultural transition. Early perceptions of 'gamers' are being challenged, with over a decade of evidence suggesting that the average age of people playing videogames is almost 35 (Brand, Todhunter, & Jervis, 2017), and close to half of these players are female (Kafai, Heeter, Denner, & Sun, 2008; Schultheiss, 2017). A gradual recognition by academia, the media and political powerholders of this diverse demographic, and the subsequent

legitimatisation of ‘gamer culture’, has resulted in broader political and social recognition for players. This has led to a more balanced discussion of the potential benefits and challenges of playing videogames, particularly in social contexts, as described by Shigeru Miyamoto (Hall, 2005) in the opening quote of this chapter.

Digital Games-Based Learning (DGBL), or the “integration of digital games or gaming mechanics into educational experiences” (Johnson, Becker, Estrada, & Freeman, 2014, p. 38) has become an increasingly popular pedagogical approach within formal educational settings around the world (Chang & Hwang, 2019). This growth in interest has also been mirrored by increasing academic interest. DGBL researchers position videogames as learning tools with the potential to develop knowledge and skills in a wide variety of areas (Gee, 2013; Squire, 2005; Voulgari & Komis, 2010). There is also academic interest in the emergence of a distinct ‘gamer’ culture over the past 30 years (Bosser & Nakatsu, 2006; Crawford, 2011; Peterson & Hogan, 2006). Educators and researchers have been exploring the use of videogames in formal and informal educational settings for a number of years. However, little research has been conducted with games-based interventions for individuals with social-emotional challenges (Faucett, Ringland, Cullen, & Hayes, 2017).

1.3 Research questions

This study seeks to explore the possibilities and challenges of using videogames as developmental tools for the social skills and behaviours required for collaboration. The research objectives and questions are presented in Table 1.1.

Table 1.1. The primary research question, objectives and guiding questions for this study.

Primary research question:	
How can children with social-emotional challenges develop targeted social skills through intervention using cooperative videogames?	
Objectives:	**Guiding questions:**
Optimising the systems of intervention: To design a set of guidelines for interventions using cooperative videogames.	a) What methods of instruction can be used to optimise the learning of targeted social skills? b) How can targeted social skills be practised and performed during cooperative gameplay? c) What is the role of teaching staff in supporting students' social skill development in this intervention?
Creating the conditions for collaboration: To develop a set of game design recommendations that create the conditions for collaboration.	d) How do the rules and mechanics of different games impact upon social interactions? e) How can game design create the conditions for inclusion?

An initial pilot study and ten iterative versions of the intervention provided the starting point for addressing these questions. This research examined the role of both game design that promotes interactions and the means through which educators can use these interactions to support the development of the targeted skills. This approach allowed for the development of new knowledge, while being directed by tested methodologies for the analysis of social interactions within collaboration.

1.4 Significance of this study

The research was justified through three interconnected levels of rationale: a personal level, a moral level and a theoretical level. These interconnections are depicted in Figure 1.2.

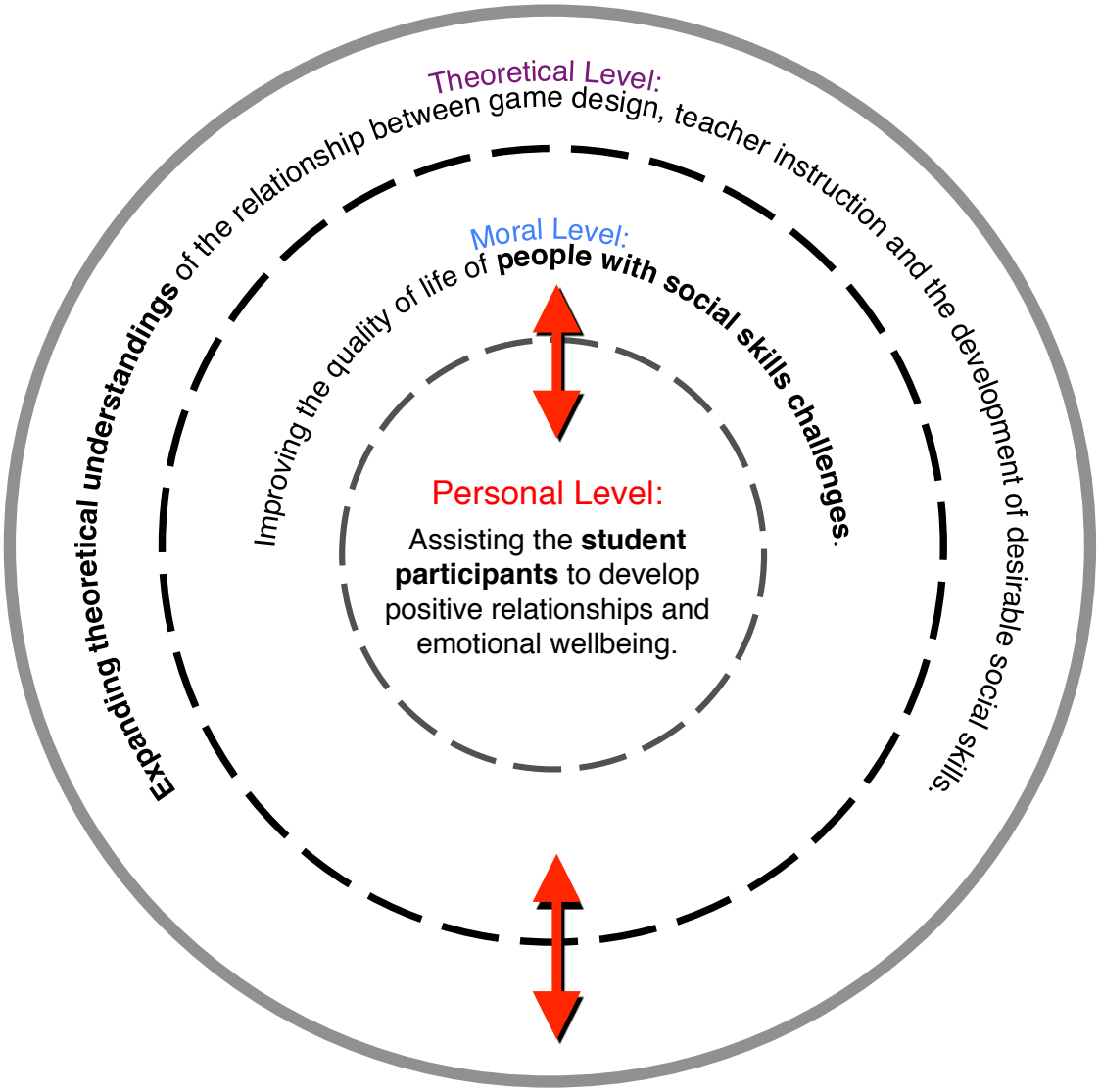


Figure 1.2. The relationship between the different levels of context for conducting this research.

At the personal level, the purpose of this research project was to assist the student participants in developing the social skills and behaviours necessary for them to develop positive relationships, to improve their sense of self-worth and to help them to feel accepted

by their community. To work towards this outcome, this study harnessed the strong levels of interest that playing videogames held for many of the students and sought to use their engagement in collaborative gaming as a space for addressing these challenges. Central to this research was knowing what each participant was ready to learn and what they needed to learn next.

There was a broader moral imperative for finding a means to increase the inclusion of this population in their wider communities. This moral responsibility is enshrined in the *Convention on the Rights of Persons with Disabilities* (CRPD) and the *Optional Protocol* (CRPD OP), on both of which Australia is a signatory (United Nations Department of Economic and Social Affairs [UNDESA], 2018). Particularly pertinent to this research study is the declaration that teachers need to utilise "appropriate augmentative and alternative modes" of education to ensure that children with disabilities can fully participate in society (United Nations General Assembly [UNGA], 2006, Art. 24). Numerous studies have identified that the focus population for this study experience disproportionately higher rates of social anxiety, separation anxiety, obsessive-compulsiveness, physical injury fears and panic attacks (Bellini, 2004; Bellini et al., 2007; Kim, Szatmari, Bryson, Streiner, & Wilson, 2000). Bellini (2004) identified a significant relationship between social skills deficits and these social anxieties. This has resulted in a wide variety of interventions being available for children with social skills challenges, including the adaption of other technologies, such as virtual reality, to develop social competencies within this population (Bellini et al., 2007; Kandalaft, Didehbani, Krawczyk, Allen, & Chapman, 2013). These established interventions have been effective to varying degrees and provide guidance for the development of new social skills interventions. While research into such interventions is useful for this study, there has been

very limited school-based research into harnessing an interest in videogames for the purposes of developing social competence (Saridaki, Gouscos, & Meimaris, 2009).

This speaks to a theoretical justification for research in order to expand upon understandings of social skills development in a videogames-based context. As already indicated, there is growing global interest in the use of digital games in formal education (Chang & Hwang, 2019; Hwang & Wu, 2012). Despite this interest, there are significant areas that remain unexplored, particularly in regard to the use of videogames for developing social competencies. Both Tsekleves, Cosmas and Aggoun (2016) and Connolly, Boyle, MacArthur, Hainey, and Boyle (2012) highlight a privileging of research directed towards improving measured academic outcomes in multiplayer DGBL. There has been substantially less attention paid to the use of multiplayer videogames for teaching the underpinning social skills required for collaborative problem-solving, particularly for children with disabilities (Eder, Diaz, Madela, Magusara, & Sabellano, 2016; Saridaki et al., 2009). This is despite a dramatic increase in the reported number of children in schools with socio-emotional disabilities such as autism (Reichow & Volkmar, 2010). The research reported here aimed to fulfil a need for a practical evidence-based understanding of the types of social skills and behaviours that children with disabilities can develop while playing digital games. It also sought to explore ways in which components of game design can support this developmental process. Although the findings of this particular study are bounded within the context of one classroom, they provide illustrative proof of concept for informing future research into games-based interventions for children with social-emotional challenges.

1.5 Structure of the thesis

This thesis is organised into nine chapters, as represented in Figure 1.3.

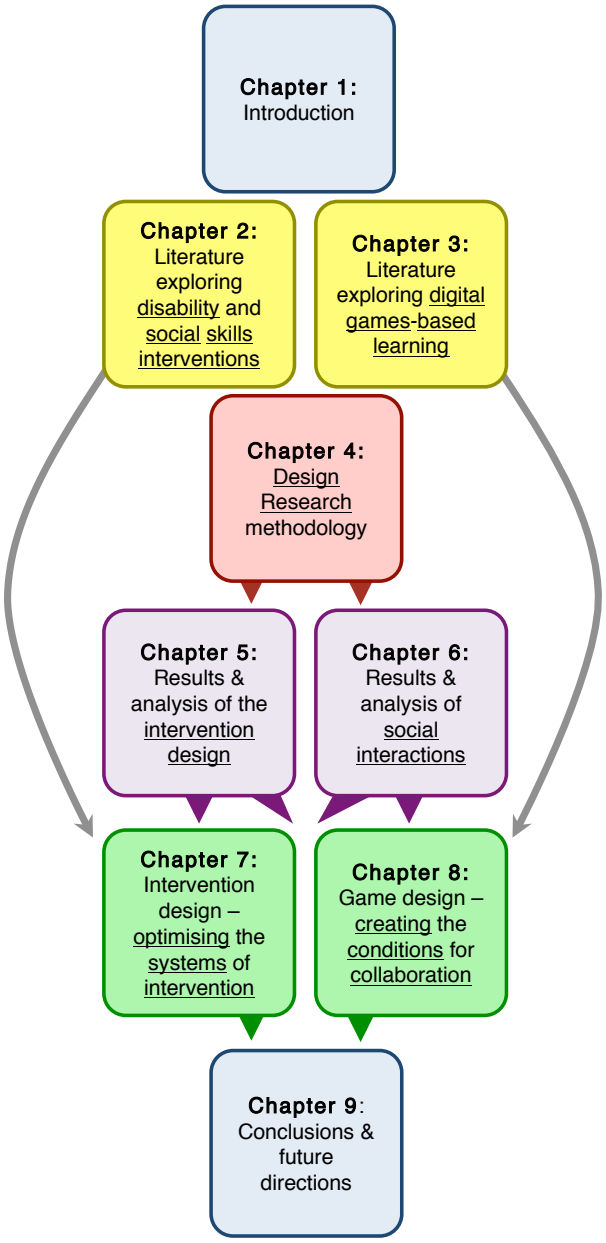


Figure 1.3. The structure of this thesis.

Following this introduction, a review of the literature is thematically organised into two chapters. *Chapter 2* presents an exploration of the social skills challenges presented by autism and Down syndrome, the reasons why these skills are considered important for all

learners and how these challenges are currently being addressed. *Chapter 3* examines the suggested affordances of videogames as learning spaces, particularly in relation to collaborative play and motivation. This discussion begins with a broad exploration of the value of play and game-based systems for learning, and then focuses in on the characteristics and levels of interaction in multiplayer gaming.

Chapter 4 introduces the methodology for this research project, with a detailed examination of design research, an introduction to the *Compleat model* of design research (Middleton, Gorard, Taylor, & Bannan-Ritland, 2008) and the methods for data generation and analysis used to evaluate and inform each iterative cycle of the intervention design. *Chapters 5* and *6* report on the results and key findings of this iterative process. Using the *Compleat model* to guide the research, *Chapter 5* examines the results from the initial pilot study and significant modifications to the skills being targeted, the methods of instruction and the games being used to create the conditions for collaboration. *Chapter 6* examines the frequency and duration of different types of interactions between the students in the physical and virtual worlds, as well as the types of interactions between the teaching staff and the students. This chapter then places these interactions in context by examining a number of significant events observed during cooperative gameplay over ten intervention lessons. These events provided clear examples that could be examined in more depth to address the research questions.

The subsequent discussion is divided into two parts: *Chapters 7* and *8. Chapter 7* examines how educators can optimise the systems of instruction in order to take advantage of these interactions, supporting and nurturing the performance of the requisite social skills at the point needed for collaboration to be possible. Based on the findings of the research, *Chapter 8* contains a set of recommendations for game design that can create the conditions for social

interaction between players in co-located multiplayer videogames. *Chapter 9* then reflects on the entirety of the study to draw a number of key conclusions and to consider future directions for this field of study.

Chapter 2: Literature exploring disability and social skills

2.1 Glossary of specialised terminology used in Chapter 2

Term:	Explanation:
Acquisition deficits	Resulting from either the absence of knowledge about how to perform a given social skill or difficulty in knowing which social skill is appropriate in specific situations (Gresham, Elliott, & Kettler, 2010).
Autism	A "life-long neurodevelopmental condition interfering with the person's ability to communicate and relate to others" (Elsabbagh et al., 2012, p. 160).
Comorbidity	The co-occurrence of one or more disorders in the same individual either at the same time or in some causal sequence (Australian Government Department of Health [AGDH], 2003).
Comprehensive treatment models (CTMs)	A set of practices organised around a conceptual framework and designed to achieve a broad learning or developmental impact on the core deficits of autism spectrum disorder (ASD) (Wong et al., 2015, p. 1951).
Dosage	The regularity with which an intervention is conducted or implemented with the focus participants (Mitchell, 2014).
Down syndrome	A cognitive disability resulting from an additional copy of chromosome 21, creating a total of 47 chromosomes (Fidler, Hepburn, & Rogers, 2006).
Neurodiversity	A political perspecitve that positions autism as an identity and part of natural human variation, with an emphasis on removing socio-political barriers and promoting equal opportunities rather than cure (Kapp, Gillespie-Lynch, Sherman & Hutman, 2013).
Performance deficits	Failure to perform a given social skill at acceptable levels even though the individual knows how to perform the social skill (Gresham et al., 2010).
SDS	Schools for students with moderate to profound intellectual disabilities (IQ below 50) or where a disability results in behavioural challenges and where IQ testing is not possible (Association for Children with a Disability [ACD], 2018).
Theory of mind	An individual's capacity to understand the mental states of others, and to recognise that those states might differ from their own (Gallagher & Frith, 2003).
Video modelling	Video-based interventions that use selected footage of the individual displaying a desirable behaviour as a self-model (self-video modelling), as well as interventions that use footage of another individual as a model (peer-video modelling) (Delano, 2007).
Video review	Video-based interventions that provide learners with access to an entire record of events. Learners and educators discuss events, identifying areas of success and challenge and then develop goals in response to this discussion (Qarabash, Heslop, Kharrufa, Balaam, & Devlin, 2018).

2.2 Introduction and structure

The following chapter explores the labels of disability with which the student participants had been diagnosed and the suggested functional social implications presented by these disabilities. As people experiencing challenges with social interaction is not a new phenomenon (Blacher & Christensen, 2011), there is a wealth of literature exploring social-emotional challenges associated with disability, and social skills interventions designed to address these challenges. This literature review is thematically organised as outlined in Figure 2.1.

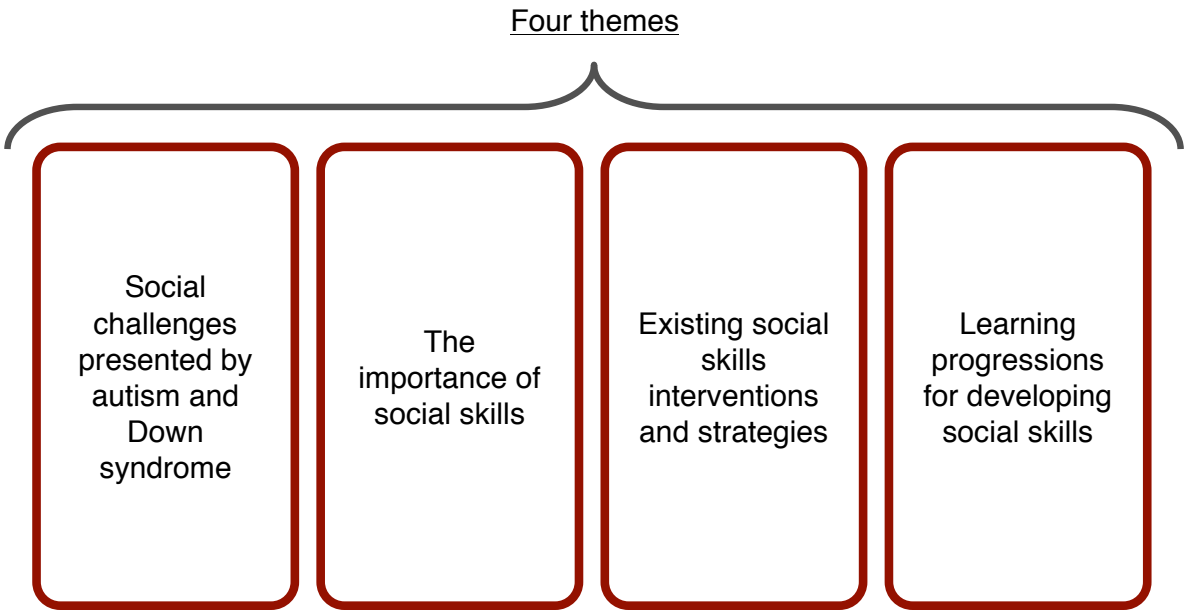


Figure 2.1. Key themes explored in *Chapter 2*.

The key themes provide perspectives on the areas of social challenge for the student participants, as well as the reasons why these skills are important for all students to develop. As the social context for this study is cooperative gameplay, there is an emphasis on the skills required for working in partnership towards a common goal. Analysis of the literature

revealed the role of social competencies in student mental wellbeing and agency, and the relationship between these social interactions and the processes of learning.

In order to address social skills challenges, it is critical to build from what is known about effective intervention. Many approaches to social skills intervention are already being used by schools and in therapy groups, with extensive research having been conducted into the conditions in which these interventions can be effective. Analysing the findings of these existing studies was important in planning the development of a new intervention. Findings from existing synthesises of evidence, such as meta-analyses and literature reviews, provided a starting point for determining which characteristics of these different approaches have been identified as being important in successful school-based social skills interventions. Characteristics included the frequency and duration of intervention sessions, the location and conditions in which interventions were implemented and the suggested effectiveness of a range of specific intervention strategies. From this analysis two specific strategies showed particular promise for inclusion within the design of a videogames-based social skills intervention: video modelling and video review. A number of more general instructional principles were also identified in the literature review as having a broad base of evidence. These are important for consideration in all educational interventions.

The specific social skills to focus on developing through an intervention are also important to consider. While the literature surrounding autism and Down syndrome highlights specific areas of social challenge, there is no suggested order in which these skills should be taught. To assist in identifying which social skills should be targeted within this intervention and the sequence in which they should be taught, two learning progressions were used:

1. the *Students with additional needs (SWANs) social processes learning progression* (Coles-Janess & Griffin, 2009), and
2. the *Collaborative problem-solving empirical progressions* (Hesse, Care, Buder, Sassenberg, & Griffin, 2015).

The *SWANs social processes learning progression* (Coles-Janess & Griffin, 2009) provides a fine-grained tool currently in use in many schools in Australia. This tool provides guidance to assess and support students identified as having social-emotional challenges, such as the participants of this study. Although the *SWANs* tool was designed to meet the requirements of teachers working with students with disabilities, it has the functional intention of "assessing students on the basis of their abilities, not their disabilities" (Department of Education and Early Child Development [DEECD], 2011, p. 5). The importance of a strength-based approach is explored in this section of the literature review.

An alternative set of learning progressions, the *Collaborative problem-solving empirical progressions* (Hesse et al., 2015), were also reviewed. A product of the Assessment and Teaching of 21st Century Skills (ATC21S) project, this set of progressions assists with unpacking the social dimensions required for effective collaborative problem-solving. Importantly, these are distinct from the *SWANs social processes learning progression* in that they were not designed specifically for students with disabilities. The *Collaborative problem-solving empirical progressions* (Hesse et al., 2015) provide a series of sequencing skills in terms of sophistication and how individual skills can be used in conjunction with other skills (Hesse et al., 2015). Comparing and contrasting the descriptions of the social skills within these two progressions was important for providing a vocabulary for describing the skills being taught. The two progressions were also useful for identifying which specific skills to

initially focus on in the intervention, and for sequencing the instruction of subsequent social skills as the students made progress over the ten lessons.

2.2.1 Inclusion criteria for the literature review

Studies included in this literature review were selected using the following criteria:

- The studies were published in English.
- A strong emphasis was placed on academic sources, such as peer-reviewed journal articles, or diagnostic tools supported by a large proportion of the professional community.
- In presenting information on the nature and prevalence of disability, reference was made to information from governmental departments and professional bodies, such as the *Australian Bureau of Statistics* and the *Australian Medical Association*.
- The studies prioritised the voices of individuals and communities, including people with disabilities. In order to ensure that these voices were included, this review referenced popular literature and online-based support groups, such as *Amaze* (Victoria, Australia) and the *National Autistic Society* (United Kingdom).
- Although year of publication was not a constraint, priority was given to articles published within the last decade. This is particularly true for literature discussing understandings of disability due to the fluid and rapidly evolving nature of these fields of study.
- Other relevant literature was included to either provide context to present understandings, or to show the evolution of thought surrounding a particular concept.

2.3 The complexities of defining and labelling disability

> **"The greatest mistake - the view of a child's abnormality as only an illness - has made our theory and practice subject to a most dangerous delusion … we meticulously analyze every corpuscle of the defect, every little speck of disease found in abnormal children, while we never notice the gold mines of health inherent in each child's organism, no matter what the affliction may be."**
>
> - Lev Vygotsky (as quoted in Rieber & Carton, 1993, p. 80)

These words from one of the forefathers of developmental models of assessment, Lev Vygotsky, bring to attention the importance of focusing on what students can do as opposed to merely highlighting the challenges. Traditional medical models are largely concerned with explaining disability in terms of deficits or deficiencies. Medical labels of disability can be particularly problematic when used to categorise individuals who share a common label but have very different functional needs (Berman & Graham, 2018; Rohmer & Louvet, 2018). Graham, Berman, and Bellert (2015) describe the complexities of working with children with disabilities, and strongly caution against seeing the label as the start and the end of a student's learning profile. This thesis mostly adopts an alternative social model for discussing disability, compared with the medical model. This approach is summarised in Table 2.1. The social model of disability considers the challenges in terms of understanding the **functional requirements** for individuals to be able to participate in society (Gallagher, Connor, & Ferri, 2014; Thompson, 2016), with an emphasis on **reducing the barriers** people with disabilities face so that this is possible.

Table 2.1. Comparisons between the medical and social models of disability discourse (Haegele & Hodge, 2016, p. 194).

	Medical model of disability	Social model of disability
What is disability?	An individual or medical phenomenon that results from impairments in body functions or structures; a deficiency or abnormality	A social construct that is imposed on top of impairments by society; a difference
Access to treatment or services	Referral by diagnosis	Self-referral, experience driven
Targets of interventions	"Fixing" the disability to the greatest extent possible; "normalising"	Social or political change in an effort to decrease environmental barriers and increase levels of understanding
Outcome of interventions	Normalised function; functioning member of existing society	Self-advocacy, changes in environment and understanding, social inclusion
The agent of remedy	The professional	Can be the individual, an advocate, or anyone who positively affects the arrangements between the individual and society
Effects on individuals who are typically functioning	Society remains the same	Society evolves to be more inclusive
Perceptions toward individuals with disabilities	The individual is faulty	The individual is unique
Cognitive authority	Scientists and doctors	Academics and advocates with disabilities
Perception of disability	Being disabled is negative	Being disabled, in itself, is neither positive nor negative

Focusing on the individual needs of children with disabilities, enabling their voices to be heard and providing supports and interventions that are responsive to their interests is enshrined in the *United Nations' Convention on the Rights of the People with Disabilities*. People with

disabilities are defined as “those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers might hinder their full and effective participation in society on an equal basis with others” (UNGA, 2006, Art. 1). A nuanced understanding of each student’s profile including interests, motivators, and specific areas of strength and challenge, is far more valuable than a generic label for planning an effective intervention to reduce barriers for social inclusion (Berman & Graham, 2018; Woods, 2017). Although this literature review examines how best to develop specific social skills, it also recognised the individuality of the participants and the prioritised stakeholder voice in the design and implementation of the intervention.

While medical labels are simply the very beginning of understanding students and how they interact with the world around them (Berman & Graham, 2018; Gallagher et al., 2014; Woods, 2017), they can serve some valuable purposes for educators when used judiciously and with sensitivity. Labels can be useful for educators in school leadership positions comparing their school population to the broader Australian population and identifying foreseeable priority areas of need, such as social skills interventions. An awareness of a diagnosis can also assist educators in recognising ‘red flags’ when a student is finding a social situation challenging to navigate (Jones, Gallus, Viering & Oseland, 2015; Winner, 2007) and can assist in foreseeing potential challenges that a student with a disability might encounter (Gallagher et al., 2014). Using labels can also help educators when seeking advice and support from specialist allied health staff, such speech pathologists. When descriptions of disability are used with precision and sensitivity, they can be effective in conveying the challenges that students can encounter as a result of their respective conditions.

However, caution should be used when attempting to ascribe labels in isolation without considering the impact of comorbidities or ecological factors. Graham et al. (2015) emphasised that the "distinctions between difference and disability or learning difficulty are complex matters" (p. 145), particularly in relation to situations where students have multiple concurrent diagnoses, known as comorbidities (AGDH, 2003). This is particularly true of the types of disabilities that fall under the umbrella 'social and emotional disabilities' in the Australian context. This includes a wide range of diagnoses, such as autism, Attention Deficit Hyperactivity Disorder (ADHD) and obsessive-compulsive disorders (AGDET, 2014). Mattila et al. (2010) emphasised that even within a single label such as autism, there are no universally agreed upon boundaries. Children with a diagnosis of autism can display indicators of several overlapping disorders and behavioral symptoms and so educators need to focus on the needs of the specific child.

With these cautions in mind, specific labels of disability offer insights into the social challenges experienced by the student participants in this study. Autism, classified by the Nationally Consistent Categories of Disability (AGDET, 2014) as a socio-emotional disability, and Down syndrome, a cognitive disability, are the two specific labels of disability that have been ascribed to the participants in this research project. A detailed examination of each is required to understand the social challenges these students can experience in collaborative problem-solving.

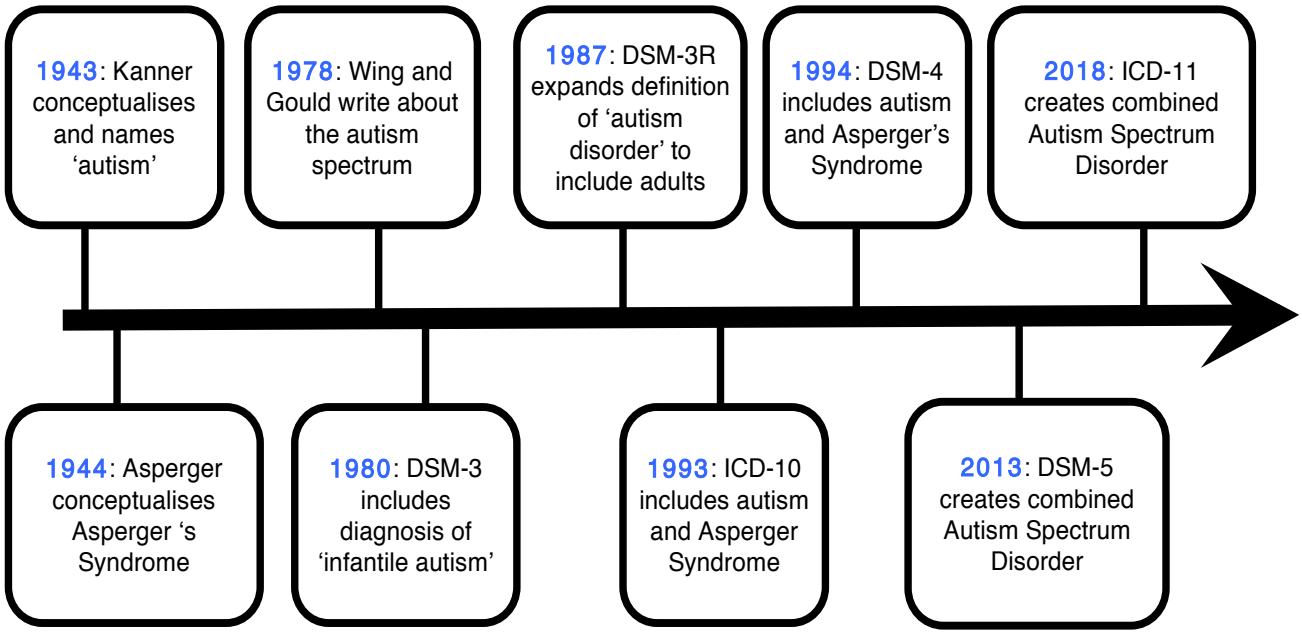
2.4 Autism and social skills

Autism is defined as a "life-long neurodevelopmental condition interfering with the person's ability to communicate and relate to others" (Elsabbagh et al., 2012, p. 160). But how autism

has been understood has changed over time and interventions to address perceived areas of challenge have evolved in response.

2.4.1 From deficits to differences: Historical changes in understanding autism

Understandings of autism have changed significantly over the past seventy years, both in defining characteristics and the ways in which students with autism can be supported. The following sections explore some of these key changes, as summarised in Figure 2.2.



Abbreviations:

- **ICD:** *International Statistical Classification of Diseases and Related Health Problems*
- **DSM:** *Diagnostic and Statistical Manual of Mental Disorders*

Figure 2.2. Significant changes in understanding autism. Adapted from Silberman (2015) and Feinstein (2011).

Early research into autism was important for recognising the existence of this population, while unfortunately also creating many misconceptions. Leo Kanner was highly influential in shaping understandings of autism. His writings, beginning in the 1940s, popularised both the term 'autism' and the notion that children with autism have an apparent lack of desire for social relatedness, which he described as *extreme aloneness* (Blacher & Christensen, 2011; Kanner, 1943). This original perception of children with autism as not wanting to be social has been strenuously challenged (Petrina, Carter, Stephenson, & Sweller, 2017; Sedgewick, Hill, Yates, Pickering, & Pellicano, 2016) yet it remains a popular misconception in many communities (Baron-Cohen, 2017; Silberman, 2015). It should be noted that the classic Kanner understanding of autism focused on an insistence that the diagnosis of autism was restricted to children (Silberman, 2015). Kanner attributed some of the causes of infantile autism to the impact of the mother in the early development of the child (Douglas, 2014; Silberman, 2015), which has now been absolutely discredited (Douglas, 2014; Sousa, 2011; Weintraub, 2011).

Modern academic understandings of autism have evolved significantly, with revised perspectives on the defining characteristics and appropriate supports for individuals with autism. These changing perceptions can be traced back to the seminal work of Wing and Gould (1979). Instead of focusing on a preference for social isolation, Wing and Gould (1979) identified abnormal communication, abnormal social development and ritualistic and stereotyped behaviour as forming the basis for the 'triad' of basic areas of challenge. The language used in the triad has been adjusted slightly to focus on the 'impairment' of social interaction, social communication and social imagination (Henriksen & Kaup, 2010), but the central tenants remain the basis for how autism is currently understood (Wing et al., 2011). This can be seen in the current edition of the *Diagnostic and Statistical Manual of Mental*

Disorders (DSM-5), which focuses on the two defining challenges within this spectrum of severity:

> **a. the impairment of social communication and interaction,**
>
> **b. and restricted patterns of behaviour, interests or activities**
>
> - DSM-5 (APA, 2013)

As the prevalent modern understanding of autism in Australia, this is the definition used for the purposes of this study. There also needs to be a recognition of the sensitivity around terms such as 'impairment' and 'disorder'. The format used in this thesis follows the example of Baron-Cohen (2017), and Jones, Baker, English and Lyn-Cook (2012), in using either the label 'autism spectrum condition' or simply 'autism', except when directly quoting from other authors.

Most significantly, Wing and Gould (1979) conceptualised a much broader autism spectrum and acknowledged individual variation in how autism can manifest. This seminal concept is still recognised today (Ruzich et al., 2015). Wing and Gould (1979) built upon the work of Hans Asperger (Feinstein, 2011) to highlight the diversity of traits in both children and adults, most importantly signaling that autism primarily impacts social-emotional capabilities as opposed to cognitive functioning (Wing & Gould, 1979; Wing et al., 2011). Mesibov, Shea, and Schopler (2005) importantly highlighted a component of believed cognitive difference, arguing that the manifestations resulting from these differences are difficult to generalise due to varied ecological influences, such as access to early intervention. Recognising this variation is important because people with autism have a wide range of abilities and needs,

and therefore it is difficult to generalise the effectiveness of any one particular strategy (Great Britain Department for Education and Skills [GBDES], 2002).

A growing recognition of individual variation by intervention researchers is reflected in the recent conceptual emergence of neurodiversity in the literature. Neurodiversity is a political perspective positioning autism as an identity and part of natural human variation, with an emphasis on removing socio-political barriers and promoting equal opportunities rather than cure (Kapp et al., 2013). Mišic et al. (2014) highlighted the role of neurological differences in executive functioning as being partially responsible for social challenges, with neurodiverse individuals showing specific differences in working memory, inhibitory control and mental flexibility. Such diversity of functional needs and perspectives on the nature of autism complicate the design of interventions to address the social challenges experienced by all people with autism.

One of the key developments resulting from the recognition of a much broader autism spectrum is the concept of 'theory of mind'. Gallagher and Frith (2003) described this theory as referring to an individual's capacity to understand the mental states of others, and to recognise that those states might differ from their own. Building on Premack and Woodruff's (1978) original conceptualisation of theory of mind, Baron-Cohen, Leslie, and Frith (1985) used this term to explain the challenges in perspective-taking that is often associated with autism. Often discussed in conjunction with theory of mind is the notion of 'weak central cohesion' (Frith & Happé, 1994; Happé & Frith, 2006). This theory considers challenges in collating and evaluating multiple pieces of information to form a broader perspective. Individuals with autism are often profiled as preferring activities that involve the recall and systematic application of information, as opposed to activities involving synthesis,

interpretation and subjective evaluation (Happé & Frith, 2006). As social interactions require synthesising many contextual variables, such as the formality of the occasion, weak central cohesion might explain why social interactions can be difficult for students with autism.

Despite the DSM-5 being the most prevalent defining criteria for diagnosis of autism today (Amaze, 2017; Cooperative Research Centre for Living with Autism [Autism CRC], 2018), most of the participants in this research project were diagnosed originally with alternative criteria due to their age. Their diagnosis was based on criteria drawn from the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-4) introduced in 1994 (APA, 2017; Kawa & Giordano, 2012). The DSM-4 made a distinction between Pervasive Developmental Disorder, Autistic Disorder and Asperger's Disorder (King & Bearman, 2009). Although the distinction remained in an update to the DSM-4 in 2000 (King & Bearman, 2009), there was an increasing shift in diagnostic thinking that this was an abstract and unnecessary distinction (APA, 2017). The DSM-5 controversially combined these three into a collective category: ASD (APA, 2013). This resulted in the elimination of new diagnoses of Asperger's syndrome as a distinct diagnosis using the DSM-5's nosography. Much of the reviewed literature discussing the lived experiences of autism is written by people diagnosed with Asperger's syndrome, but most critically the descriptions of social difficulties are very similar to those experienced by the student participants in this study.

The World Health Organization (WHO) explicitly notes the importance of looking beyond diagnostic classifications, as labels shift but the nature of the challenges remains. Their alternative set of diagnostic criteria, the International Statistical Classification of Diseases and Related Health Problems (ICD) (WHO, 1993), retained the distinction between autism and Asperger's syndrome until the 11th revision in 2018 (WHO, 2018). The WHO

acknowledges that this fluidity should be expected, and perspectives will continue to shift in light of new research:

> **"A classification is a way of seeing the world at a point in time. There is no doubt that scientific progress and experience with the use of these research criteria will require their revision and updating."**
>
> - World Health Organisation (1993, p. viii)

It is important to be mindful of this fluidity in definition, particularly in relation to the diverging criteria being used in different geographical locations utilising different diagnostic criteria. Evolving definitions impact on how society has conceptualised the challenges and responses to these challenges at a certain point of time.

2.4.2 The prevalence of autism in Australia

The National Disability Insurance Agency ([NDIA], 2016) recorded those diagnosed with autism as the largest disability group as of 2015. This was reflected in the Survey of Disability, Ageing and Carers (ABS, 2016), which reported 111,400 Australians with a formal diagnosis, or 0.5% of the population. Autism is identified more commonly in males than females (ABS, 2016), although there are suggestions that gender-specific social expectations result in females being less likely to be identified at an early age (Halladay et al., 2015; Silberman, 2015). In Australia, current figures suggest males are four times more likely than females to have autism, with respective prevalence rates of 0.8% and 0.2%, consistent with overseas estimates (ABS, 2015). The NDIA (2016) noted considerable variation in the prevalence of autism across age groups, with a marked drop off in prevalence after peaking in the 5 to 9 years age group.

2.4.3 Suggested impacts of autism upon social skills

Central to modern understandings of autism is the notion of impaired or atypical social skills (APA, 2013; WHO, 2018), or differences in social interaction (Baron-Cohen, 2017; Silverman, 2015). Social skills can be understood as specific behaviors that conform to cultural expectations and are seen as generating positive social interactions (Gresham, 1986; Gresham & Elliott, 1987). This includes both overt, observable behaviors, as well as more discrete interpersonal problem-solving skills (Elksnin & Elksnin, 1998). These behaviours can be both verbal and non-verbal and are essential for effective interpersonal communication (Rao, Beidel, & Murray, 2008). Cultural and socially-generated norms within a community have a strong influence on what can be considered to be desirable or positive interpersonal interaction (Garcia, Breslau, Hansen, & Miller, 2012).

Of central importance to this study was recognising the difference between skill aquistion, learning the defintion of the skill and rules for its use, and skill performance. Hadwin, Baron-Cohen, Howlin, and Hill (1996) note that while many learners with autism can memorise definitions and rules, the real challenge is in recognising the appropriate contexts for performing the skill. *Acquisition deficits* result from either the absence of knowledge about how to perform a given social skill or difficulty in knowing which social skill is appropriate in specific situations (Gresham et al., 2010). *Performance deficits* are conceptualised as the failure to perform a given social skill at acceptable levels even though the individual knows how to perform the social skill (Gresham et al., 2010). This distinction was important for conceptualising and discussing the nature of the skills challenges that needed to be addressed in this research project.

It is also important to acknowledge the strengths of many people with autism. Purported strengths include an analytical approach to evaluation and problem-solving (Dawson, Soulieres, Gernsbacher, & Mottron, 2007), skills derived from an individual's area of special interest (Kirchner & Dziobek, 2014), and character strengths in social contexts (Kirchner, Ruch, & Dziobek, 2016). Specifically in relation to social skills, Kirchner et al. (2016) identified a number of relative strengths in the neurodiverse population examined in their study compared with their neurotypical control group. Using an online scenario-based tool, the participants with autism were found to be more open-minded in evaluating their peers' ideas without being influenced by social pressure. For the same reason, these researchers also found that this population valued fairness and truth, character values that society purports to hold in high regard. While Di Tore, Giuseppe and Corona (2017) cite conflicting results regarding the effects of autism upon empathy, Smith (2009) argued that many people with autism are actually hyperempathetic but communicate emotional empathy in ways that neurotypical audiences do not expect. In their study, Chen, Planche, and Lemonnier (2010) found that participants labelled as having high-functioning autism or Asperger's syndrome displayed superior non-verbal intelligence, which is suggested as being one important component in non-verbal communication (Kirchner et al., 2016; Winner, 2007). Finally, although the manifestations of autism can make social interactions challenging, children often exhibit a desire for social connection and a willingness to persist through these challenges (Ringland et al., 2016).

Although by definition autism creates areas of significant social challenge, there is no universal agreement around the precise nature and boundaries of these social challenges (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001; Bernardini, Porayska-Pomsta, & Smith, 2014; Vickerstaff et al., 2007). Areas of agreement and tension exist regarding the

exact nauture and importance of social skills that people with autism find challenging. Eight perspectives were purposefully selected to illustrate a range of understandings of the impacts that students with autism might experience in social interaction, as shown in Figure 2.3.

***Literature Key**: Colours align with the authors listed below in Tables 2.2 to 2.4.*			
Clinical perspective 1: Examples drawn from the DSM-5 (APA, 2013) (for formal diagnosis)	**Clinical perspective 2:** Examples drawn from the ICD-11 (WHO, 2018) (for formal diagnosis)	**Clinical perspective 3:** Examples drawn from Baron-Cohen et al. (2001) (for self-identification)	**Practitioner-researcher perspective 1:** Examples drawn from Wing and Gould (1979) (milestone research)
Practitioner-researcher perspective 2: Examples drawn from 'I LAUGH' Model (Winner, 2007) (framework for intervention)	**Practitioner-researcher perspective 3:** Examples drawn from Vickerstaff et al. (2007) (sharing voices of students with autism)	**Lived-experience perspective 1:** Examples drawn from Grandin (2006) (personal recount)	**Lived-experience perspective 2:** Examples drawn from Jackson (2002) (personal recount)

Figure 2.3. Colour coded literature key for the following three tables outlining the eight sets of focus authors.

These diverse voices, as shown in Figure 2.3, included clinical perspectives, practitioner-researchers and individuals with lived experiences. The DSM-5 (APA, 2013) and the ICD-11 (WHO, 2018) are tools designed for clinicians for the diagnosis of disorders and conditions, and as such provide two sets of respective diagnostic criteria. Both diagnostic tools also include examples of behaviours for pediatricians and psychologists, to illustrate how the criteria for autism can manifest in individuals. While interested in addressing challenges as opposed to providing a label, practitioner-based research is largely interested in understanding autism to intervene more effectively to address the suggested challenges (Haegele & Hodge, 2016). As such, much of the reviewed practitioner-based research is

framed in the medical, deficit-focused language. This includes research conducted by teacher-researchers, academics and allied health professionals, such as speech pathologists. Shifting perspectives from intervention to understanding, it is also vital to recognise the value of lived experiences, whether it be the reflections of an adult recalling their childhood experiences (Grandin, 2006) or a teenager who at the time of writing was navigating the Australian schooling system (Jackson, 2002).

Tables 2.2, 2.3 and 2.4 thematically analyse the eight representative perspectives (as shown in Figure 2.3) using the three broad categories utilised by the DSM-5: challenges in 1) social-emotional reciprocity; 2) non-verbal communicative behaviours used for social integration; and 3) the development, maintainance and understanding of relationships. It is important to note that the absence of a 'tick' in the tables does not denote that authors necessarily challenge a particular characteristic, but rather that this characteristic is not emphasised in their work. An analysis of these perspectives served as one point of reference in identifying the social skills to be priortised when planning the intervention.

2.4.3.1 Challenges in social-emotional reciprocity

Cultural norms have an important role in informing the boundaries of what is considered acceptable social behaviour, particularly in the intricacies in how people interact with each other (Winner, 2007; 2013). What is interesting about the differences shown in Table 2.2 is the way in which cultural norms are explicitly mentioned within each of the eight sets of perspectives.

Table 2.2. Examples of the difficulties children with autism can experience in social-emotional reciprocity.

Suggested social skills that present challenges for people with autism:	APA, 2013	WHO, 2018	Baron-Cohen et al., 2001	Wing & Gould, 1979	Winner, 2007	Vickerstaff et al., 2007	Grandin, 2006	Jackson, 2002
Abnormal social approach	✓			✓	✓		✓	✓
Failure of normal back-and-forth conversation	✓	✓	✓		✓			
Reduced sharing of interests	✓		✓	✓	✓	✓	✓	✓
Failure to respond to social interactions	✓	✓		✓	✓			
Difficulty continuing conversations on topic		✓	✓		✓	✓		
Difficulty knowing when and how to end social interactions		✓	✓		✓			

Particularly evident is a neurotypical-neurodiverse divide in many of the listed challenges related to conversational skills. This had implications for which social skills to prioritise in this research project. For example, while the reviewed clinical and practitioner perspectives characterise people with autism as generally having a reduced interest in ensuring that their interests align with those of their peers, Grandin (2006) and Jackson (2002) did not describe back-and-forth conversation as a challenge. It might be inferred that Grandin (2006) and Jackson (2002) are themselves unaware that others perceive them as having challenges in this area, or they simply cannot think that the perceptions of others are a priority. While the WHO (2013) or Winner (2007) might think these skills are important, Grandin (2006) and Jackson (2002) recognise the expected social norms but simply do not value them enough

to continue a conversation that remains on a topic of little interest. These conflicting priorities and perspectives continue to be evident when examining the perceived challenges of non-verbal behaviours. Considering these competing priorities was a key responsibility of the teacher-researcher in this research project, and another reason why it was imperative to involve all of the stakeholders in the intervention design process.

The lone area of near universal agreement in Table 2.2 relates to the 'reduced sharing of interests', suggesting that when a person with autism's area of passion aligns with the interests of their peers, this can be a valuable opportunity for social engagement. A circumscribed interest, such as playing videogames, could also be used as a motivating vehicle for instruction in areas of specific challenge, such as social skills.

2.4.3.2 Challenges in non-verbal communicative behaviours used for social integration

In conjunction with challenges with verbal communication, autism also presents challenges with non-verbal behaviours. Table 2.3 presents a selection of these suggested challenges, and again highlights some of the competing priorities found in the reviewed literature.

Table 2.3. Examples of the difficulties children with autism may experience in non-verbal communicative behaviours used for social integration.

Suggested social skills that present challenges for people with autism:	APA, 2013	WHO, 2018	Baron-Cohen et al., 2001	Wing & Gould, 1979	Winner, 2007	Vickerstaff et al., 2007	Grandin, 2006	Jackson, 2002
Poorly integrated verbal and non-verbal communication	✓	✓			✓			
Abnormalities in eye contact and body language	✓		✓	✓	✓	✓		
Differences (deficits) in understanding and use of gestures	✓	✓	✓	✓	✓		✓	✓
Minimal facial expressions and non-verbal communication	✓	✓		✓				
Difficulty in processing and integrating information from the environment				✓		✓	✓	✓

As can be seen in Table 2.3, while the two diagnostic criteria and Winner (2007) are concerned with perceived challenges in integrating verbal and non-verbal information, the interventionists, researchers and people with autism are more focused on differences in understanding the use of gestures. One explanation for these contrasting points of focus is that the second group of authors have a developmental lens, looking to support rather than diagnose. As such, they might be prioritising the most immediate areas of challenge or those most easily tested, focusing first on the meanings of gestures before integrating verbal and non-verbal channels of communication. Difficulties in integration are noted by Grandin (2006) and Jackson (2002) in terms of collating environmental information, such as understanding that a group of people dressing in nicer than usual clothes suggests a special occasion.

Vickerstaff et al.'s (2007) study of self-perceived social competences confirms that adolescents with high-functioning autism are aware of their differences with their neurotypical peers in understanding social norms. Troublingly, Vickerstaff et al. (2007) connect the participants' awareness of these differences with high instances of clinical depression within the surveyed population. This highlights the importance of social skills interventions targeting the individual developmental needs of each student and seeking student input into their perceived areas of challenge.

2.4.3.3 Challenges in developing, maintaining, and understanding relationships

In describing the practical social outcomes for people with autism, such as difficulties in making friends and difficulties in distinguishing between playful and malicious teasing, there is far more agreement between the authors, as shown in Table 2.4.

Table 2.4. Examples of the difficulties children with autism may experience in developing, maintaining, and understanding relationships.

Suggested social skills that present challenges for people with autism:	APA, 2013	WHO, 2018	Baron-Cohen et al., 2001	Wing & Gould, 1979	Winner, 2007	Vickerstaff et al., 2007	Grandin, 2006	Jackson, 2002
Difficulties adjusting behaviour to suit various social contexts	✓		✓		✓	✓	✓	✓
Difficulties in sharing imaginative play	✓		✓	✓	✓		✓	
Difficulties in making friends	✓	✓	✓	✓	✓	✓	✓	✓
Apparent absence of interest in peers	✓	✓	✓	✓	✓			
Difficulties in detecting the difference between friendly joking and bullying			✓		✓	✓		✓
Difficulties in sharing enjoyment with others	✓							
Challenges in inferring the interests of others	✓	✓	✓		✓	✓		✓
Challenges displaying cognitive empathy			✓		✓		✓	

From the lived perspectives provided by Grandin (2006), Jackson (2002) and Vickerstaff et al. (2007), to the early analysis of the lives of people with autism by Wing and Gould (1979), to the examples provided by the modern diagnostic instruments, there is a near universal consensus that people with autism can easily become socially isolated. The clear divide that emerges between the assumed neurotypical authors and the neurodiverse authors pertains to the reasons for this isolation. Jackson (2002) suggests a lack of societal understanding,

while the five authors who make no mention of having a diagnosis of autism explicitly or implicitly point to underdeveloped or inadequate social skills. One point of particular contention is in regard to the suggestion that individuals with autism may lack some form of empathy. While Winner (2007), Baron-Cohen et al. (2001) and even Grandin (2006) agree with this sentiment, Vickerstaff et al. (2007) and Jackson (2002) challenge this notion. While these tables provide important insights into the nature of the challenges that may be experienced by some learners with autism, they serve as yet another reminder of the importance of ensuring that the voices of people with autism are included in any discussions of those challenges and needs.

2.5 Down syndrome and social skills

While the majority of participants in this study had been diagnosed with autism, one of the participants had been diagnosed with Down syndrome, less commonly known as trisomy 21. The vast majority of people diagnosed with Down syndrome have an additional copy of chromosome 21, resulting in a total of 47 chromosomes compared with the typical 46 (Fidler et al., 2006; Vičić et al., 2017). Down syndrome is the most frequently occurring chromosomal abnormality in Australia (Down Syndrome Western Australia, 2015) and the most common genetic cause for cognitive disability (Gass et al., 2013). That said, there is a lack of consensus around the exact number of people with Down syndrome due to there being no national, state or territory register of Australians with Down syndrome, with the exception of Western Australia (Down Syndrome Australia, 2017). Down Syndrome Australia uses this sole state register to proportionally estimate the population of people with Down syndrome in Australia as being approximately 13,000 (0.05%). This assumes that Western Australia is proportionally representative of the rest of the nation. Down syndrome occurs in all races,

ethnic groups and across all socio-economic classes (Sherman, Allen, Bean and Freeman, 2007). Looking at current global estimates, Vičić et al. (2017) suggest a comparatively higher figure of somewhere between 1 in 1,000 (0.10%) to 1.4 in 1,000 (0.14%). While population statistics for this disability are still being assessed, there is a growing body of research that has identified the implications of Down syndrome on social skills and behaviours.

2.5.1 The impact of Down syndrome upon social skills

There is a very limited body of research around the strengths and challenges of children with Down syndrome in relation to social skills, with most of the existing studies focusing on social interaction in the context of differences in communication (Hehir et al., 2016), or with a comorbid diagnosis of autism (Davis, Spriggs, Rodgers, & Campbell, 2018). A number of researchers note a historical perception within the literature that social interaction is a strength for children with Down syndrome (Fidler et al., 2006; Mundy, Sigman, Kasari, & Yirmiya, 1988), which may explain why this area has received relatively minimal attention. This perception appears to be based on an observed preference of these children for interacting with people over objects (Gass et al., 2013). A number of recent studies identify some areas of shared strength for participants with Down syndrome, such as initiating social interactions with peers through culturally normalised greetings (Fidler et al., 2006). There is also evidence suggesting a willingness for this population to seek out interactions (Kasari & Freeman, 2001; Kasari, Freeman & Hughes, 2001), reinforcing the long-held notion that a key characteristic of Down syndrome is a desire for social interaction.

Kasari and Freeman (2001) also found that children with Down syndrome were more willing than their neurotypical peers to look to others for assistance when engaging in problem-solving and would actively ask for assistance from adults. The research findings indicate a

high level of stability in the social skills of individuals with Down syndrome, as the skills that these individuals developed as children were retained throughout adolescence and into adulthood. This also stands in contrast with some of the previously identified research around the regression of social and communication skills for some individuals diagnosed with autism. It could suggest a level of awareness of their own performance and the relative performance of their neurotypical peers, although Kasari and Freeman (2001) note that, upon further questioning, the participants with Down syndrome were unable to articulate this awareness. This reflects an acknowledgment in recent research of a more complex profile of the social skills of children with Down syndrome, including the identification of some areas of common challenge (Fidler et al., 2006; Gass et al., 2013).

2.5.2 Using the literature to identify the suggested impacts of Down syndrome upon social skills

There is evidence that individuals with Down syndrome have differences in how they interpret social and emotional cues, and how they understand mental states (Kasari, Freeman & Bass, 2003; Kasari et al., 2001). Seven perspectives were selected to represent the differing voices describing the challenges that Down syndrome might present in relation to social interaction, but this specific body of literature was very limited. As there is a genetic test for Down syndrome, observation diagnostic criteria are not required (Baxter, Moran, Richtsmeier, Troncoso, & Reeves, 2000). Figure 2.4 shows that the majority of the identified perspectives on the social challenges for this population were found in research by practitioner-researchers, such as occupational therapists. Social skills were often discussed in conjunction with other areas of perceived strength or challenge. While Dyke, Leonard, Bourke, Bebbington and Bower (2007) focused on capturing the voices of parents, no

perspectives included people with lived experiences of Down syndrome describing their own social challenges. This is an obvious area requiring further attention in subsequent studies.

***Literature Key**: Colours align with the authors listed below in Table 2.5.*

Practitioner-researcher perspective 1:	**Practitioner-researcher perspective 2:**	**Practitioner-researcher perspective 3:**	**Practitioner-researcher perspective 4:**
Examples drawn from Mundy et al. (1988) (non-verbal social skills)	Examples drawn from Gass et al. (2013) (non-verbal social skills)	Examples drawn from Williams et al. (2005) (emotional recognition and regulation)	Jahromi, Gulsrud, and Kasari (2008) (emotional recognition and regulation)

Practitioner-researcher perspective 5:	**Practitioner-researcher perspective 6:**	**Guardian perspective 1:**
Examples drawn from Kasari et al. (2001) (social skills in collaborative problem-solving)	Examples drawn from Sigman et al. (1999) (comparing the social skill profiles of Down syndrome and autism)	Examples drawn from Down Syndrome Needs Opinions Wishes Survey (Dyke et al., 2007) (experiences of parents of children with Down syndrome)

Figure 2.4. Key outlining the seven sets of focus authors writing about Down syndrome.

The findings from this review broadly suggested that people with Down syndrome can experience some areas of challenge in social interaction and communication, although the nature of some of these challenges differ from those of autism. Examples of the specific social challenges for people with Down syndrome are listed in Table 2.5.

Table 2.5. Examples of how the manifestations of Down syndrome can impact upon social skills and behaviours.

Challenges in social interaction and communication							
Challenges identified in the literature:	Mundy et al., 1988	Gass et al., 2013	Williams et al., 2005	Jahromi et al., 2008	Kasari et al., 2001	Sigman et al., 1999	Dyke et al., 2007
Challenges in understanding non-verbal communication	✓	✓				✓	
Challenges in incorporating non-verbal gestures in communication	✓	✓					
Specific challenges in processing emotional expression, such as facial expressions		✓			✓	✓	
Differences in socio-cognitive understanding, such as recognising social norms		✓	✓		✓		✓
Passivity and slowness in emotional processing		✓	✓		✓		
Emotional regulation		✓			✓		✓
Challenges in monitoring others' performance			✓				✓
Challenges in breadth and selection of vocabulary	✓	✓	✓	✓		✓	✓

A common finding across the literature is that many of the social challenges experienced by children with Down syndrome originate from poor auditory memory and delayed rates of cognitive processing. Despite this agreement, the literature focuses on differing manifestations of how these challenges impact upon the development of social skills for this population. The absence of a 'tick' in Table 2.5, therefore, does not indicate disagreement, but rather that the author's focus is elsewhere. One area of strong agreement, as shown in Table 2.5, is the challenges experienced by many students with Down syndrome in selecting appropriate vocabulary. Gass et al. (2013) and Dyke et al. (2007) explicitly connect this to challenges with auditory memory. This has implications for the teaching of unfamiliar social skills, as the language being taught might be completely unfamiliar to the students. This should be considered both in planning the timing of an intervention and ensuring that supporting resources are available to reinforce the meaning of new vocabulary (Dyke et al., 2007).

There are also several contradictions in the reviewed literature. Only Sigman and Ruskin (1999) contested the suggestion that children with Down syndrome may find expression through the use of non-verbal gestures challenging, finding that this population can sometimes exceed the capabilities of their typically developing peers. If Sigman and Ruskin (1999) are correct, this presents interesting implications for social skills interventions where students with Down syndrome are working alongside students with autism. Both populations may have areas of need that fall within the broad category of 'social skills challenges', but the nature of these challenges may be very different. As such, there is a potential for students to build from their respective areas of strength and to serve as 'knowledgeable others' for their peers.

2.6 The importance of social skills

There are important legal, moral and academic imperatives for assisting these learners to gain the skills required for them to participate in their communities. It is evident that students with social-emotional challenges will face difficulties throughout their lives across multiple contexts due to the described social differences and specific areas of need. Rankin, Weber, Kang and Lerner (2016) contend that these challenges are becoming more pronounced as a result of technological developments, such as the automation of many jobs that have historically been an avenue for people who prefer to work independently. Amongst other benefits, effective social skills are vital in obtaining and maintaining employment and contributing to society. Developing these prerequisite skills begins with all children being able to access high systems of inclusive education.

2.6.1 The relationship between collaboration and social skills

Collaboration can be understood as a “style for direct interaction between at least two co-equal parties voluntarily engaged in shared decision-making as they work toward a common goal” (Friend & Cook, 2007, p. 7). Within this definition the inclusion of the word ‘style’ is important because collaboration refers to how learners interact with each other, and not the outcome of the problem-solving itself. Vangrieken, Dochy, Raes, and Kyndt (2015) agreed that this emphasis on the interpersonal processes denotes whether a group is working in a collaborative manner or whether they are merely cooperating to achieve a shared goal. Collaboration requires “a joint interaction in the group in all activities that are needed to perform a shared task” (Vangrieken et al., 2015, p. 23), whereas cooperation can be seen as asynchronous individual contributions towards achieving a common goal (Klieve, 2018).

Essentially the difference between collaboration and cooperation is in the level of interaction between participants as indicated on a spectrum (Klieve, 2018). The following list presents a collation of perspectives identified by Klieve (2018) as indicative characteristics of collaboration:

- voluntary participation;
- based on parity of all participants;
- participants must have mutual goals;
- participants must share responsibility for decision-making;
- shared accountability for outcomes;
- sharing of resources; and
- collaboration depends on development of trust, respect and a sense of community or team.

When reviewing Klieve's characteristics, it becomes evident that certain discrete social skills are required. Social skills are difficult to comprehensively define as they are constructs bound in cultural norms and are context specific (Winner, 2007). Adopting McFall's (1982) definition of social skills as "specific abilities required to perform competently at a task" (p. 12), the umbrella term collaborative social skills is used in this thesis to refer to a specific subset of social skills required for collaboration.

An example of a collaborative social skill is when an individual uses their voice to offer advice to their partner on a strategy to complete a joint task, sharing their knowledge. Such an exchange represents the sharing of resources in working towards a common goal. While an individual keeping their hands to themselves when interacting with others is an important general social skill, it is not specifically related to achieving a shared goal, and therefore is

not considered in thesis as a collaborative social skill. This research project explored collaboration in a particular context, with the student participants playing cooperative videogames together. The following chapter of this thesis explores existing literature identifying which collaborative social skills are important in this specific context.

Often mentioned alongside social skills is the concept of social competence. Gresham, Sugai, and Horner (2001) describe social competence as an evaluative term, where judgments are made on the quality of performance of social skills and the abilities of individuals to combine these skills in ways conducive to achieving common goals. This research project was interested in supporting the development of the student participants' collaborative social skills in order to improve their social competencies when working towards Klieve's (2018) indicative characteristics of collaboration.

2.6.2 Social competencies required for successful inclusive education

There are moral arguments for ensuring that students with social-emotional challenges who wish to attend their local mainstream school are able to do so on the basis of equal access to educational opportunities being a universal human right. This line of reasoning informed the development of Article 24 of the *Convention on the Rights of Persons with Disabilities*, to which Australia is a signatory (UNGA, 2006). Article 24.2 is clear and unambigious in entrenching this right for learners with disbilities to be supported and included in accessing schooling "without discrimination and on the basis of equal opportunity" (UNGA, 2006):

a) Persons with disabilities are not excluded from the general education system on the basis of disability, and that children with disabilities are not excluded from free and compulsory primary education, or from secondary education, on the basis of disability;

b) Persons with disabilities can access an inclusive, quality and free primary education and secondary education on an equal basis with others in the communities in which they live;

c) Reasonable accommodation of the individual's requirements is provided;

d) Persons with disabilities receive the support required, within the general education system, to facilitate their effective education;

e) Effective individualized support measures are provided in environments that maximize academic and social development, consistent with the goal of full inclusion.

- United Nations General Assembly (2016)

Clauses c, d and e of Article 24.2 all pertain to the right to accommodations and supports to assist learners with disabilities so that they can access education on an equal basis to every other child in their community. Consequently, students have a legal and moral right to programs such as targeted social skills interventions that allow them to experience the full benefits of inclusive education.

Most importantly for this study, there is widespread agreement that evidence-based interventions are needed so that all students develop the required skills to navigate complex school environments. These environments were described by Bronfenbrenner (1994) as

layered systems of interaction between students, educators, school policy makers, families and the broader community. Hehir et al. (2016) highlighted that the keys to students thriving in these systems are *communication* and *social understanding* from all parties. When these are evident, genuine inclusion is possible, not just integration (Hehir et al., 2016). The differences between students being excluded, segregated, integrated and included in school systems are shown in Figure 2.5.

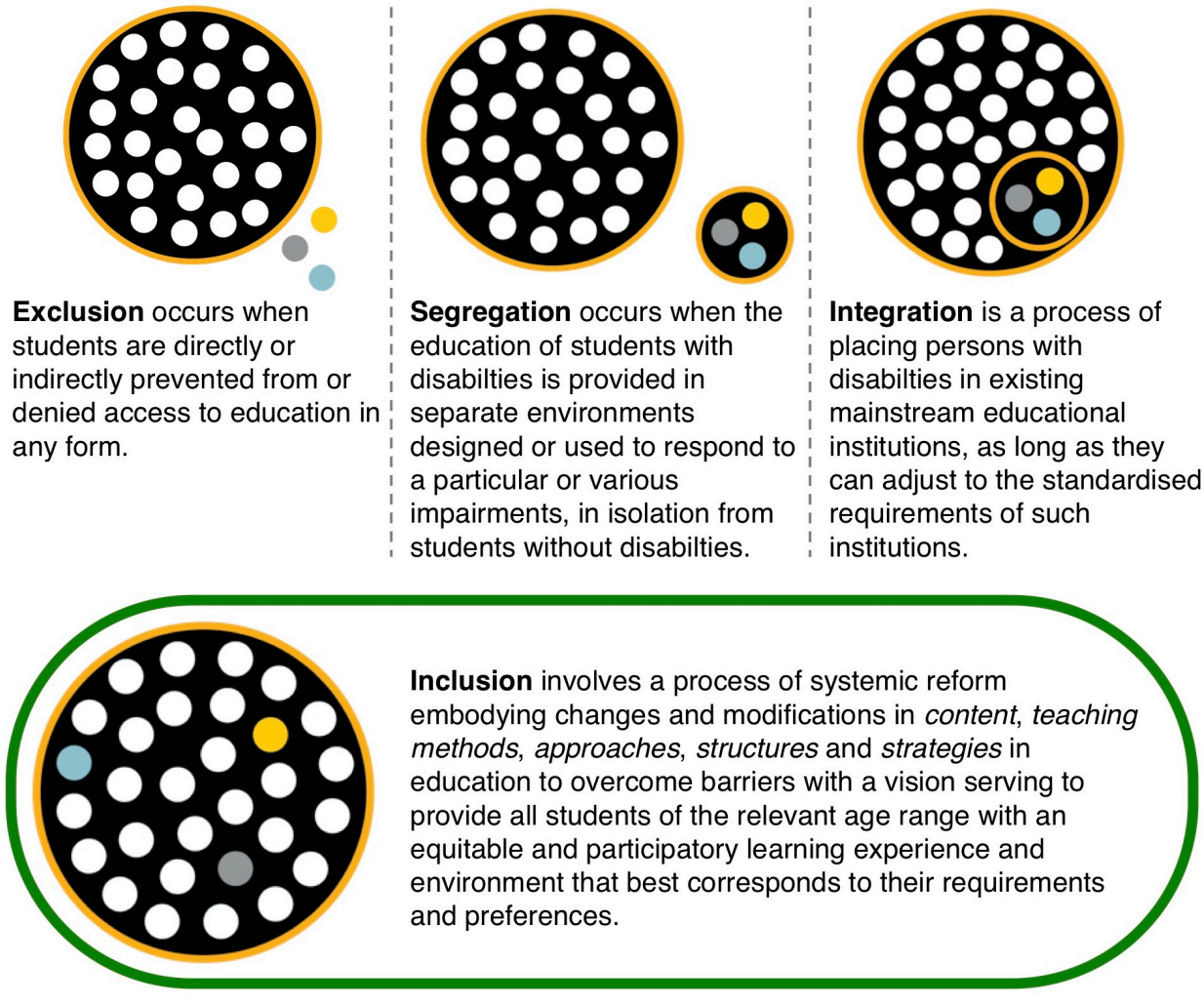


Figure 2.5. The differences between exclusion, segregation, integration and inclusion. Adapted from Hehir et al. (2016, p. 3).

When considering the importance of such interventions in fostering access to mainstream schooling, it is morally important to consider the mental wellbeing of students. As noted in *Chapter 1*, students with socio-emotional disabilities experience disproportionately higher rates of social anxiety, separation anxiety, obsessive-compulsiveness, physical injury fears and panic attacks (Bellini, 2004; Bellini et al., 2007; Kim et al., 2000). There are potentially very serious mental health consequences for students with disabilities who find social interactions challenging in all settings, so it is important to provide students with early intervention programs and the tools to navigate these interactions (Da Paz & Wallander, 2017). Bellini (2004) identified a significant relationship between social skills deficits and social anxieties. Elksnin and Elksnin (1998) suggested a strong connection between unaddressed socio-emotional problems during primary-aged schooling and poor performance and low completion rates in secondary schooling. They attribute this partially to the challenges presented by poor mental health. Importantly, Vickerstaff et al. (2007) identified that early intervention is essential, particularly in developing social competencies, as they found older students with autism and social challenges reporting high levels of depression.

Students with disabilities are more susceptible to bullying, particularly as a result of a perceived power imbalance between the bully and victim (Attwood, 2016). While bullying can often involve unsophisticated acts of violence, it also often includes more subtle and systematic forms of social exclusion. For students with autism in particular, the inability to comprehend the shades of meaning and social context that separate playful banter from malicious teasing can present feelings of insecurity and anxiety (Attwood, 2016; Bellini et al., 2007). The meaning of laughter is a good example of this. People can laugh at something in an inclusive way, inviting everyone to participate in acknowledging the humour in a situation,

it can be an involuntary response to a feeling of awkwardness, or it can be a derogatory, conscious effort to ridicule someone and to bring on negative feelings in the victim. Attwood (2016) highlights a risk of children with disabilities developing a pathological disposition towards gerontophobia, or a fear of being laughed at for no discernable reason. This can result in them avoiding social interactions, cutting themselves off from the world and, in extreme cases, can lead to suicide attempts (Attwood, 2016; Maiano, Normand, Salvas, Moullec, & Aimé, 2016). Social skills interventions, such as the one developed through this research project, support the formation of positive relationships between neurotypical and neurodiverse peers. This reduces the likelihood of bullying (Maiano et al., 2016).

2.6.3 Social theories of learning

A growing body of evidence suggests that inclusive education in mainstream settings provides demonstrably better academic and social outcomes for students with disabilities, particularly in relation to language development and reading ability (Hehir et al., 2016; Mitchell, 2014). For example, it is suggested that the inclusion of students with Down syndrome in mainstream educational settings results in them demonstrating improved memory and stronger language and literacy skills (de Graf & van Hove, 2015; Hehir et al., 2016). This is consistent with Hehir and Katzman's (2012) findings of a positive correlation between the amount of time that students with disabilities spend in inclusive settings and higher outcomes on standardised assessments for language ability. These findings also affirm the earlier conclusions of Blackorby, Knokey, Wagner, Levine, Schiller, and Sumi (2007), who reported a marked increase in the reading speed of students with disabilities learning in mainstream settings. Socially-orientated models of learning may offer some

explanation as to why this is the case. These explanations emphasise the inherently social processes that underpin these models of learning.

It is widely accepted that social communication and interactions have important roles in learning (Bandura, 1977; Kim, 2001; Vygotsky, 1978; Woolfolk & Margetts, 2016), although different models have presented alternative conceptualisations of how these processes occur (Woolfolk & Margetts, 2016). This thesis examines two social models of learning that are regularly cited as underpinning many of the specific intervention strategies explored in *Chapter 3*. While this study largely adopts an understanding of learning from a social constructivist perspective, much of the reviewed literature utilises a social behaviourist perspective: Bandura's 'social learning theory' (1977). Despite different ontological and epistemological underpinnings, social constructivism and social learning theory both position interpersonal interactions as essential in the processes of learning. Where they differ is the emphasis each theory places on either behaviourist or cognitive principles to explain the processes of learning. This is illustrated in Figure 2.6.

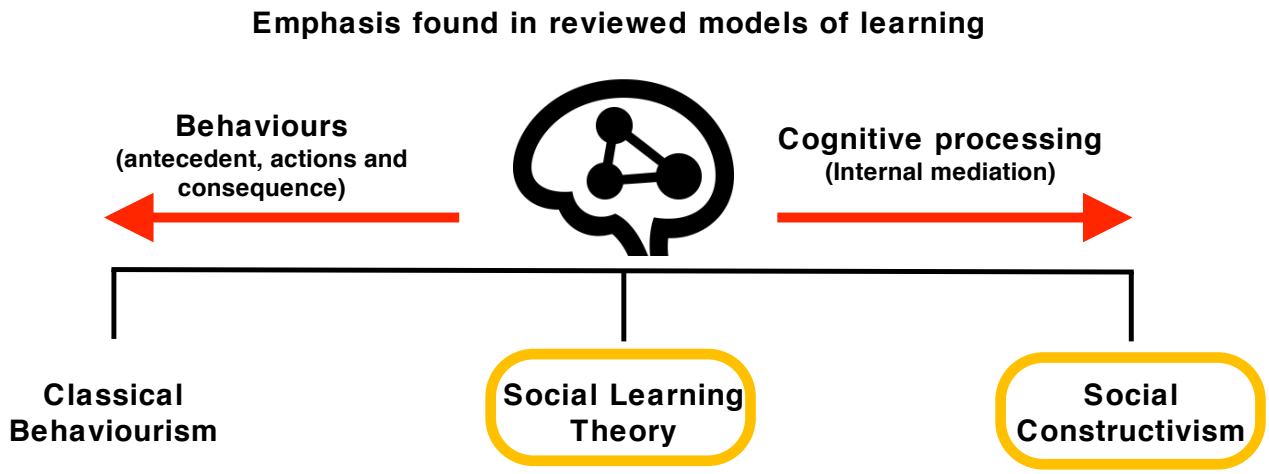


Figure 2.6. Emphasises found in the two focus models of learning. Adapted from descriptions by Bandura (1977) and Kim (2001).

These different emphases are explored in the following examination of social learning theory and social constructivism. Understanding the assumptions within these models can have significant implications for effectively teaching and increasing the appropriate performance of targeted social skills.

2.6.3.1 Social learning theory

A large number of existing behavioural interventions use the assumptions of social learning theory, which is an integration of behaviourist stimulus-response or reinforcement theories and cognitive models of learning focusing upon the role of the environment (Kretchmar, 2008; Rotter, 1982). That is, behaviour is learnt through reinforcement and consequences in the social environment. Ho, Stephenson and Carter's (2013) meta-analysis of cognitive-behavioural approaches for students with high-functioning autism could offer an insight into why so many authors (discussed in the following chapter) adopt interventions that use cognitive-behavioural theory, such as social learning theory, to explain the learning processes. They found a significant effect size for interventions adopting cognitive-behavioural theory, particularly for students with high-functioning autism (Ho et al., 2013).

In describing his model of social learning theory, Bandura (1977) built upon the established behaviourist learning theories that focused upon classical conditioning and operant conditioning. Classical conditioning focuses on learning through *involuntary* psychological or emotional responses, such as fear, while operant conditioning describes learning through which *voluntary* behaviour is either strengthened or weakened by the consequences of antecedents (Bandura, 1977; Bitterman, 2006). Importantly, positive reinforcement will have little impact if the consequence does not align with an individual's needs (Duchesne & McMaugh, 2016). Using these theoretical assumptions as his starting point, Bandura (1968)

contributed two important ideas. First, that there are mediating processes that occur between stimuli and responses; that is, the internal cognitive processes occurring between an input in the environment and a responding behaviour. Bandura (1968; 1977) suggested four mediating 'internal' processes: the attention paid to a particular environmental input; the retention or recall of a particular behaviour that can be used as a response to the input; the ability to reproduce the behaviour; and the motivation to perform a behaviour. These mediating processes all contribute to whether a learner produces a certain behaviour in response to an input. Bandura (1968; 1977) also suggested that these stimuli and responses are provided in the social environment through the process of *observational learning*. Bandura (1968; 1977) described observational learning as a process through which an individual observes and imitates the behaviours or skills of models, who can be either adults or peers, leading to a natural acquisition of these behaviours or skills. This is where cognitive understandings of the social environment, particularly notions of social capital, become important as the learner has to value the actions of the model in order to want to imitate their behaviours. While it is important to note that Bandura (1993, 1978) and Rotter (1982) did not contend that social learning theory explains all behaviours, many of the reviewed social skills interventions use the theoretical lens of observational learning to explain why they are effective.

2.6.3.2 Social constructivism

Papert and Harel (1991) described constructivism as a theory of learning that demands "everything be understood by being constructed" (p. 1). That is, knowledge is constructed by people, either individually or socially, rather than simply being transmitted from person to person. The work of Vygotsky, who himself had a keen interest in the learning of children

with disabilities (Rieber & Carton, 1993), is often cited as being the starting point for many authors in understanding cognition as a socially-mediated process (Burr, 2015; Kim, 2001). Vygotsky stressed the fundamental role of social interaction in the development of emerging skills (Griffin, 2018; Vygotsky, 1978), which is a key component underpinning social constructivist theories of learning (Brooks & Brooks, 1999; Kim, 2001):

> **"Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers"**
>
> - Lev Vygotsky (1978, p. 90).

One of the most influential components of Vygotsky's work is his conceptualisation of a 'zone of actual development' (ZAD) and a 'zone of proximal development' (ZPD) being present in all learners. The ZAD refers to the tasks or skills that the learner has mastered to a point of independent competence, while the ZPD refers to the discrepancy between the current developmental level of what the learner can do independently, and the level of potential development when assisted by more capable adults or peers (Vygotsky, 1978). In other words, the ZPD defines an interpersonal imperative in the relationship between the learner and a more 'knowledgeable other' who supports the learner to construct their own understandings of a piece of knowledge or a skill that the learner has not yet mastered.

Kim (2001) continued this line of thought, contending that the social constructivist conceptualisation of learning is based on three key assumptions:

1. Knowledge is a product of social interaction;

2. Knowledge is socially and culturally constructed, influenced by the group and its environment; and
3. Learning is a social activity.

This thesis positions artefacts, such as digital games, as a form of asynchronous social interaction as they have been purposely designed to be used by someone else and to provide a certain set of experiences. These artefacts are inherently informed by the knowledge and values of their creators, which are interpreted by their audience.

Understanding the means through which the ‘knowledgeable other’ can support the learner was a key consideration of this research project. Wood, Bruner and Ross’s (1976) metaphor of ‘scaffolding’ is often cited as being influential in the development of social constructivist theory and was particularly useful language for describing the role instructional support by the teacher in social skills interventions. Describing the role of the 'knowledgeable other' without using Vygotsky's language, scaffolding involves structured interactions between the learner and the mentor working towards a goal (Wood, Bruner, & Ross, 1976). A narrower understanding in a classroom-based context is that scaffolding is the temporary assistance provided by teachers as they guide their students towards the independent recall of knowledge or performance of a skill (Hammond & Gibbons, 2005). This classroom conceptualisation is useful in considering applied examples of this theory.

For this research project, human interaction in the learning processes can be through both synchronous and asynchronous modes. Examples of synchronous modes of human interaction are cited in many of the DGBL studies examined in *Chapter 3*, particularly in regard to collaborative learning through play. Likewise, Woolfolk and Margetts (2016) discussed the role of peers in ‘make believe’ play as being an example of the ‘knowledgeable

others' guiding the understandings of others as they pretend to fulfil a certain role, such as playing 'doctors'. Peers help each other to understand the expected rules of behaviour for this role or to simulate skills they have not yet mastered, such as speaking with patients or performing surgery. Examples of asynchronous interaction are also provided, although this language is rarely used. The most prominent example in this thesis is of a student playing a game, an artefact designed for play by another human. This is a delayed form of social interaction.

Both social learning theory and social constructivist understandings of learning have important contributions to this thesis. Many existing social skills interventions are grounded in understandings of learning informed by social learning theory, while many investigations of games-based learning adopt a social constructivist lens to understand the formation of social norms in multiplayer gaming and gamer culture, as explored in *Chapter 3*.

2.7 Considering the nature of evidence-based intervention

Exploring 'evidence-based intervention' requires an understanding of the nature of educational interventions, and the criteria by which particular approaches are validated by research. At first glance, defining intervention might appear to be straight forward. Hattie (2012) provided a very broad but popular definition describing teacher intervention as essentially anything that they do within their classroom. The boundaries of this definition can be better understood when examining how Hattie defined what constitutes 'teaching'. Hattie positions the processes of teaching as being an inherently 'deliberate intervention':

"The act of teaching requires deliberate interventions to ensure that there is cognitive change in the student."

- John Hattie (2009, p. 23)

While Hattie's (2009) definition is useful in demonstrating the breadth with which the intervention may be used, Odom, Collet-Klingenberg, Rogers, and Hatton (2010) presented a narrower definition tailored specifically for the context of social skills intervention. They make a distinction between CTMs and *focused intervention* practices described in the literature surrounding autism. Odom et al. (2010) posited that CTMs serve as an umbrella intervention, containing a range of practices and strategies that are designed to address multiple skills or areas of challenge, and can be implemented across multiple settings. Focused intervention practices target a specific skillset, and while they might contain multiple steps, they hinge around a central strategy or instructional method in a single context (Odom et al., 2010; Wong et al., 2015). Focused intervention practices also tend to occur over a shorter period of time and use operational language (Wong et al., 2015). Using a range of complementary practices and strategies aligns with the objectives of this study, as cooperative videogames were always envisioned as being used in conjunction with more traditional interventions. Therefore, this study is best seen as developing a CTM that focuses upon a number of social skills over a longer period of time.

It is also important to consider what constitutes an acceptable standard of 'evidence' for a particular strategy or instructional method to be termed 'evidence-based practice'. While centrally a question of methodology, there are political dimensions. Wang and Spillane (2009) acknowledge the broad ambiguity with which the term 'evidence-based' is used and highlight the many contrasting understandings depending on the methodological biases of the parties

using the term. Although Odom et al. (2010), Wang and Spillane (2009), and Yates and Hattie (2014) did not agree on a common definition, they all noted the politicisation of educational research. All three sets of authors noted the privileging of quantitative group experimental or quasi-experimental research or single subject research. Wang and Spillane (2009) contended this is because these two categories of research are primarily used to identify cause-effect relationships between an intervention and a behaviour. Cook and Odom (2013) provided an illustrative definition that encapsulates these characteristics:

> **"Typical guidelines require that for a practice to be considered evidence-based it must be supported by multiple, high-quality, experimental or quasi-experimental (often including single-case research) studies demonstrating that the practice has a meaningful impact on consumer (e.g., student) outcomes."**
>
> - Cook and Odom (2013, p. 136)

Gersten, Fuchs, Compton, Coyne, Greenwood, and Innocenti (2005) listed some common positivist characteristics associated with 'quality evidence-based' research:

1. a random assignment of participants between control and experimental groups;
2. the calculation of effect size; and
3. multiple outcome measures used to ascertain the impact of an intervention.

Riffel and Eggleston (2018) added three more characteristics:

4. clear implementation procedures;
5. replication of outcomes across implementation sites; and
6. evidence of sustainability.

The drive for ensuring 'quality' positivist research has spread to research focusing on populations with disabilities. Gersten et al. (2005) and Horner, Carr, Halle, McGee, Odom, and Wolery (2005) developed guidelines specifically for educators working with children with 'special educational needs', with these authors also privileging research conducted with group experimental and single-subject designs, respectively. While the merits of positivist educational research are contentious (Berliner, 2002), there are clear practical benefits for designing a new intervention using a research methodology that incorporates the listed six positivist characteristics. Interventions that have been 'validated' through positivist research can be used in educational jurisdictions that require such confirmation, thus potentially having an impact on more students (Linn, Baker, & Betebenner, 2002; Sencibaugh & Sencibaugh, 2016). A perception of research validity was an important consideration in the selection of a design research methodology, as one of the central objectives of this research project was to develop an intervention that could be implemented in schools beyond the context in which it was designed.

2.8 Frameworks and models for implementing social skills interventions

Existing frameworks and models for planning, implementing, monitoring and evaluating interventions offer insights for researchers into how targeted social skills interventions can be introduced into school settings. It is important to note the different purposes of each, as they can be used as complementary approaches.

2.8.1 A system for targeting intervention: Response to Intervention

Response to Intervention (RtI) is a system level framework that uses a multitiered approach to intervention in a manner that promotes both efficiency and recognition of individual needs (Balu, Zhu, Doolittle, Schiller, Jenkins, & Gersten, 2015; Mitchell, 2014). This system is used to determine the required levels of learner support (Balu et al., 2015; Hawken, Vincent, & Schumann, 2008) and also for identifying learners with learning disabilities (Mitchell, 2014, Fuchs & Fuchs, 2006). Hammond, Campbell, and Ruble (2013) argued that RtI is better suited as a means of targeting interventions for known areas of challenge rather than initial identification or diagnosis, as the time required to implement this framework may delay early intervention.

Over the last decade, this framework has been used as a system for ascertaining which students require more intensive levels of social skills intervention (Fairbanks, Sugai, Guardino, & Lathrop, 2007; Walker, Marquez, Yeaton, Pennefather, Forness, & Vincent, 2015). RtI focuses on initially planning and implementing an intervention for an entire cohort (Tier 1), known as the universal tier (Balu et al., 2015). The research suggests that, ideally, Tier 1 should be effective for approximately 80% of the student population (Hawken et al., 2008), and preventative and proactive in nature (Fairbanks et al., 2007; Walker et al., 2015). For learners who do not respond to this initial intervention, Tier 2 provides a more intensive application of an intervention in a targeted group (Walker et al., 2015). This secondary level is effective for approximately 15% of students (Hawken et al., 2008). In a SDS, smaller class sizes and an increased student-teacher ratio mean that a Tier 2 intervention might only include two or three students. For the approximately 5% of learners who do not respond to Tier 1 and Tier 2 interventions, Tier 3 provides for specialised and intensive individual

treatment (Balu et al., 2015; Fairbanks et al., 2007; Walker et al., 2015). Building on the data obtained during Tier 1 and Tier 2 about the specific areas of challenge for this individual, educators work with behavioural and communication specialists using tools such as functional behavioural analysis (Mitchell, 2014). Figure 2.7 illustrates this three-tiered system, highlighting the movement of students through the tiers of intervention based on their existing needs.

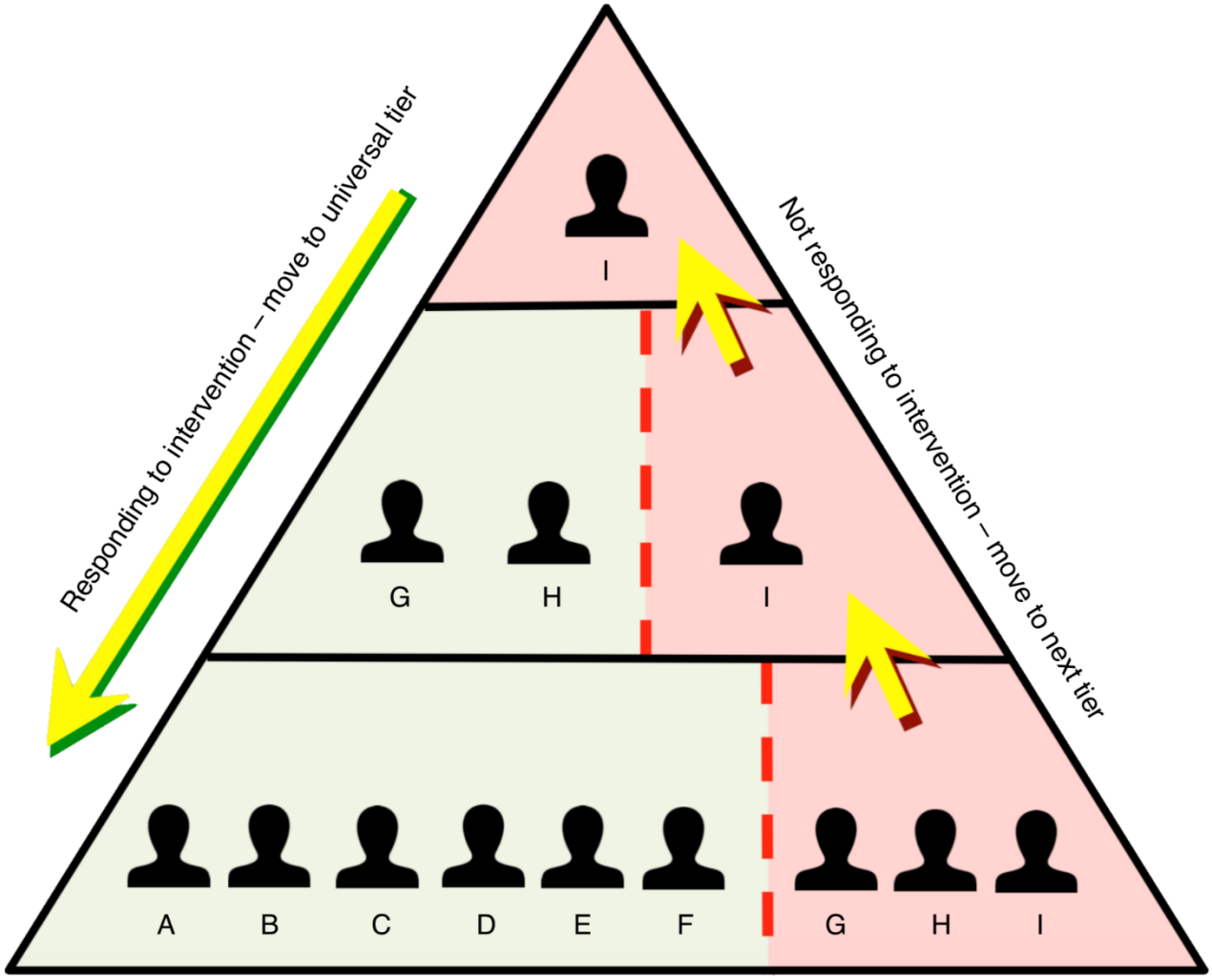


Figure 2.7. The RtI tiered framework. Adapted from Balu et al. (2015, p. 7).

RtI is designed to ensure that evidence-based instruction is matched to student needs. Use of the tiered system is directed by the individual's performance, with decisions regarding the

duration and intensity of instruction being governed by data (Walker et al., 2015). It important to note for this study that the majority of the research regarding RtI has been predominately in primary school settings, and it has only relatively recently started to be used to structure social skills interventions (Mitchell, 2014). Mitchell (2014) argued that such systems need some sort of mechanism to 'triage' students with extreme academic or social-emotional challenges straight to Tier 3, bypassing the earlier two stages. While this makes sense from the perspective of responding to the needs of an individual with such challenges in a timely manner, it does seem to undermine the point of a graduated, data-informed system. For the purposes of this research project, RtI provided a macro-level framework that was useful for considering the role of the designed intervention as one component of a broader system of support for the students.

2.8.2 A framework for planning and implementation: SPELL

While RTI provides a structured system for planning who receives which form of intervention, the *Structure, Positive approaches and expectations, Empathy, Low arousal, Links* (SPELL) framework is used for the planning and implementation of an intervention. This framework could be used for interventions at the universal level (Tier 1), the secondary level (Tier 2), or the individual tertiary level (Tier 3). The SPELL framework, shown in Table 2.6, was developed by the National Autistic Society (2016) to address the specific needs of people with autism. This approach seems to be influenced by the values of the social model of disability, with the emphases being on the functional needs of the child and how educators can address these requirements. Table 2.6 explores each of the five components of SPELL, and the implications for conducting an intervention with children with autism.

Table 2.6. Five components of the SPELL framework (National Autistic Society, 2016).

Component	Implication for intervention
Structure: Structure makes the world a more predictable, accessible and safer place.	✓ Create structured environments using visual information. ✓ Environments and processes can be modified to ensure each person knows what is going to happen and what is expected of them, reducing anxiety.
Positive approaches and expectations: Establish and reinforce self-confidence and self-esteem by building on natural strengths, interest and abilities.	✓ Assessments should be made from as wide a perspective as possible and should include a view of the barriers in accessing opportunity. ✓ For example, many people on the autism spectrum can have difficulty with verbal communication, leading to an underestimation of their ability and potential.
Empathy: Making efforts to understand, respect and relate to the experience of the autistic person must underpin attempts to develop communication and reduce anxiety.	*(None suggested beyond description)*
Low arousal: Approaches and the environment need to be calm and ordered in such a way so as to reduce anxiety and aid concentration.	✓ There should be as few distractions as possible, paying attention to noise levels, colour schemes, odours, lighting and clutter, for example. ✓ Some people can need more time to process information, especially speech. ✓ Clear information should be given in the medium best suited to the individual with care taken not to overload or bombard them.
Links: Recognise the benefits of sharing information and working alongside the individual, their families and other professionals.	✓ Autistic people, their parents or advocates should be seen as partners.

These considerations are useful in thinking about whether the design of a planned intervention addresses the needs of individuals. There is opportunity for integration of an evaluative framework, such as SPELL, with the processes of iterative design found in the *Compleat model*, which is explored at length in *Chapter 4*.

2.8.3 A model for teaching social skills: Elksnin and Elksnin's instructional model for social skills instruction

Moving from implementation frameworks to a model for intervention instruction, Elksnin and Elksnin (1998) provided an instructional model specifically for social skills instruction. While not specifically directed at students with disabilities, their five-step process reflects many of the reviewed social skills interventions designed specifically for children with cognitive or socio-emotional disabilities. This process involves:

1. Defining the skill.
2. Listing the steps involved in the performance of the skills.
3. Providing a rationale for why the skill is important to the learner.
4. Describing situations and settings in which the skills should be applied.
5. Modelling the skill through methods such as role-play and providing students with specific feedback on their performance of the skill.

These steps provide a suggested pathway for supporting students to acquire new social skills or reiterating the meaning of the previously taught skills and the contexts in which they should be performed. Elksnin and Elksnin's (1998) instructional model has a dual focus on both skill acquisition, which comprises steps one to three, and skill performance, comprising steps four and five. Step four is particularly important given the evidence that many students with social-emotional challenges find knowing when to perform a particular skill the most challenging aspect of navigating social interactions (Bellini et al., 2007; Camargo, Rispoli, Ganz, Hong, Davis, & Mason, 2016; Winner, 2013). This model provided a systematic and tested approach for skill instruction, which is a key component of any social skills intervention.

2.9 Critical intervention components for developing social skills

In response to the challenges highlighted within this chapter, there have been an ever-increasing number of social skills interventions targeting different populations and different specific subskills. Interventionists need to consider the components of interventions that are critical for developing targeted skills. Comparing the findings of systematic reviews highlighted a number of common components identified in effective social skills interventions (Bellini & Akullian, 2007; Bond et al., 2016; Camargo et al., 2016; Wang & Spillane, 2009; Wong et al., 2015). While some reviews focused on targeting specific skills and other reviews focused on comparing methods of intervention delivery, two specific areas of agreed importance emerged from the analysis: the need for contextualised instruction and matching the teaching strategy with the type of skill deficit. Additionally, these studies bring to attention a range of ecological and methodological variables that can impact on the rate of skill development.

2.9.1 Contextualised instruction

The most prevalent component found throughout these systematic reviews was the need for contextualised instruction. Contextualised instruction involves ensuring that interventions occur in the situations and settings in which the skills should be performed, rather than detached hypothetical scenarios with non-familiar peers or adults (Bellini et al., 2007; Camargo et al., 2016). Given the previously discussed difficulty children with autism have in generalising the application of social skills, this is not surprising. Reichow and Volkmar (2010) suggested contextual relevance as a reason why social skills groups are the only category of intervention with a demonstrable base of evidence using their method of analysis. Rather

than relying on hypothetical situations, they often draw on authentic challenges that have come to the teachers' attention (Reichow & Volkmar, 2010). Interestingly, Bellini et al. (2007) contended there is no significant difference in the effectiveness of one-to-one interventions and group-based interventions, and that it is the setting in which the intervention occurs that matters. Interestingly, in their meta-analysis of social skills programs, Reichow and Volkmar (2010) reported poor maintenance of skills. They suggest this could be due to these programs being used in decontextualised settings such as group therapy sessions, further emphasising the need for contextually-relevant interventions.

2.9.2 Matching the teaching strategy with the type of skill deficit

A second common component found in many effective social skills interventions is the need to match the strategy used to teach a particular skill with the type of skill deficit. This means that the features of an intervention should be tailored to address the unique characteristics of the participants and their areas of need rather than a 'one size fits all' generic approach (Camargo, Rispoli, Ganz, Hong, Davis, & Mason et al., 2014). Strategy selection is not a static process, but rather educators should be responsive to the changing needs of the student (Bellini et al., 2007; Quinn et al., 1999). Camargo et al. (2016) noted that this can be difficult for educators in inclusive settings who may not have the depth of experience required for selecting a specialised social skills intervention that is appropriate for addressing a specific area of challenge. In order to assist less experienced educators with this process, it is vital that interventions developed for use by classroom teachers provide detailed and plain language instructions that clearly communicate the purpose of the intervention and the steps required for implementation with a high degree of fidelity.

2.9.3 Ecological and methodological variables within social skills interventions

When drawing conclusions from systematic reviews, it is important to be mindful of the variables, or moderators, that can have an impact on whether the suggested outcomes can be generalised to a specific population (Slavin, 2018). Variables can be restricted purposely through research design, such as the purposeful restriction of participant age, or incidental to the design of a review. In other words, the context in which a study was conducted was critical to its applicability to the students in this study.

It is important to consider the profile of the ecology in which research has been conducted. There is a dichotomy within the research between studies conducted in naturalistic environments in which the skills are intended to be applied, such as schools, and studies that have been conducted in specialised spaces designed to optimise data collection and the sensory environment (Bond et al., 2016). Ideally, studies would have used a methodology that allows for an intervention to be refined in one context and then for broader testing in other ecologies to test for the boundaries of effective transportation (McKenny & Reeves, 2012). This is significant due to the influence of the unique variables that might be found in each context. Crucially, there was no identified social skills intervention research that involved students working in a 'satellite room' within a mainstream primary school. Consequently, this current research addresses a significant ecological gap in the literature.

Methodological variables resulting from the ways in which interventions were tested also needed to be considered. These variables make a significance difference in determining the suitability of an intervention for a particular context (Bellini et al., 2007), yet often they are not included in systematic reviews that primarily focus on the outcomes of interventions rather

than the processes of implementation. Variables include how often an intervention is conducted (dosage), how closely a study has adhered to the specifications and directions for implementation (fidelity), and the precise measures by which an intervention is judged to have successfully 'developed' the social capabilities of a learner (Bellini et al., 2007; Camargo et al., 2016). Significantly, different measures are used for interventions primarily designed around the acquisition of new social skills, and for interventions for increasing the situational performance fluency of existing skills (Gresham et al., 2010). This research project aimed to both support students to acquire targeted social skills and help them recognise when they should perform these skills. These ecological and methodological variables were central in analysing the existing research for two forms of intervention that were of particular importance to this study: video modelling and video review.

2.10 Video as an instructional tool: Video modelling and video review

One of the common findings within three of the systematic reviews was the effectiveness of using video modelling (Bellini et al., 2007; Camargo et al., 2016; Wong et al., 2015). Shepherd, Hoban, and Dixon (2014) described video modelling as "enhancing positive behaviours and efficacy through visually cued instruction and modelling strategies for students" (p. 151). Delano (2007) described video modelling as a broad umbrella term, encompassing interventions that use selected footage of the individual performing the incremental steps for displaying a desirable behaviour or performing a skill. These video models can feature either the targeted individual (self-video modelling) or another individual as a model (peer-video modelling) (Shepherd et al., 2014).

A large number of autism intervention researchers argue that individualised video modelling is effective due to the emphases on 'visually cued instruction' (Bellini & Akullian, 2007;

Delano, 2007; Dowrick, 1999; Shepherd et al., 2014). Video modelling draws upon the assumptions of social behaviourist theories of learning, such as social learning theory. Pointing to an assumption of observation leading to imitation, Reagon, Higbee and Endicott (2006) argued that video modelling is effective because it allows for the systematic repetition of the identical footage, allowing for multiple observations of the same desired behaviour and positive consequence.

Video review is an instructional technique that provides students with more agency than video modelling. Rather than editing the footage to only show positive or desirable instances of behaviour, video review, or video coaching, provides learners with access to an entire record of events (Barlow, Burroughs, Harmon, Sutton, & Yopp, 2014). Adopting many of the assumptions of social constructivism, the contexts in which students learn that skill performance is appropriate is co-constructed by the collective reaction to the video footage (Maione & Mirenda, 2006). While educators facilitate conversations around the cognitive mediation, or 'thinking processes', used in deciding when to perform a skill, the learner is also influenced by their peers' reactions (Maione & Mirenda, 2006; Qarabash et al., 2018). Learners and educators discuss events, identifying areas of success and challenge and then develop goals in response to this discussion (Qarabash et al., 2018). While there is considerable research into using video modelling with students with disabilities, there is significantly less exploring the use of video review.

2.10.1 Instrumental features of effective video modelling and video review

Effective interventions using video modelling and video review share a number of features. There is a need for the explicit modelling and labelling of the desired or targeted behaviours

(Delano, 2007). Learners should see the sequence of actions that they need to perform segmented into concrete steps and supported with frequent references to the vocabulary used to label these steps (Mason et al., 2016; Reagon et al., 2006). Video should feature a person known to the learner, such as a classmate or a sibling (Delano, 2007; Mason et al., 2016, Reagon et al., 2006). Underpinning this notion of familiarity is the need for the learner to be engaged through closely watching the video for at least one minute (Rayner, Denholm, & Sigafoos, 2009). Delano (2007) noted that this is much more likely when the learner has an affinity for the peer they are watching. This speaks to the need for individualisation in order to meet the specific needs of a child rather than the use of generic videos (Bellini et al., 2007).

Part of this need for individualisation relates to both the nature of the targeted behaviour and the context in which it will be used. However, despite some guidance given in the literature, this is an area requiring more research. Delano (2007) noted that self-modelling videos featuring the learner can be more effective than peer-modelling in improving social initiations, but he did not state whether this is limited to classroom interactions or is true of other settings. One area of strong agreement within the literature is the need for creating videos in naturalistic settings where the skills will be applied.

2.10.2 Evidence for generalisation and transferability of social skills

Generalisation and transferability of skills beyond the contexts in which a skill is taught are also important in determining if an intervention is successful (Green et al., 2017; Mechling & Swindle, 2013). Studies examining the generalisation of skills developed through video instructional techniques predominately focus on children with autism (Green et al., 2017; Maione & Mirenda, 2006; Mechling & Swindle, 2013; Rayner, 2011). When using the explicit instructional prompts of video modelling, maintenance of a skill is likely but generalisation

beyond what has been shown to the student is less certain. Maione and Mirenda (2006) cited the scripted nature of video models as being a challenge. This is where questions around the characteristics of the research population become pertinent. As most studies involved students with autism, it might be that the participants' restricted behaviours created a barrier to using skills in new contexts. Using video modelling to assist students with autism in generalising acquired social skills requires further investigation.

Compared with explicit and scripted instructional sequencing, video review can offer a greater opportunity for discussing the performance of skills in other contexts. In a very different context from this study, Qarabash et al.'s (2018) research provides some important guidance in how video review can be implemented in order to promote reflection on skill performance. Their participating students collected and 'tagged' video footage of themselves engaging in collaborative, group-based activities over a number of weeks. Students then reviewed this footage, self-identifying instances of them engaging in a number of broad social skills.

Maione and Mirenda (2006) proposed a compromise between the explicit instruction of video modelling and student-led video review. They suggested a 'third way', using such student-led video review systems in parallel with the interventionist-led video models to optimise generalisation. It is important to note that while Maione and Mirenda (2006) claimed this compromise can optimise the generalisation of performance, no supporting studies were identified in this literature review. Using both forms of video instruction in combination with other complementary strategies was a central feature of this research project, testing the feasibility of this compromise.

2.11 Universal teaching strategies for instruction

In addition to video-based interventions specifically targeting the development of social capabilities, a number of general features for effective instruction were also identified through an examination of the broader literature surrounding the science of learning. These features have been organised into three distinct themes:

1. Clear goals and identifiable measures of success;
2. Reducing cognitive load through the use of explicit instruction and spaced practice;
3. Meaningful feedback.

The three themes were referred to constantly throughout the literature as they are universally applicable in the delivery of any form of intervention and offer important insights for future intervention designs.

2.11.1 Clear goals and identifiable measures of success

There is a strong emphasis in the literature on the importance of clear, explicit goals if instruction is to achieve the intended outcomes in both academic and social interventions (Berman & Graham, 2018; Conzemius & O'Neill, 2009; Locke & Latham, 2002). Learners must also recognise what the actualisation or achievement of this goal looks like, often referred to as the 'success criteria' (Hattie, 2009, Wiliams, 2008; Yates & Hattie, 2014). In the broadest sense, a goal is a desired outcome or attainment (Locke & Latham, 2002; Woolfolk & Margetts, 2016). Locke and Latham (2002) identified four dimensions of goal-setting that have an impact upon learning: goals direct attention to the task, they energise effort from the learner, they increase persistence, and promote the development of new knowledge and

strategies. These dimensions are relevant for all forms of learning, including social skills interventions (Locke & Latham, 2002).

Exploring what makes an 'effective goal', both Schunk and Ertmer (1999) and Locke and Latham (1990) suggested that achievable goals must be personalised, sufficiently challenging and attainable for the learner. Locke and Latham (2002) later added that goals also need to be relevant to the learner. Anderman and Anderman (2014) added that for a goal to be motivating, a student must also believe that the goal will be reached in the near future. Hattie and Timperley (2007) noted a connection between specific goals and the precision of feedback, as setting specific goals in response to feedback allows for the learner to focus attention on their next developmental step. A goal should have clear desired outcomes in meaningful language for both the teaching staff and, more importantly, for the learner, with clear standards for judging performance (Hattie, 2009; Mitchell, 2014; Woolfolk & Margetts, 2016).

It is when discussing specificity that the formatting of success criteria comes to the fore. Travers, Morisano and Locke (2015) argued that it is vitally important that the goals are presented in such a way that students understand the purpose underpinning the goal, and the steps required to achieve the goal. Success criteria are important for students in developing the skills required for self-regulated learning (Yates & Hattie, 2014). Criteria should provide students with indicators of progress they can use to monitor and self-assess their learning, so they know when they have achieved the goal (Berman & Graham, 2018). For this to occur, the success criteria must align with the assessment criteria (Griffin, 2018). Hence, goals in a social skills intervention must be framed in a way that is concrete and tangible so that they can be measured.

While teacher-led goals offer certain affordances in terms of guiding students along a set learning progression, such as those presented later in this chapter, these goals might not be shared by the students. Mitchell (2014) discussed the importance of students being involved in the goal-setting process to ensure that they understand and value these learning objectives. Both Mitchell (2014), and Yates and Hattie (2014) asserted that understanding goals is an essential step in assisting learners to develop the skills to monitor their own progress towards achieving these goals. Mitchell (2014) did recognise that the degree to which students can set their own goals is constrained by the realities of curriculum and the challenges students might face in recognising their current level of capabilities and the next stage within a sequence of learning. This can lead to students setting goals that are beyond what they are ready to learn. As such, when conducting an intervention, teachers need to both consult with students and use their professional judgement to ensure that goals are specific, meaningful, achievable in a limited timeframe and allow for progress to be measured.

2.11.2 Meaningful feedback

In order for learners to know how close they are to achieving their goals, there is a suggestion that learners need to receive feedback that is meaningful to them. Hattie and Timperley (2007) conceptualised feedback as “information provided by an agent regarding aspects of one’s performance or understanding” (p. 81). In understanding what constitutes ‘meaningful feedback’, Berman and Graham (2018) referred to information that provides a learner with a clear understanding of the differences between what a learner currently knows or skills they can perform, what they need to know or be able to do in order to reach their goals and, most importantly, the steps required to be able to bridge this gap. Hattie and Timperley (2007)

provided three questions for the learner that they argued are central for bridging the discrepancy between the goal and performance:

1. Where am I going?
2. How am I going?
3. Where to next?

Well-constructed feedback should allow students to be able to reflect on these questions in order to evaluate their goals, their performance and implement changes to address the identified areas of need (Berman & Graham, 2018; Quinton & Smallbone, 2010). Crucially for the participants in this study, Quinton and Smallbone (2010) noted that learners need to be explicitly taught and initially guided through the processes of self-reflection. Feedback is also a bilateral exchange, with educators receiving constant feedback from students on the ways in which the learners respond to the intended learning outcomes, incidental or unintended outcomes and the factors that supported or hindered learning (Berman & Graham, 2018). It was therefore essential that this research project allocated sufficient time within the intervention for self-reflection, teacher-led feedback and student-led feedback.

When considering what learners should be receiving feedback on in an intervention, Hattie and Timperley (2007) described four overarching categories: feedback on achievement in completing the task; feedback on the processes used to complete the task; feedback on the learner's level of self-regulation during the task; and feedback evaluating the person rather than the learning. In most instances of learning, Hattie and Timperley (2007) suggested that the emphasis should be on the educator providing feedback on the processes used to complete a task and the individual's self-regulatory processes, such as self-monitoring of process. Given the challenges experienced by the student participants in this study, this

emphasis on teacher-led feedback made sense. Both Brookhart (2007) and Wiliams (2008) agreed with this sentiment but added that feedback should be positive in nature in terms of focusing on what has been achieved and what the next developmental steps involve. A positive and strength-based approach to feedback aligned with the values of the school setting in which this research was conducted, and framed the design of the feedback supports used in this study.

The timing of feedback also needs to be considered. Some authors have suggested that there is no single response in terms of timing as, although immediate feedback is often positioned as being the ideal (Brookhart, 2007; Wiliams, 2008), Hattie and Timperley (2007) argued that students could need processing time between a complex task and the feedback. In considering the source of the feedback, Hattie (2009) noted that his meta-analysis found that computer-assisted instructional feedback has an above average effect size. This was of interest in designing an intervention using DGBL and is explored in the following chapter in the context of looking at the types of feedback afforded by videogames.

2.11.3 Reducing cognitive load through the use of explicit instruction and spaced practice

Many interventions reviewed in this study referred to Sweller's concept of 'cognitive load theory' (Sweller, 1994; Sweller, Ayres, & Kalyuga, 2011). This theory essentially contends that learners have a limited working memory and can only process a few items at a time, but there is no limit in terms of processing information that has been consolidated in long-term memory (Department of Education New South Wales [DENSW], 2018). This is illustrated in Figure 2.8. There are suggested instructional strategies that educators can use to transfer

new and unfamiliar knowledge from working memory to long-term memory, which is essential in developing more sophisticated social skills.

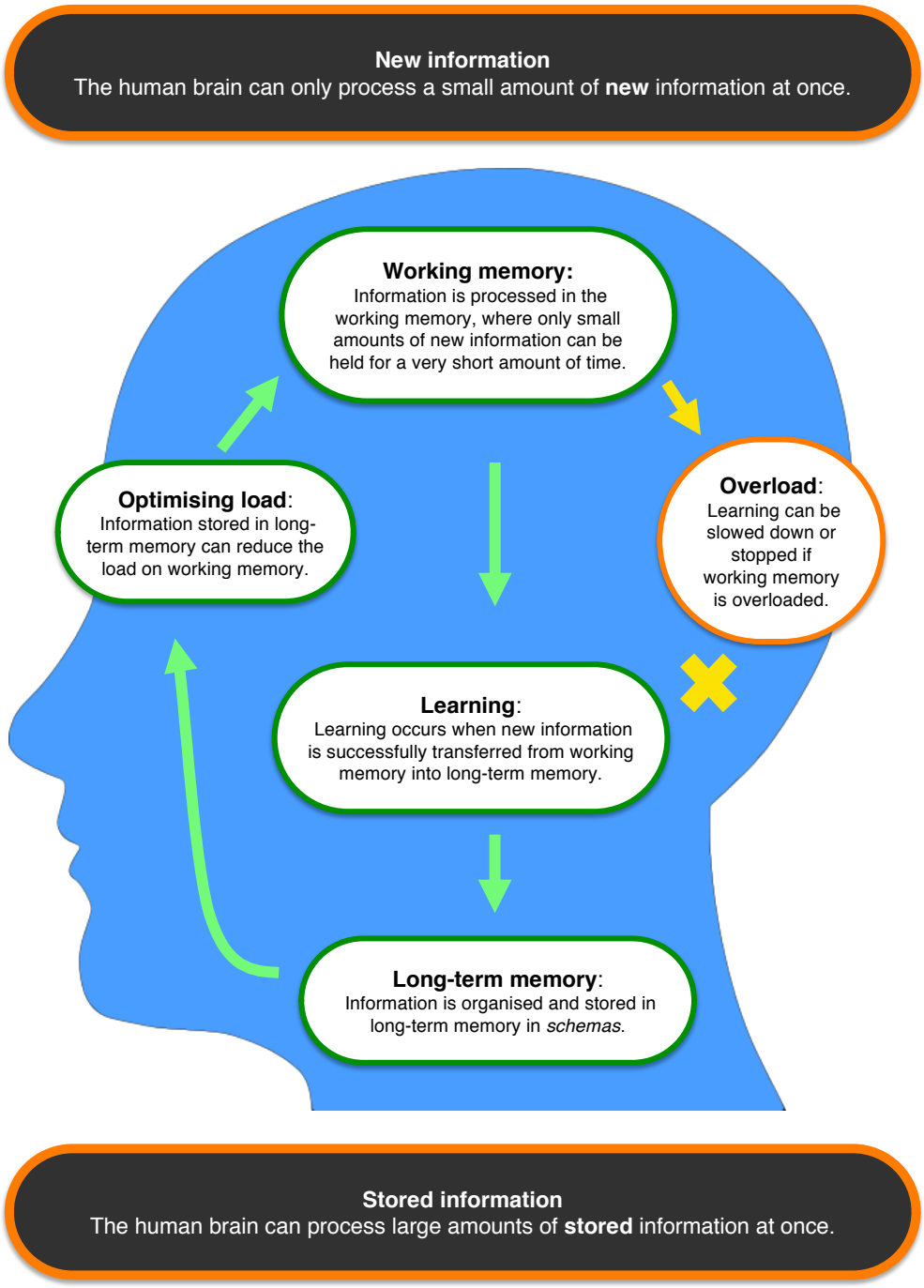


Figure 2.8. Processing new information according to cognitive load theory. Adapted from DENSW (2018, p. 2).

2.11.3.1 New information and working memory

As shown at the top of Figure 2.8, new or unfamiliar information is initially processed in a learner's working memory. Only small amounts of information can be retained for a limited time while it is being processed in a learner's working memory (Sweller et al., 2011). While adults can retain somewhere between five to eight individual pieces of information at once, they can only simultaneously process a maximum of four of these (DENSW, 2018). It is argued that while this number can be increased by chunking through the use of patterns, categories, and groupings (Ang, Zaphiris, & Mahmood, 2007; Preece, Rogers, & Sharp, 2002), these strategies are not intuitive and need to be developed (DENSW, 2018). For learners with cognitive impairments, such as Down syndrome, both the period of retention and the amount of information that can be processed can be significantly lower (Blanck, 2014). Figure 2.8 highlights that in order for the students in this study to acquire and retain knowledge of steps for performing the targeted social skills, information needed to be transferred to long-term memory through the processes of learning.

2.11.3.2 Learning and cognitive overload

Cognitive load theory posits that learning occurs when information is successfully transferred from a learner's working-memory to their long-term memory (DENSW, 2018). This chapter previously presented two models of learning, social learning theory and social constructivism, that presented alternative social understandings of how this transfer process occurs. Cognitive load theory focuses on the role of processing learning at an individual level. Sweller et al. (2011) contended that it is vital that key new information is processed and transferred to long-term memory to allow a learner to process further new information.

DeLeeuw and Mayer (2008) highlighted three kinds of cognitive processing during learning that can contribute to cognitive load:

> **Intrinsic** (or essential) **processing**: The learner engages in cognitive processing that is essential for comprehending the material.
>
> **Germane** (or generative) **processing**: The learner engages in deep cognitive processing, such as mentally organising the material and relating it to prior knowledge. This depends on the learner's motivation and prior knowledge, as well as prompts and support in the lesson.
>
> **Extraneous processing**: The learner engages in cognitive processing that does not support the learning objective. An example of this is students being confused by poorly labelled diagrams.
>
> - Adapted from DeLeeuw and Mayer (2008, p. 223)

When designing an intervention for this study, it was important that strategies and supports were used that afforded intrinsic and germane processing by the learner, while reducing extraneous processing. This provided the most efficient transfer path from working memory to long-term memory for the key concepts being targeted by the intervention.

If a learner's working memory is at full capacity and they then attempt to process additional information, cognitive overload occurs. Consequently, the rate of learning can either be reduced or completely stopped (Ang et al., 2007; DENSW, 2018). Ang et al. (2007) also noted other undesirable emotional consequences of cognitive overload, such as stress and frustration. When working with students with a reduced working memory capacity, it is particularly important to be aware of the cognitive overload. Spaced or distributed instruction

reduced the amount of new information being processed by the student participants' working memories, affording processing time for this information to be stored and organised within their long-term memory. This highlighted the importance of ensuring the participants in this study had multiple and spaced exposures to key vocabulary that was used to label the targeted social skills.

2.11.3.3 Long-term memory, stored information and optimising load

While the capacity of working-memory is extremely limited, long-term memory stores information using knowledge structures, or schemas, allowing for the processing of large amounts of information (Sweller et al., 2011). Woolfolk and Margetts (2016) defined a schema as "a pattern or guide for representing an event, a concept or skill" (p. 260). The complexity of a schema can vary from a few pieces of information to a highly complex organisation containing an enormous amount of information (DENSW, 2018). Schemas are invaluable in the process of learning as information stored in long-term memory reduces the load on working memory, as capacity limitations only apply when processing new or unfamiliar information (Sweller et al., 2011). Optimising the learners' cognitive loads was essential for this study, as the acquisition of increasingly sophisticated social skills relied upon the students being able to build upon their existing knowledge.

2.11.3.4 Instructional strategies to reduce cognitive load

There are a number of instructional strategies that can reduce the cognitive load for all students. In their synthesis of the evidence surrounding cognitive load theory, DENSW (2018) suggested seven specific strategies, as presented in Table 2.7.

Table 2.7. Strategies to reduce cognitive load. Adapted from DENSW (2018).

	Strategy	Rationale
Explicit instruction	1. Tailor lessons according to students' existing knowledge and skill	Students learn best when teachers tailor lessons to their existing knowledge and skill (DENSW, 2018, p. 5).
	2. Use worked examples to teach students new content or skills	Students learn new content or skills best when they are given lots of worked examples (DENSW, 2018, p. 11).
	3. Cut out inessential information	Students do not learn effectively when their attention is directed to inessential information (DENSW, 2018, p. 19).
	4. Present all the essential information together	Students do not learn effectively when their limited attention is split between two or more sources of essential information that have been separated (DENSW, 2018, p. 23).
	5. Simplify complex information by presenting it both orally and visually	Students can process complex information more easily when it is presented in both oral and visual forms at the same time (DENSW, 2018, p. 27).
	6. Encourage students to visualise concepts and procedures that they have learnt	Encourage students to visualise concepts and procedures that they have learnt (DENSW, 2018, p. 31).
	7. Gradually increase independent problem-solving as students become more proficient	Students benefit from gradually being given more opportunities for independent problem-solving to practise using knowledge and skills they have learnt (DENSW, 2018, p. 15).

Six of these strategies are found in a form of pedagogy known as 'explicit instruction', as highlighted in yellow in Table 2.7. Sometimes referred to as 'direct instruction', explicit instruction has connotations of highly scripted and teacher-centred pedagogy (Kirschner, Sweller & Clark, 2006; Rosenshine, 2012). This is certainly one form of explicit instruction. However, for the purposes of this study explicit social skill instruction is defined as teachers defining key vocabulary in language the students understand, explaining the context in which a skill should be used, and discussing with the students the micro-steps required to perform

a particular skill (Hattie, 2009; Kirschner et al., 2006). Explicit instruction is central to Elksnin and Elksnin's (1998) instructional model for social skills and formed an essential component of the skill instruction within this research project.

Students also require repeated exposure to new ideas and multiple opportunities to practise and receive feedback upon their performance of a new skill in order for this information to be consolidated. As shown earlier, this is particularly pertinent for learners with cognitive disabilities such as Down syndrome (Gass et al., 2013; Williams et al., 2005). 'Spaced practice', sometimes referred to as 'distributed practice', operates on the principle that shorter but more frequent sessions of instruction are more effective than a single, larger block of time of teaching as learners need time to process and consider the fundamentals of what they are learning. Yates and Hattie (2014) suggested that in most contexts, multiple blocks of less than 30 minutes are ideal, although Mitchell (2014) noted that some students may find five minutes extremely challenging. Spaced practice was an essential component of this research project and provided a significant justification for implementing the intervention through ten lessons over ten weeks.

2.12 Determining the utility of learning progressions for developing social skills

As indicated in the introduction to this chapter, learning progressions provide a pathway for the sequencing of specific social skills and for assessing levels of social sophistication. This section focuses on two sets of learning progressions developed for understanding the development of the social skills, the *SWANs social processes* and the *Collaborative problem-solving empirical progressions*. Both learning progressions were derived using 'task analysis', which refers to the deconstruction of a task into its component parts (Graham et al., 2015;

Klett & Turan, 2012). Using developmental continua assumes that there is a linear 'typical' progression of social skill development, or an underlying structure that dictates the order in which subsets of particular skills are ideally developed (Coles-Janess & Griffin, 2009). Component parts are then sequenced so that by mastering each component in turn, students will progress towards the accomplishment of the entire task (Griffin, 2018). While there is an argument that 'splinter skills' can disrupt these linear progressions in some learning areas (MacKay, Knott, & Dunlop, 2007), the University of North Carolina School of Medicine (2019) and Coles-Janess and Griffin (2009) argued that social development does have a typical pattern of development. Assuming these developmental sequences are calibrated for the intended audience and context, progressions provide interventionists with one source of data on what students are ready to learn and the subsequent developmental steps.

Griffin (2018) provided a methodology for using task analysis to construct learning progressions, developed through a synthesis of the work of Glaser, Vygotsky and Rasch. Glaser (1963; 1981) and Rasch (1960; 1980) have significantly influenced the field of developmental assessment, sharing a common understanding of student performance and development "in terms of the nature and order of tasks performed" (Griffin, 2018, p. 88). This implies that distinct levels of competence are always possible and that these can be arranged in levels of increasing sophistication. Glaser's (1963; 1981) criterion-referenced framework provides a means for interpreting the different levels of progression for a skill or task. It is underpinned by the notion that knowledge or skills acquisition can be organised in comparative stages from low proficiency to high proficiency along a continuum. The continuum informs the learner and the educator of what the student can do and what the next level of sophistication requires of the student (Coles-Janess & Griffin, 2009; Griffin, 2018). This framework is designed for interpreting assessment outcomes in terms of stages along

progressions of increasing competence (Glasser,1981). Each of the points on the continuum is identified through the use of indicative behaviours, or indicators of what the student can do, say, make or write. A criterion-referenced framework centres around this progression, and demands that students are assessed solely in relation to their level of performance of the task, as opposed to being comparatively measured in relation to the performance of other students.

At this point, Vygotsky's (1978) theory of ZPD becomes pertinent, as this theory helps educators understand how to progress students from one level of performance to the next level along the constructed continuum. Using this concept of ZPD, the role of the instructor, or the knowledgeable other, is to support the learner in taking this next step and nurturing the emerging skills; the ZPD captures "the skills that have not yet come to fruition but are in the process of maturing" (Griffin, 2018, p. 32). Rasch's 'Item Response Modelling' provides a means for measuring student ability and the difficulty of the task on a single scale (Griffin, 2018). This helps to identify the point at which the difficulty of the task matches the ability of the student. A task is within a student's ZPD when there is a 50% probability of successful completion. This can be thought of as the 'Goldilocks point', where a task is neither too easy nor too difficult for the student. A synthesis of Glaser, Vygotsky and Rasch's conceptualisations are central to both of the following developmental learning progressions.

The *SWANs social processes learning progression* (Coles-Janess & Griffin, 2009) is the learning progression that was used to assess and guide the development of the participants' interpersonal capabilities in the past, and provided a reference point for the types of social skills that had been focused on previously by the classroom teacher. The second reviewed learning progression, the *Collaborative problem-solving empirical progressions*,

conceptualises three social strands within Hesse et al.'s (2015) model of collaborative problem-solving. These social strands provide guidance on the nature of the social skills that participants required specifically to work collaboratively in solving problems. Although this instrument had never been used to assess the participating students, it provided a tool for interpreting the observed behaviours in a more specific social context than the *SWANs social processes learning progression*. Comparing the two sets of learning progressions also allowed for a juxaposition of the respective skills and hierarchies found in each.

2.12.1 The *SWANs social processes learning progression*

It is important to understand the historical development of *SWANs* to understand their suitability for this research project. Developed to provide a systematic and fine grain approach to the assessment of children with specialised learning needs, the *SWANs* have a particular emphasis on students who are performing at levels below those outlined in the state curriculum (Woods, Coles-Janess & Roberts, 2010). The founders of this project were seeking a systematic way to profile the capabilities of these students, and to provide educators with a heirarchical learning continuum for the development of these skills (Woods et al., 2010, Coles-Janess & Griffin, 2009). This continuum was constructed through a collation of observations from 700 educators, from 77 mainstream and specialist schools, describing their students' proficiencies in a range of areas, including emotional self-management, interpersonal processes and communication. Over a two-year period, a calibration study was conducted to transform these observations into a criterion-referenced framework (Coles-Janess & Griffin, 2009). Six different levels are shown in Table 2.8, arranged with the lowest level of proficiency at Level One. Indictative behaviours for the first

two levels are shown in order to provide insights into what students could be expected to be able to do at each developmental stage.

Table 2.8. Social processes learning progression: Interacting and connecting with people (Coles-Janess & Griffin, 2009).

Increasing levels of sophistication

Level One: Learning how to be socially receptive
Indicative behaviours: • The student is learning to focus attention on others and acknowledge their presence. • S/he may be forming emotional bonds with familiar adults. • The student is learning to accept assistance from familiar adults and may be learning how to undertake simple tasks with their coactive support.
Level Two: Learning how to be socially responsive
Indicative behaviours: • The student is learning to participate, with the support of familiar adults who direct and regulate the student's involvement. • Increasingly, the student is directing attention towards other people, but his/her interest may not lead to active participation. • The student may express affection towards, and a preference for, particular others and yet engage in activities alongside rather than with them. • If the student does interact with other students, this may not evolve into friendships. • The student is learning to operate in the social environment by following the direction of familiar adults. For instance, under direct supervision the student may be able to follow class rules and routines, greet others, control impulses, use property safely, and interact fairly with other students.
Level Three: Learning how to be socially active
Level Four: Learning how to be socially perceptive
Level Five: Learning how to be socially self-sufficient
Level Six: Learning how to be socially flexible

Collating such a broad range of educator observations captures a breadth of contexts, but this also creates challenges. Although these indicative behaviours are descriptive of how a

student would act in a social setting at each respective stage of development, they focus primarily on the outcomes of skill performance rather than the social skills themselves. Broad statements about what a student can do makes sense in the context in which this instrument was developed, but it can be too ambiguous for the purposes of developing a targeted social skills intervention. For example, this progression references "forming emotional bonds" but does not provide clear examples of what this should look like in a school setting. Interestingly, it does provide examples of students "learning to operate in the social environment." This disparity is particularly problematic as a tool for educators, as it lacks references to the individual fine-grain social skills that are required to achieve these broad outcomes and the conditions and contexts in which these skills should be expected to be used. As such, a more context specific instrument was required to complement this progression to provide a developmental pathway for this research project.

2.12.2 *Collaborative problem-solving empirical progressions*

The *Collaborative problem-solving empirical progressions* were considered a more useful set of learning progressions for this study as they provide a particular social context in which a specific set of social skills are required (Hesse et al., 2015). As indicated by their name, these progressions focus on collaborative problem solving and the performance of collaborative social skills. In order to measure the degree to which students collaborate at a more sophisticated level, the ATC21S project used task analysis to identify three social dimensions required for collaborative problem-solving (Hesse et al., 2015). The social dimensions present a hierarchy of social skills and behaviours that students use to work together to solve a problem. These dimensions are: participation, social regulation, and perspective-taking (Griffin, Murray, Care, Thomas and Perri, 2010; Hesse et al., 2015). These are in addition to

two identified cognitive dimensions, involving the ways in which the students learn and develop in those skills (Hesse et al., 2015): task regulation and knowledge building. The organisation of these skills is shown in Figure 2.9, with the emphasis being on the social strands or dimensions.

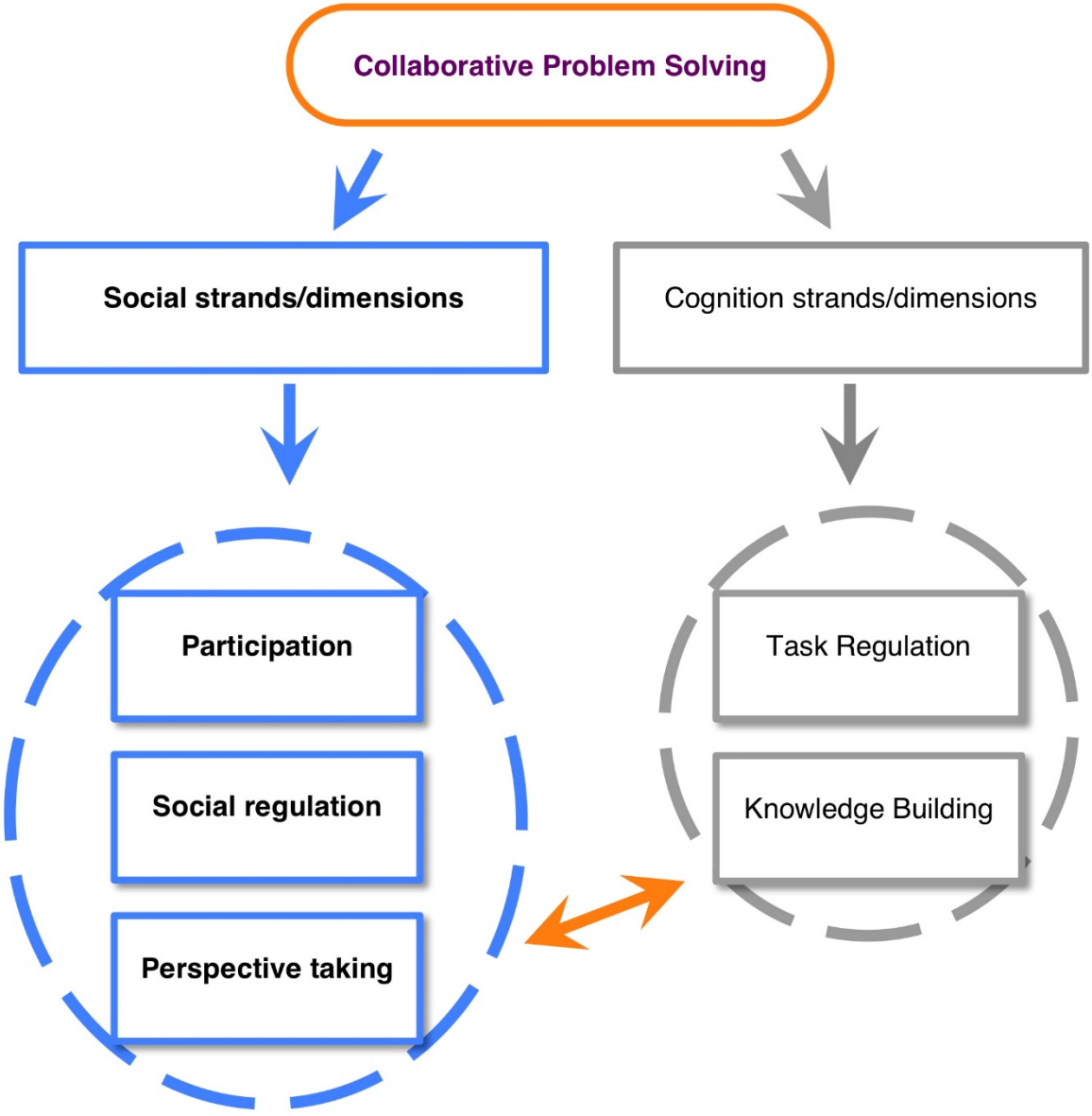


Figure 2.9. Organisation of social and cognitive skills within the *Collaborative problem-solving empirical progressions*. Adapted from Griffin, Murray, Care, Thomas and Perri (2010).

Despite the complexities of defining boundaries between these subsets of skills, the division serves a purpose by allowing for the unpacking of each strand into linear points of developmental progression. It is important to acknowledge the complex interplay between these strands, but at the same time, the language used by Griffin et al. (2010) has a level of simplicity that provides a foundation from which to further debate and unpack the subsets of these skills.

2.12.3 Unpacking participation, perspective-taking and social regulation

The social skills sub-elements of the *Collaborative problem-solving empirical progressions* are presented below in Table 2.9. Like the *SWANs social processes learning progression*, a hierarchy of increasingly sophisticated performance is presented for each of the three social dimensions.

Table 2.9. The social dimensions of the *Collaborative problem-solving empirical progressions* (Hesse et al., 2015).

Level	Participation	Perspective-taking	Social regulation
F – Cooperation & shared goals		The student can tailor communication with their partner based on their awareness of their partner's understanding from the start of the task. The student incorporates the contributions from their partner to suggest new solution paths or modify incorrect ones. They use solutions provided by their partner and work more collaboratively through the problem-solving process.	The student assumes group responsibility for the success of the task. They can manage conflicts with partners successfully, resolving differences before proceeding on a possible solution path. The student is able to evaluate their overall performance in the task. They are also able to evaluate the strengths and/or weaknesses of their partner based on their performance during the task.
E – Appreciated & valued partnership	The student is able to actively participate in unfamiliar tasks. The student initiates and promotes interaction with their partner often before entering their own answer.	The student acknowledges and responds to contributions from their partner but does not make changes to their original plan.	The student attempts to resolve differences in understanding with their partner but resolution of differences is not reached. The student is able to comment on their partner's performance during the task.
D – Mutual commitment	The student perseveres to solve the task by repeating attempts and/or multiple strategies.	The student modifies communication with their partner to improve common understanding and share resources and information.	The student comments on or shares information with their partner regarding their own performance while attempting the task. The student is aware of their partner's performance on the task.
C – Awareness of partnership	The student demonstrates effort towards solving the problem. The student discusses the task with their partner by responding to communication cues and requests.	The student makes contributions to their partners understanding.	They have a common understanding with their partners in regard to the problem. The student reports to their partner regarding their own activities on the task.
B – Supported working	The student actively participates in the task when it is familiar. Interaction between partners occurs more frequently but it is limited to only when it is necessary for completing the task.	The student is not overtly responsive to their partner, often taking a long time to respond or not responding at all and tends to ignore their partners contributions.	The student still works largely independently taking responsibility for their own actions during the task. The student is aware of their own level of performance during the task.
A – Independent working	The student commences the task independently focusing on the instructions provided. Interaction with their partner is limited to the beginning of a task and only in those situations where the instructions are clear.		

Like *SWANs*, the *Collaborative problem-solving empirical progressions* approach has a Glaser-informed developmental continuum that focuses on identifying what students can do and, subsequently, what they are ready to learn (Hesse et al., 2015). Although the general level statements presented on the left-hand side of the table above provide a combined summary of the social skills constructs for that level, they are too general for the purposes of coding collaborative behaviours for the participants of this research project. Participation, perspective-taking, and social regulation represent the skill subconstructs, with the indicators of performance, or indicative behaviours, listed at each level under these headings. These provide a much finer grain breakdown of the social skills dimension. This was useful for identifying levels of social sophistication in this research project.

In these progressions, participation involves examining the degree and quality of participation of individuals in completing the group task (Hesse et al., 2015). This dimension requires an opportunity for students to work with others to complete a task. According to these progressions, students at a foundational level complete tasks independently of each other. As students develop a more sophisticated level of participation, they begin to interact with their peers, prompting and responding to the contributions of others (Griffin et al., 2010; Hesse et al., 2015). Table 2.9 highlights that taking an interest in how others are attempting to solve the problem is a prerequisite for any form of social regulation or perspective-taking. If the students are not interacting with their peers, then there is no opportunity for them to perform and practice other social skills. It is this initial challenge where the need for learner engagement and motivation becomes obvious, and this is further explored in the context of DGBL in *Chapter 3*.

The ATC21S project (Hesse et al., 2015) defined perspective-taking as the degree to which students understand that others do not always see what they can see, and the degree to

which they can adapt their communication to account for this. Rehfeldt, Dillen, Ziomek and Kowalchuk (2007) emphasised an awareness of the potential for differences between an individual and their peers, defining perspective-taking as an individual's "awareness of informational states in oneself and in others" (p. 24). The authors label this as ‘audience awareness’, with more sophisticated levels of this dimension resulting in an individual being able to adapt their own behaviour to increase the suitability for others. Perspective-taking is also described as an essential prerequisite for social skills such as reciprocal conversation, cooperative play and empathy, and this has connections to the notion of theory of mind. Importantly for this study, Rehfeldt et al. (2007) contrasted the traditional developmental psychology understanding of perspective-taking as being a function of cognitive development, with more recent behaviourist perspectives seeing perspective-taking as something that can be learnt.

The final social dimension is social regulation, which is understood as examining the degree to which students can recognise and manage the sharing of different tasks within the group (Hesse et al., 2015). Developing social regulation from Level B to Level F reflects the work of both Grau and Whitebread (2012), and Volet, Vauras and Salonen (2009), in mapping the complex interplay between task regulation at the individual level and at a group level. Negotiating with others is an example of this interplay, where a mutual recognition of the goal is important in reconciling different approaches to completing a task. As a construct, social regulation could perhaps better reflect this interplay by being renamed ‘self and social regulation’, as Gesthuizen, Harrison, and Latheef (2018) contended that self-evaluation of one’s own performance is central to recognising when to control the actions of others. This also presents an example of where the artificial boundaries between dimensions can become blurred. For example, in order for an individual to form a common understanding with their

partner, there is a necessary degree of perspective-taking, as highlighted by Rehfeldt et al. (2007).

Despite these apparent challenges in drawing clear distinctions between the three subconstructs, these progressions offered a means for identifying the levels of proficiency that the students demonstrated in collaborative problem-solving and served as a point of reference for sequencing goals. These progressions also provided a rigorous evidence-based foundation for pre-emptively considering the barriers that might present during a social skills intervention with students with social-emotional challenges.

2.13 Chapter conclusions

At the centre of this chapter were the social emotional-challenges that the student participants in this study could be expected to experience throughout their lives. *Chapter 2* has explored the literature surrounding the challenges pertaining to two specific labels of disability most relevant to the study participants: autism and Down syndrome. A key finding was the importance of focusing on the functional impacts of disability through the lens of the social model of disability. This model emphasises the need for interventionists to consider how the ecology around the learner can be modified in order to better support learners with these areas of challenge.

A number of unique characteristics for autism and Down syndrome that impact on the way in which these populations may socially interact were identified. Grandin (2006) and Jackson (2002), who have lived experiences of autism, saw the nature of their challenges differently from the neurotypical perspectives of the clinical practitioners, interventionists and researchers. Where there was strong agreement was on the impact of the social differences upon the ability of people with autism to build friendships with their peers. Unfortunately, there

is insufficient literature examining the perspectives of people with Down syndrome on their own social capabilities, so comparisons are not as easy to make for this population. Despite the general paucity of research into the social challenges manifesting from Down syndrome, there was a recognition that challenges with oral language and working memory impacted upon perceptions of social competence.

Chapter 2 also examined why social skills are important from a number of perspectives. Beginning with the legal and moral rights of all learners to access inclusive education, the literature shows that social skills have an important role in helping these populations access mainstream education. Two theories of learning, social constructivism and social learning theory, were examined. Both theories emphasise the importance of social interactions in the processes of learning. Vygotsky's (1978) articulation of the ZAD and the ZPD are central in addressing the primary research question.

Looking at specific interventions targeting the development of social skills, multiple meta-analyses identified video modelling as having a substantial body of supporting evidence (Bellini & Akullian, 2007; Bond et al., 2016; Wang & Spillane, 2009). Less evidence is available supporting the use of video review in social skills intervention, although this might be due to it not having been tested with this population. Video review was found to be effective in other contexts (Barlow et al., 2014; Qarabash et al., 2018). This chapter also identified universal teaching strategies suggested as being important in any educational intervention. These include having clear goals and identifiable success criteria, explicit and spaced instruction of targeted knowledge and skills, and providing meaningful feedback.

Finally, two learning progressions were presented, providing two developmental pathways for identifying the sequence in which social skills should be taught. These progressions both provide directly observable 'indicative behaviours' that allow educators and researchers to

pinpoint what the learner can do and what they are ready to learn. The *Collaborative problem-solving empirical progressions* were more relevant to the objectives of this research project as they provide a specific context in which the social interactions are occurring. Figure 2.10 provides an overview of the means through which these findings informed this research project, particularly in shaping the initial design of the intervention. Alongside these key findings, the literature surrounding videogames, gamer culture and digital-games based learning offered valuable insights into developing effective games-based social skills interventions.

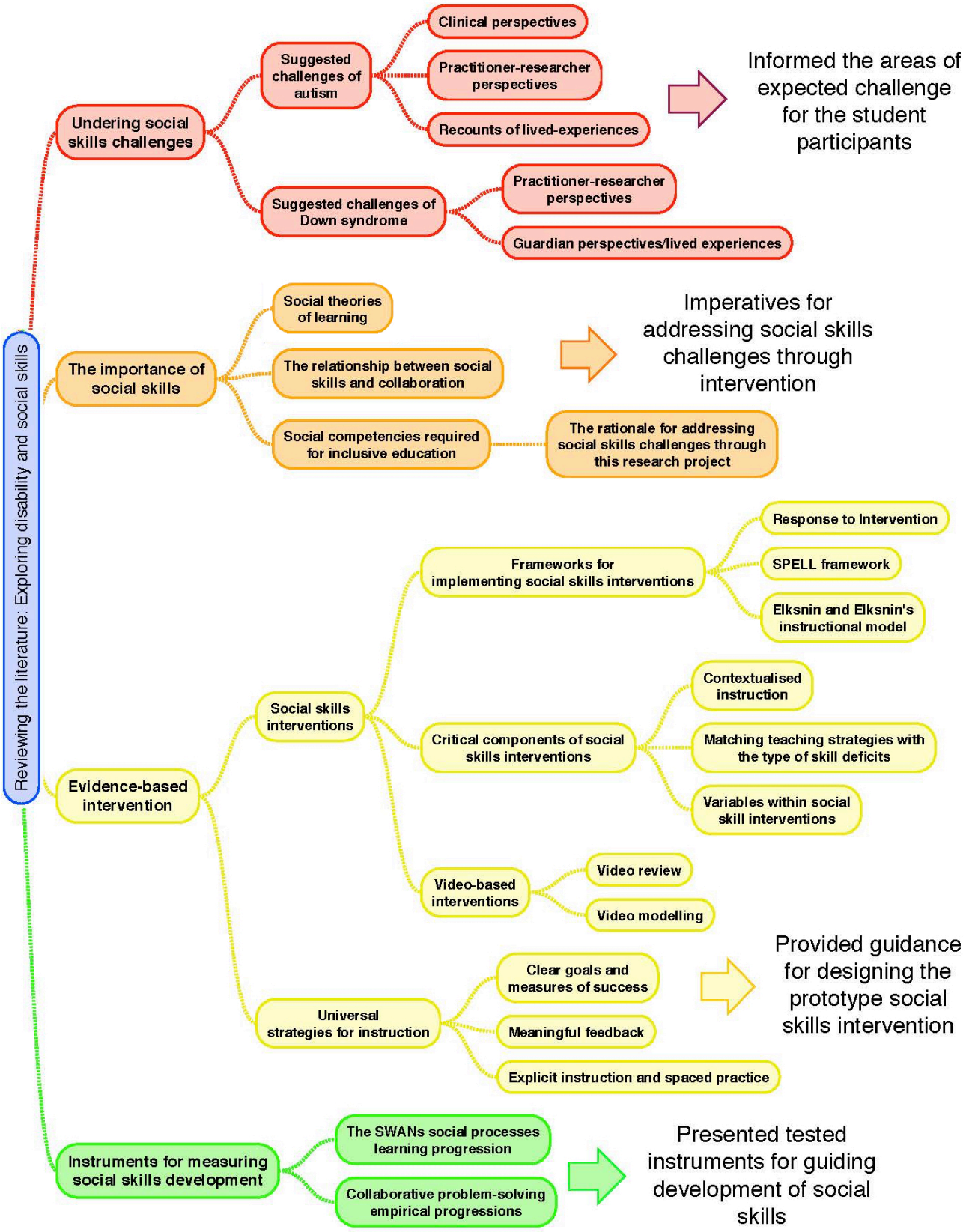


Figure 2.10: Implications of the reviewed literature in Chapter 2 for this research project.

Chapter 3: Literature exploring videogames, gamer culture and games-based learning

3.1 Glossary of specialised terminology used in Chapter 3

Term:	Explanation:
Affinity spaces	Shared spaces with some common interests surrounding gaming, or types of games but members have individual motivations and objectives (Hayes & Duncan, 2012).
Avatar	A virtual representation of the player in a videogame (Brown, 2014).
Commercial games	Videogames that are primarily developed as an entertainment product (Van Eck, 2006).
Cooperative multiplayer	Videogames where multiple participants collaborate to accomplish the shared task of defeating common opponents or challenges (Schmierbach, Xu, Oeldorf-Hirsch & Dardis, 2012).
Emergent metagame	The game beyond the game where strategies and lore that transcend the designed experiences of a game emerge through player interaction (Schwensfeier, 2019).
Game	A system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome (Salen & Zimmerman, 2004, p. 83).
Gamer culture	A common set of norms and values amongst the gaming community that have evolved over a 40-year history but, like other cultures, contains a wide variance of interpretation and practice for these norms and values (Crawford, 2011; Peterson & Hogan, 2006).
Videogame	Videogames are digital games with the following four traits: 1. Immediate feedback on player performance within the design and rules of the game. 2. Game designers share some information with the player, while concealing other information. 3. Automation of complex systems and procedures. 4. The facilitation of networked communication between players in multiplayer games. (Salen & Zimmerman, 2004).

3.2 Introduction and structure

> **"It may have once been true that computer games encouraged us to interact more with machines than with each other. But if you still think of gamers as loners, then you're not playing games."**
>
> - Jane McGonigal (2011, p. 63)

Increasingly, videogames are being seen as both culturally embedded and valued as genuine social experiences (McGonical, 2011). This chapter focuses on the literature exploring the use of the virtual environments provided by videogames as tools for creating the conditions for collaboration. Particular focus is given to examining the affordances of multiplayer interaction and game design.

Although a useful starting point, this review moves beyond the literature investigating the use of games in formal education settings, as much of this work is ethnographic in nature and written by people who explicitly declare that their expertise lies within learning theory or discipline-based learning areas, not game design and gamer culture. This study is unique in considering the role of gamer culture in a social skills intervention. Given this focus, *Chapter 3* draws upon literature from a diverse range of academic fields such as sociology and computer science, as well as gaming forums and community sites.

This chapter begins by considering definitions and categories of videogames based on current understandings. Multifaceted cultural dimensions often found in gaming communities are then explored, challenging the notion of 'gamers' being a single homogenous population. The focus then shifts to examining the emerging body of literature that examines videogames as pedagogical tools, the suggested affordances and challenges presented by components

of game design and the positioning of these components within educational settings. Research surrounding two of the suggested affordances of multiplayer videogames most relevant to this study, multiplayer game design and motivation, are then examined in greater detail.

3.3 Defining and categorising videogames

A knowledge of videogames and gaming conventions is vital to understanding the design of this study. This begins with understanding what is meant by the term 'videogame', and the associated subcategories within this broad definition. Beginning with the oft-debated morphological controversy surrounding whether researchers should be referring to 'video games' or 'videogames', this review will adhere to industry and cultural convention and use the single compound form, videogame (Kohler, 2007), an approach that is largely consistent in this field (Brown, 2014; Wright & Bogost, 2007). To grasp the complexities of competing definitions, there is a need to first investigate understandings of the morphograph 'game', and then examine the modifier 'video'. There are a myriad of different priorities and considerations that have historically been used to define what constitutes a game (see Table 3.1).

Table 3.1. Comparing elements of different definitions of the term 'game' (as cited in Salen & Zimmerman, 2004, p. 83).

Elements of a game definition	Parlett	Abt	Huizinga	Caillois	Suits	Crawford	Costikyan	Avedon/Sutton-Smith
Proceeds according to rules that limit players	✓	✓	✓	✓	✓	✓		✓
Conflict or contest	✓					✓		✓
Goal-oriented/outcome-oriented	✓	✓			✓		✓	✓
Activity, process, or event		✓			✓			✓
Involves decision-making		✓				✓	✓	
Not serious and absorbing			✓					
Never associated with material gain			✓	✓				
Artificial/safe/outside ordinary life			✓	✓		✓		
Creates special social groups			✓					
Voluntary				✓	✓			✓
Uncertain				✓				
Make-believe/representational				✓		✓		
Inefficient					✓			
System of parts/resources and tokens						✓	✓	
A form of art							✓	

Although the terms italicised in the above table lack clarity, the majority of these terms are useful in considering the defining elements that together constitute a game. Salen and Zimmerman (2004) combined the most prevalent of these components to form their own definition, with a game being "a system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome" (p. 83). Although this definition is over a decade old, it still shares many common characteristics with more recent definitions. For example, McGonical's (2011) oft-cited four defining traits of a game, "a goal, rules, a feedback system, and voluntary participation" (p. 23), refer to rules and a feedback system, which can be seen as providing a quantifiable outcome for players. Using a broader interpretation of 'artificial conflict' as a conflict between the players and the designed barriers to progress, the desired outcome for the players, or the goal, is to overcome these barriers. Salen and Zimmerman's (2004) definition is preferable to McGonical's (2011) for the purposes of this research project, as the inclusion of a reference to 'voluntary participation' is problematic in traditional school settings. Given the wealth of literature around student perceptions of a dictatorial dynamic in teacher-student power relations, it is difficult to foresee involvement being truly 'voluntary' and not directly or systematically coerced (Thornberg, Wänström, Pozzoli, & Gini, 2018; Wagner, 2007; Wong, 2016). Salen and Zimmerman (2004) strongly contended that the "underlying properties of games and the core challenges of game design hold true regardless of the medium in which a game manifests" (p. 91), which suggests that many of the opportunities and challenges discussed in the literature are shared across all forms of game-based learning.

3.3.1 The traits of videogames

There is a broad and often conflicting range of definitions for the term 'videogame'. Examining the traits of 'digital' games, interpreted here as videogames, Tavinor (2008) focused on the

medium used to deliver the game and the purpose. He highlighted the visual medium used by videogames and argued that the purpose is to provide entertainment "through the employment of one or both of the following modes of engagement: rule-bound gameplay or interactive fiction" (Tavinor, 2008, p. 8). This definition reflects a traditional view of videogame design but becomes problematic when considering less traditional examples of game design. For example, games such as *1-2 Switch* (Nintendo, 2017) rely primarily on audio cues and vibrations from the game controller, known as 'haptic feedback' (Jalink, Goris, Heineman, Pierie, & Henk, 2015), rather than the visual medium to direct the action. Likewise, there is a debate as to whether the designed purpose of simulations is to provide a realistic experience or to entertain (Ellington, Fowlie, & Gordon, 2013; Gee, 2013).

Alternative definitions emphasise common narrative content found within videogames. Hainey, Connolly, Stansfield, and Boyle (2011, p. 2199) point to the six defining dimensions of videogames first suggested by Garris, Ahlers, and Driskell (2002, p. 447). These dimensions are:

- Fantasy: imaginary themes, characters or contexts.
- Rules/goals: clear rules, goals and feedback.
- Sensory stimuli: novel auditory and visual stimuli.
- Challenge: optimal level of difficulty and goal attainment uncertainty.
- Mystery: similar to curiosity, providing optimal level of complexity of information.
- Control: active learner control.

The dimensions make reference to rules and goals, but also introduce the problematic dimensions of fantasy and mystery. Mystery as a distinct dimension is problematic because the use of this term in a gaming context is sometimes associated with a particular genre of game: adventure games. This dimension makes more sense when using Garris et al.'s (2002)

original description of mystery within a games-based context. Garris et al. (2002) discuss the generation of mystery through the design of the game mechanics, with information being strategically revealed and concealed at certain points of the game. This applies to a much broader range of games. Fantasy, and a focus on videogames including imaginary scenarios, presents a similar problem to mystery in that this dimension could be deemed to be genre-specific (Chen, 2012). Hainey et al.'s (2011) definition of fantasy also seemingly excludes collaborative simulations that have been used in some of the reviewed research in this chapter.

A more expansive definition that accounts for these critiques was provided by Salen and Zimmerman (2004). They identified four traits that summarise the unique qualities of 'digital' games, which for the purposes of this discussion are synonymous with 'videogames'. The first of these traits is an "immediate but narrow interactivity", in the sense that the player receives immediate feedback, but videogames are concurrently narrow, in the sense the player is limited by the design and rules of the game (p. 87). Immediate feedback in a designed experience is an important part of the experience of playing a game. The second trait is the "manipulation of information" (p. 88). This can be understood in terms of what information the game designers choose to share with the player and what information is concealed. Salen and Zimmerman (2004) use this category to describe a wide range of components of a videogame as being manipulated information. This includes graphics, audio, the internal logic of the game environment and the ways in which the games allow the player to interact with it.

The third trait is the "automation of complex systems and procedures" to facilitate the play of games that would be prohibitively complex in a non-digital environment (p. 88). The fourth trait, which is particularly pertinent to the multiplayer focus of this study, is the "facilitation of

networked communication" (p. 89). Salen and Zimmerman (2004) noted that this is not in every game, but multiplayer has become an increasingly popular way to play games (Chen, Leary, Peterson & Simkins, 2018). This will be explored further in discussions relating to the classification of different methods of multiplayer games. To summarise, the following definition of videogames is used in this research project:

Videogames are digital games with the following four traits:

1. **Immediate feedback on player performance within the design and rules of the game.**
2. **Game designers share some information with the player, while concealing other information.**
3. **Automation of complex systems and procedures.**
4. **The facilitation of networked communication between players in multiplayer games.**

- Salen and Zimmerman (2004)

This literature review pays particular attention to these four traits and uses them as a lens to explore both game design and the underpinning theoretical explanations that have been used to explain the design decisions.

Finally, two terms often used in conjunction with videogames in educational contexts are digital game-based learning (DGBL) and game theory. For the purpose of this thesis, the use of videogames as tools for learning is referred to as DGBL. Game theory refers to the examination of game rules as a means of explaining how people are thought to behave. For example, a rule that limits whether a player's character can hurt another character suggests that some players are more interested in individual gain than team gain. Anthropy and Clark (2014) contended that the examination of such rules allows game theorists to suggest how

certain game design features can construct certain types of communities, which is central to the objectives of this study.

3.3.2 Distinguishing between the mechanical design and content of videogames

Gee (2013), and Voulgari and Komis (2010), emphasised an important distinction between the *mechanical design* of the game and the *content* of the game. The mechanical design, which Gee (2013) referred to as the gameplay, is described as the goals, rules and mechanics of play, and modes of interaction with the environment. Game content refers to the stylistic design of game, affecting the aesthetic and narrative dimensions. This includes thematic direction (for example a science fiction themed game environment), which influences the visual and audio design of the characters and world, and the way in which a story is presented to the player. This dichotomy is useful in understanding the work of other authors in examining how mechanical design and content impact upon social interaction, player motivation and design considerations for players with a diverse range of needs.

3.3.3 Defining 'multiplayer' and 'cooperative multiplayer'

Central to addressing the research question was the use of multiplayer digital games as tools for supporting learning. 'Multiplayer' can be defined at the simplest level as denoting a videogame that is designed for, or involving, several players (Armitage, Claypool, & Branch, 2006). This broad understanding of the term at a basic level is shared in all of the literature that was examined and appears to be widely accepted.

This study focuses on 'cooperative multiplayer' games, in which participants are encouraged or required to coordinate their actions to accomplish shared tasks such as defeating common

opponents or overcoming obstacles (Schmierbach et al., 2012). It is important to differentiate between this classification of multiplayer games and the characteristics of learner cooperation-collaboration, as described in *Chapter 2*, with the latter classifying how individuals interact with each other in working towards a common goal. As explored later in this chapter, cooperative multiplayer games can create opportunities for players to work together but by themselves cannot guarantee either cooperation or collaboration between individuals.

3.3.4 Comparing 'serious games' and 'commercial games'

Much research makes a clear distinction between two broad categories of games: 'serious games' and 'commercial games' (Annetta, 2010; Annetta, Mangrum, Holmes, Collazo, & Cheng, 2009; Bidarra, Rothschild & Squire, 2011; Van Eck, 2006). Bidarra et al. (2011) defined serious games as sharing many of the characteristics and design fundamentals with games designed for entertainment "but with intended educational outcomes targeted at specific groups of learners" (p. 72). The use of the adjective 'serious' describes the educational purpose of the game, in that the games are designed to develop the player's knowledge or skillset in a desired area (Godwin-Jones, 2014; Kim, 2010). When used in the context of games designed for use in schools, Godwin-Jones (2014) described serious games as those that developers tailored to address specific areas of the curriculum.

The term 'commercial games' refers to digital games that are primarily developed as an entertainment product (Van Eck, 2006). It has been suggested that commercial off-the-shelf videogames can offer some potential benefits in terms of engagement (Gee, 2007b), scale of budget (Van Eck, 2006), cultural relevance (Lacasa, Méndez, & Martínez, 2008; Shaffer,

Squire, Halverson, & Gee, 2005), and accurate representations of “scientific laws, historical scenarios, and medical knowledge, among other concepts” (Sun, Ye, & Wang, 2015, p. 170).

Lacasa et al. (2008), and Charsky and Mims (2008), highlighted the social benefits of integrating commercial games into the classroom. It is commonly acknowledged that while commercial games are developed primarily for entertainment, many modern multiplayer games have also been designed specifically to facilitate the growth of communities within and around the game (Lacasa et al., 2008; Virvou & Katsionis, 2008). Lacasa et al. (2008) argued that part of this requires that games encourage the development of interpersonal and intercultural communication skills. Mysirlaki and Paraskeva (2011) even suggested that intrinsic motivation is more easily fostered in commercial games than in serious games, although there is no supporting evidence for this contention.

While a dichotomy between serious educational and commercial games is convenient for analysing the implementation of games in school environments, it is important to acknowledge that it is an abstract distinction (Bidarra, Rothschild, Squire, & Figueiredo, 2013). Such a distinction ignores ‘edutainment’ games that simultaneously seek to serve both entertainment and educational objectives (Bidarra et al., 2011; Bidarra et al., 2013). Angelides and Agius (2014) described games that have dualistic entertainment and educational purposes as multi-purpose games, with ‘lusory dimensions’ and ‘ludic dimensions’. Lusory dimensions position games as a ‘means-to-an-end’ tool, consisting of elements of game design such as goals and means of achieving the goal. In juxtaposition to this, ludic dimensions position games as entertaining experiences for players and focus largely on aesthetics and narrative presentation. While this lusory-ludic dichotomy might seem reminiscent of the division between mechanical design and game content, the

difference is that the lusory-ludic distinction focuses on the underlying purpose for the player rather than describing the design itself.

Angelides and Agius (2014) contended that multi-purpose games straddle a balance between entertainment and education to differing degrees. The authors argued that for a multi-purpose game to be considered successful, a balance has to be reached between the lusory constraints and the ludic enjoyment (Angelides & Agius, 2014, p. 2). However, when reviewing other descriptions of the use of specialised serious games and commercial games in educational contexts, it appears that all games have a lusory dimension. Some authors emphasise the role of a game in promoting this dimension (Connolly, Hainey, Boyle, Baxter, & Moreno-Gee, 2014; Ellington et al., 2013), while others emphasise the positioning of a game in the context of a broader lesson (Mysirlaki & Paraskeva, 2011; Squire, 2005). For this study, distinguishing between serious and commercial games is important in considering the intention of game designers when reviewing specific lusory and ludic dimensions.

While the games used in this research project were all designed as commercial products, they share many design characteristics with multiplayer serious games designed to promote curriculum-focused collaborative learning. Unique to commercial games is the ability to leverage the participants' passion for recognisable gaming franchises and their rich knowledge of gamer culture in order to engage them in addressing areas of specific challenge resulting from their social-emotional challenges.

3.4 Understanding gamer culture

Although traditional perceptions persist of videogames being a trivial pursuit targeted towards children (Wright & Bogost, 2007), the discussions around gaming are maturing. More than an interest or a hobby, gamer culture, like other forms of cultural identity, has a common set

of norms and values that have evolved over a 40-year history (Crawford, 2011; Peterson & Hogan, 2006). Gamer culture contains a wide variance of interpretation and enacted practice of these norms and values. For example, there are variations in abbreviations used for text-based chat between different communities that have developed around different games (Chen, 2012; Salter & Blodgett, 2012). Despite such subcultural differences, there are some broad overarching areas of alignment between different gamer communities. Considering the implications of gamer culture is important in understanding the motivations, cultural assumptions, potential interests and challenges for the participants involved in this study beyond the stereotypes held by 'n00bs' (meaning 'newbies' or inexperienced gamers) (Chen, 2012).

3.4.1 The game beyond the game

'Gamers', who self-identify as belonging to gamer culture, do not just play games, but rather play specific types of games that have been designated as 'hardcore'. This term denotes that the game is seen within a gaming community as being for experienced players, and that it requires a certain level of skill and specialised knowledge in order to play (Bosser & Nakatsu, 2006). Players who master the intricacies of these games increase their social and cultural capital in their respective gaming communities. Many gamers are also not content to just play these games as consumable, fixed goods, but they want to customise or 'mod' (modify) these games to demonstrate a level of mastery in understanding the core constructs of the game design (Gee, 2013; Prensky, 2006). Knowledge of the fictional lore, gaming celebrities and the 'modding' community is as much a part of gamer culture as knowledge of the games themselves.

Gamer culture is as much about the community that forms around the game as it is about the game itself. This is what is referred to as the 'metagame' (Gee & Hayes, 2012). Central to this is the notion of social capital, or the advantages people obtain from the interpersonal bonds they have formed (Reer & Krämer, 2017, p. 97). Adopting a *Bourdieuian* perspective of social capital, one such advantage may be influencing the actions of others and gaining power within a group (Bourdieu, 1986; Siisiainen, 2003). When an individual is recognised as possessing a particular skill or mastery in an area that is valued by a community, then a person can increase their influence within their social network (Bourdieu, 1986). In order to obtain, share and demonstrate mastery of a game, thus gaining social capital within gaming communities, players have turned to social media to broaden their audience. This can be seen in the explosion of 'live streaming' channels such as Twitch and YouTube Gaming, where players share their screens and narrate the events of a game (Burroughs & Rama, 2015; Pires & Simon, 2015). The motivations for doing this are usually to share knowledge of specific sections of a game, to parade the quality of their skill and to critique the game design (Burroughs & Rama, 2015). Monetisation of these services has created and maintained a growing industry of live streaming celebrities (Pires & Simon, 2015). There is also the emergence of 'fan fiction' and expanded universes, where people create artefacts such as stories set in the fictional universes of these games (Salen, 2008). These are all examples of the "game beyond the game" (Gee & Hayes, 2012, p. 3), and come with specific cultural considerations that could inform the actions of the young players in this study. As the participants were all under the age of thirteen, perspectives exploring the impact of gamer culture upon children were prioritised.

3.4.2 A diverse culture

Understanding the common traits of people who identify as gamers at any time is complex, because it is both fluid and diversely represented around the world. The term has evolved alongside and accelerated through the advent of the Internet. It is sometimes presented as a subgenre of popular culture (Crawford, 2011; Shaw, 2012), but this is being increasingly disputed as it has its own defining traits. Rather than relying on stereotypes or assumptions, Shaw (2010) argued for the use of evidence to interrogate gamer culture through a series of questions:

- Who plays videogames?
- How do they play?
- What do they play?

Some answers to these questions can be found in the research literature. Despite widespread representations within traditional forms of media of gamers overwhelmingly being children and adolescents (Wright & Bogost, 2007), data from Australia's Interactive Games and Entertainment Association suggests that the average age of gamers is 35 (Brand et al., 2017). This aligns with the notion that the children who grew up playing on the early gaming consoles are now adults, and they continue to play games (Chen, 2012; Prensky, 2006).

Likewise, media portrayals of gaming as being an almost exclusively male endeavour are incorrect, with an almost even split between male and female players (Newzoo, 2018). This can be argued for most forms of media, particularly games, which are played by everyone but designed predominately by men. The advent of a cultural distinction between 'casual' gaming and 'hardcore' has led to some high-profile players becoming increasingly vocal and exclusionary, particularly along gender lines (Kowert, Breuer, Festl & Quandt, 2015).

Addressing these tensions within gamer culture has implications for both the positioning of games and the role of the teacher within a DGBL intervention.

3.4.3 A diverse culture with some tensions

The literature also reveals a high level of contested critical analysis and defence of videogame content and gamer culture, with three themes of contention being particularly prevalent. Game content and this culture are often critiqued in unison (Shaw, 2012), so they will be explored together in this section with an emphasis on the critiques most relevant to the child participants in this study.

The first critique is the representation of females and minorities within game content. Kowert et al. (2015) argued that gender stereotypes found in some games are rooted in a broader narrative through which media is used as a tool for the cultural reproduction of outdated gender identities. This highlighted the importance of ensuring that the selected games and the language used by teaching staff depicted female characters as being equal to their male counterparts. There is another pertinent line of critique surrounding the treatment of female players within gaming communities, but this is beyond the scope of this thesis as all of the student participants in this study are male.

The second category of critique is the effect of 'screen time', or the time children spend engaging with digital media, and their wellbeing and neurological development. This has been reflected in a growing body of research. Must, Phillips, Curtin and Bandini (2015) found that students with autism were significantly more likely to spend a greater amount of time using digital media and were less likely to engage in physical activity. However, they positioned screen time as a consequence of being excluded from physical activity as a result of other barriers, such as being unable to afford fees for organised sports. In their systematic review

of the effect of mobile devices, including portable gaming devices, on sleep outcomes for children, Hale and Guan (2015) identified some troubling patterns. They found that device access at bedtime resulted in significantly poorer sleep quality and quantity. These are just two examples of studies that highlight a growing concern about the effects of significant amounts of digital media consumption. Interestingly, Przybylski and Weinstein (2017) offered a dissenting voice, finding that the wellbeing of children using digital devices above the recommended two hours a day was indistinguishable from children using their devices less than two hours a day. Although concerns on encouraging further use of digital devices is worth considering, these studies focus on excessive consumption as opposed to controlled and structured use of videogames for a specific purpose.

A third tension is the one that traditionally has received the most media and political attention but has the most contentious evidence-base: the suggested link between depictions of violence in videogames and violent acts carried out by those who play them (Peterson & Hogan, 2006). Given that this study is focused on a school-based intervention, this review focuses, where possible, on literature surrounding games rated as being appropriate for children. Examining the research provides mixed messages on the strength of any correlation between playing videogames and increases in undesirable psychological states for the players.

On one end of the spectrum, a systematic review by Calvert et al. (2017) found that videogames where players engaged in acts of aggression were a risk factor for adverse outcomes. This supported Maras et al.'s (2015) findings of a connection between playing videogames depicting violence and self-harm, anxiety and depression. Alternatively Lobel, Engels, Stone, Burk, and Granic (2017), and DeCamp and Ferguson (2017) argued that there is only a very weak correlation between virtual depictions of violence and the players

engaging in aggressive actions. They found that violent videogames had no association with psychosocial changes over a one-year period in a sample of 194 children between the ages of eight and 12. Durkin and Barber (2002) actually identified increases in family closeness, positive school engagement and activity involvement for 16-year-old students who were habitual video game players. Despite these positive findings there is a paucity in information surrounding the types of the games being regularly played by the participants. This brings to attention the nature of some of the methodological oversights found in many of these studies.

Questions surround the validity of many previous studies that have found a connection between exposure to videogames and enacted aggression. Markey, Markey and French (2015), for example, argued that these studies did not control for other variables that are known to contribute to aggressive psychological states. Critiques of methodology were supported by DeCamp and Ferguson (2017), who argued that once other known predictors are controlled, the effect size of videogame violence as a predictor for externalised youth violence becomes trivial. Of most interest to this study are findings by Greitemeyer and Osswald (2009; 2010) that 'prosocial' games, such as games featuring cooperative multiplayer modes, can lead to increases in desirable behaviours outside of the game environments. The diversity of conclusions highlights the importance of careful game selection for videogame-based interventions, particularly in considering the subtle messaging of cartoon violence found in many commercial games targeted towards children.

The literature cited above demonstrates the importance of seriously contemplating the representations of gender and depictions of violence in the game content used as part of a social skills intervention. This applies both in the selection of the games themselves, and how teaching staff model and engage in discussions surrounding games and gameplay. Additionally, the controversary around the amount of time spent playing the games needs to

be taken into consideration when planning the dosage, or frequency with which a games-based intervention is conducted with the participants.

3.4.4 Theoretical perspectives to explain the metagame

A key part of gamer culture is the emergent metagame. This is the game beyond the game, where strategies and lore that transcend the designed experiences of a game emerge through player interaction (Schwensfeier, 2019). An example is players sharing information of game 'bugs', or errors in the game design, so that players can access areas of the game world not intended by the game designers to be accessible. Diverging interpretations of the nature of player interaction that underpins the metagame often draw on competing theoretical conceptualisations and assumptions to explain the generation of culture and community surrounding digital games. Understanding these theoretical perspectives is useful in clarifying the different narratives explaining the emergence and evolution of gamer culture.

Two of the most popular theoretical conceptualisations that have been used to explain gaming communities are communities of practice (Lave & Wenger, 1991, Wenger, 1999) and affinity spaces (Gee & Hayes, 2012; Hayes & Duncan, 2012). Importantly, while the concept of communities of practice was developed to explain learning in informal groups in the physical world (Lave & Wenger, 1991), the idea of affinity spaces was designed specifically to model the social interactions occurring in online spaces dedicated to gamer culture (Hayes & Duncan, 2012). These two conceptualisations share some common assumptions. Both perspectives suggest that communities form around common outcomes, such as completing an objective in a game, or collaboratively 'modding' a game to transform it into something new. It is through the social interactions in these communities that players collectively build their knowledge and skills (Hayes & Duncan, 2012; Wenger, 1999; Wenger, McDermott, &

Snyder, 2002). Both theoretical lenses of communities of practice and affinity spaces have been used by games studies researchers to suggest that the norms and values of gamer culture are negotiated, co-constructed, and challenged through player interaction (Abrams & Lammers, 2017; Hayes & Duncan, 2012). For example, Chen (2012) highlighted the norms around the forming and maintenance of a raiding party within the popular online game *World of Warcraft*. There are also cultural norms around the use of other creators' art assets when 'remixing' an existing mod (Kretzschmar & Stanfill, 2019). For the purposes of this study, integrating the student participants' established understanding of the social norms and values of gamer culture within the norms and values of their broader community was critical for the objectives of the intervention.

Beyond these areas of agreement, there are a number of tensions between these two theoretical perspectives, particularly around the level of commitment to a group in multiplayer gameplay. Proponents of the communities of practice model argue that communities are formed when there is an understanding amongst individuals of three dimensions: the community focus, the community functionality through the mutual engagement of participants, and the capabilities produced as a result of this engagement (Lave & Wenger, 1991; Wenger; 1999). The affinity spaces model was developed in response to perceived oversights of applying these three dimensions to a digital games-based context (Gee, 2018; Hayes & Duncan, 2012). Proponents of this model highlight implicit connotations of the term 'community' as suggesting personal ties and familiarity, which they contend does not always accurately describe online gaming environments. Gee and Hayes (2012) also took issue with the lack of clarity in defining community membership and what constitutes the qualifying criteria for 'belonging'. Interestingly, some of the examples that Gee and Hayes (2012) provided as evidencing the limitations of Lave and Wenger's (1991) understanding of

community membership, extend beyond online gaming. Examples in the physical world are particularly pertinent for games-based interventions using local multiplayer games. As a practical example of the difficulty in defining a 'community', Gee (2018) suggested that players sharing a common game 'space' may have entirely different objectives and motivations for being there. He contended that they belong to different communities even though they are sharing an identical physical space, curriculum and instructor. As an alternative model, affinity spaces, or shared spaces with some common interests, more accurately reflect the social interactions in modern gaming (Gee, 2018; Hayes & Duncan, 2012). The significance of affinity spaces for this research project is in the formation and boundaries of communities playing games. While the players in this study were classmates, and therefore familiar, questions around the role of individual motivation in group interaction were particularly relevant for this research study.

These two competing theoretical perspectives on the metagame are further explored in understanding motivation within game-based collaboration.

3.5 Videogames as pedagogical tools

Commercial and serious games have been considered to possess certain characteristics that lend themselves to being effective pedagogical tools. The following sections of this chapter explore specific suggested affordances of videogame design and the theoretical models underpinning these suggestions.

3.5.1 Gee's principles of good game design

If there is one author who is synonymous with exploring game design and learning, it is Gee (2003; 2007b 2013; 2018). Much of the reviewed literature refers to principles that he

articulated in his writing. Over the past 15 years, Gee's emphasis seems to have subtly shifted from suggesting how good game design reflects effective teaching principles, to explaining how good game design reflects 'good principles of learning'. There is an important distinction between discussing the tool as 'teacher', and the process of learning through videogames, with Gee (2013), in his more recent work, seemingly becoming more interested in the learner rather than the tool.

Table 3.2 compares the principles presented in the two editions of his oft-cited text *Good Video Games + Good Learning* (2007a; 2013). The reasoning behind including both lists is that, although the 2007 and 2013 editions share some common principles, there are some important differences in language. In Gee (2007a), the emphasis is on the principles of good game design that afford effective learning opportunities, while Gee (2013) discusses principles of effective learning first, and then relates this to good game design. These two lists have been collated and reorganised so that principles shared across the two editions are presented first, with differing principles presented underneath. There are a number of instances in Table 3.2 where the earlier language used by Gee (2007a) better aligns with the co-located multiplayer games used in this research project. When revising this list for the second edition, Gee (2013) seemingly modified his language to better reflect the increased popularity of online gaming in the intervening years (Gu & Jia, 2018).

Table 3.2. The principles of learning in videogames, as listed in *Good Video Games + Good Learning* (1st & 2nd eds.) (Gee, 2007a; 2013).

<table>
<tr><th></th><th>Principles in the first edition
(Gee, 2007a)</th><th>Principles in the second edition
(Gee, 2013)</th></tr>
<tr><td rowspan="5">Shared principles between Gee (2007a) and Gee (2013)</td><td colspan="2">Player identity: Players build a sense of identity throughout the video game, either through direct input or an on-screen character they inherit.</td></tr>
<tr><td colspan="2">Customise: Games usually offer a level of customisation so that users can play — and succeed — at their competency level.</td></tr>
<tr><td colspan="2">Well-ordered problems: The gaming environment contains problems that naturally lead into one another, allowing a player's mastery to grow and evolve.</td></tr>
<tr><td colspan="2">'Just in time' or 'on demand': Players receive information as they need it, not before, which teaches them patience and perseverance and improves critical-thinking abilities.</td></tr>
<tr><td colspan="2">Pleasantly frustrating: The game should frustrate the student enough to challenge them but be easy enough that they believe they can overcome the problem(s) faced.</td></tr>
<tr><td rowspan="6">Shared elements, different language</td><td colspan="2">System thinking: Games make players think in a bigger picture, not just individual actions taken, helping them see how the pieces fit or can be fitted together.</td></tr>
<tr><td>Production: Gamers help produce the story through some form of interaction, such as solving a puzzle or completing a level.</td><td>Co-design: Good learning requires that learners feel like active agents (producers) not just passive recipients (consumers).</td></tr>
<tr><td>Agency: Players have control over the gaming environment.</td><td rowspan="3">Manipulation and distributed knowledge: Perception and action are deeply inter-connected. Humans feel expanded and empowered when they can manipulate powerful tools in intricate ways that extend their area of effectiveness.</td></tr>
<tr><td>Interaction: Communication occurs between the player and the game.</td></tr>
<tr><td>Smart tools and distributed knowledge: In-game tools help students understand the world. Through using them, they gain confidence to share their knowledge with others.</td></tr>
<tr><td>Risk taking: Failing in a game holds few consequences in comparison to real life, empowering players to take risks.</td><td rowspan="2">Cycles of expertise: Expertise is formed in any area by repeated cycles of learners practising skills until they become automatic, and then having those skills fail in ways that cause the learners to have to think again and learn anew.</td></tr>
<tr><td>Performance before competence: Competency occurs through taking action in the game, reversing the typical</td></tr>
</table>

	model in which students are required to learn before being allowed to act.	
	Challenge and consideration: Games offer a problem that challenges students' assumed expertise.	
	Situated meanings: Students learn new words by experiencing them within game situations.	**Meaning as action image**: Words and concepts have their deepest meaning when they are clearly tied to perception and action in the world (p. 35).
Unique principles	**Explore, think laterally, rethink goals**: Games force players to expand their situational knowledge and consider courses of action other than linear ones.	**Sandboxes**: A metaphor for experiences that have a sense of realism, but with risks and dangers greatly mitigated (p.32).
	Cross-functional teams: In multiplayer environments, players have different skills, forcing them to rely on each other—a needed soft skill for students.	**Skills as strategies**: People learn and practice skills best when they see a set of related skills as a strategy to accomplish goals they want to accomplish (p. 33).
		Fish tanks: A metaphor for the use of simplified ecosystems that clearly display some critical variables and their interactions that are otherwise obscured in highly complex ecosystems (p. 31).

Although the two lists differ in the number of principles, Gee maintained some common ideas. The first section of Table 3.2 presents six principles that have remained largely consistent across the two versions. These are followed by principles that contain common ideas but have changed in the language used to describe them. Gee's later list also attempted to consolidate multiple ideas into single principles. Finally, Table 3.2 presents ideas unique to each list. It is important to note that Gee never discredited the language used in the original. As such, this thesis uses the language that best describes the tool or the learner, switching between the sets of principles as necessary. The principles that are particularly relevant to this study are:

- player identity;
- well-ordered problems;
- ‘just in time’ or ‘on demand’;
- pleasantly frustrating;
- agency;
- interaction;
- smart tools and distributed knowledge;
- cycles of expertise;
- situated meanings;
- explore, think laterally, rethink goals; and
- cross-functional teams.

Gee’s principles provide the necessary vocabulary to discuss components of games design and DGBL.

One potentially problematic observation about the way Gee described these principles is in the use of the value-laden term ‘good’. This term is highly subjective, and this is where the work becomes more speculative in nature. Gee (2013) framed his discussion of learning using a number of critical assumptions about formal schooling. One central assumption made by Gee that requires further investigation is that ‘good games’ are more effective than the traditional means of education that he critiques. While providing anecdotal evidence to support this claim, Gee provided no references to scientific studies involving a control group using alternative methods of instruction (Gee, 2013; 2007a). These assertions are more a result of philosophical critique rather than born from empirical research. Ascertaining the conditions in which games-based learning can be effective as a means of social skills

development was a central consideration of this research project, as is explored in subsequent sections of this chapter.

3.5.2 Player identity and representation within the game

The idea that a person can take on a new identity through the use of an avatar within a virtual world is an influential suggested affordance of videogames in education (Brown, 2014; Gee, 2013; Prensky, 2006). Brown (2014), Chen (2012), and Salen and Zimmermann (2004), all highlighted the possibilities of a transformed sense of identity in enabling the player to become situated within this environment and interact with people they normally would not interact with in other contexts. This provides opportunities for the practise of social skills. While there is broad agreement that games can provide a transformed sense of identity through immersive environments in which the players are placed within imaginary narrative arcs (Brown, 2014; Echeverría, 2010; Prensky, 2006), there remains important tensions and points of difference between researchers. As shown in this section, the relationship between the player's 'real-world' identity, their virtual identity in the game and the ecology, is still being contested by games scholars.

There are divergent perspectives on the source of a player's identity in multiplayer games. Gee (2003) and Brown (2014) talk of players transforming their identity from their physical self to their virtual avatar, taking on their understandings of how that character should act. Brown (2014) compares this process to a masquerade ball, with players transforming their identity from a player in the physical world to match their expectations of how they interpret their avatar. For example, the cultural conditioning of most players might lead them to see a knight as noble and hence they would never steal from non-playable characters, while a thief is culturally not bound by this code of honor and can take advantage of any opportunity for

material gain. Gee (2003) has a slightly different perspective on identity, referring to the notion of projective identities where players role-play what they want their characters to be. For example, a knight might be honorable, or the player could invent a back story where they have fallen from grace and now act like a thief. Games such as *World of Warcraft* do attempt to shape identity through setting cultural expectations, through cut-scenes and dialogue with non-playable characters (Chen, 2012).

The extent to which players bring with them an established set of cultural views, values and biases to the game and project these onto their avatar remains contested. Brown (2014) described a "projection of the self into the virtual world" (p. 139). Castronova (2005) also argued that there is often a sense of identification with avatars from creation. Newman (2002) adopted a more instrumental view, pointing to the role of observing non-players in suggesting the selection of a character for the controlling player to use. This sees the selection of an avatar as a strategic gameplay choice that builds over time, prioritising success in the game over a personal identification with a character.

Both Brown (2014), and Salen and Zimmerman (2004), refer to Huizinga's (1955) concept of a 'magic circle' in play, helping to explain the connection between avatar and player. This interpretation positions virtual play environments, such as those in videogames, as "a special time and place" (Salen & Zimmerman, 2004, p. 95), where the term 'magic circle' is used to describe "a porous boundary" where players can interchange between reality and the imaginary (Brown, 2014, p. 138). This has important connotations for social interactions both within and outside of the game environment, as Brown suggests that while people are moving between reality and imaginary, their assumptions and attitudes will change between reality and 'play'. Crawford (2009) and Castronova (2005) challenged the idea of the magic circle, suggesting a strong relationship between assumptions, attitudes and values in and outside

of the game. The player's perception of their own identity, and the identity of others, is further complicated within multiplayer environments by notions of relative social capital between the players in both the real and virtual environments.

3.5.3 Rules of play

One standout component of Salen and Zimmerman's (2004) definition of games is the role of rules constraining the possibilities within the virtual environment. This results in players having to navigate these boundaries in order to achieve the goal. Creating a list of common rules representative of most videogames is controversial. Salen and Zimmerman (2004, pp. 122-123) listed the following common characteristics of rules in videogame design:

- Rules limit the action
- Rules are explicit and unambiguous
- Rules are shared by all players
- Rules are fixed
- Rules are binding
- Rules are repeatable

However, Crawford (2011) critiqued this list, questioning just how generalisable these 'common characteristics' can be, given that each genre of game has its own set of rule conventions, and game designers are increasingly challenging player expectations by violating these conventions. Salen and Zimmerman (2004) themselves noted examples of games that contradict this list. When considering the role of rules in a games-based social skills intervention, it is therefore more useful to examine categories of rules rather than specific rules. Salen and Zimmerman (2004, p. 130) seemed to recognise this as well, presenting three categories of rules:

- **Operational rules** – these are the 'rules of play'; the guidelines that are required for play to take place.
- **Constitutive rules** – these are the underlying formal structures that exist below the surface of the game, such as the logical and mathematical processes inherent in the game.
- **Implicit rules** – this refers to the 'unwritten rules of a game', such as rules of etiquette, 'sportsmanship' and other less formal rules, which may be problematic for students with social-emotional challenges.

The first two categories are concrete in the sense that in any intervention using commercial games, the central rules are largely unchangeable, although many games do allow minor rule settings to be altered (Anthropy & Clark, 2014). If a fundamental rule within a game is a barrier to player access or is prohibitive to the goals of an intervention, then this is a significant challenge that will likely require a new game with a new set of rules (Anthropy & Clark, 2014). Gamer culture will foreseeably have a significant impact upon the third category, implicit rules, as this helps to shape the social norms around etiquette and sportsmanship. In interventions targeting individuals with social-emotional disabilities or differences, the interpretations or acceptance of these norms are also a significant consideration.

3.5.4 Targeted feedback

Feedback is so often seen as central to what constitutes a videogame that it is sometimes considered a defining trait of the medium (Hainey et al., 2011; Salen & Zimmerman, 2004). It is also argued that the ways through which many videogames provide players with feedback is precisely why they can be considered tools optimised for learning (Bidarra et al., 2013; Prensky, 2006). Before delving into arguments surrounding game-based feedback and

optimising the conditions for learning, it is important to understand the types of feedback that games might provide the users. Examples of in-play feedback include performance-based metrics, such as player and team scores, experience points, health bars and lives and visual cues to the condition of the player's avatar. It can also include objective-based metrics such as distance from a checkpoint or goal, or a number of required items that need to be collected. Post-play feedback includes summaries of a player's or team's total score, items collected, and objectives achieved (Bidarra et al., 2013; Chen, 2012; Salen & Zimmermann, 2004). The use of these labels is helpful in providing educators with a familiar vocabulary for categorising feedback in videogames, but also presents a number of challenges.

3.5.4.1 Ascribing labels to the types of feedback in games

When trying to ascribe the labels of formative and summative to in-game and post-game feedback, problems emerge when using popular definitions found in educational literature. One such definition is that of Shute (2008), describing formative feedback as "information communicated to the learner that is intended to modify the learner's thinking or behaviour for the purpose of improving learning" (p. 1). While the previously provided examples of in-game feedback align with the goal of modifying player behaviours, it can be argued that this is the same intention as the post-play feedback that comes in between levels. Even the feedback found on many 'game over' screens presents information on where the player has made critical errors, strategically placed to encourage the player to reattempt a failed objective or mission (Gee, 2003). The issue may in fact be with the labels of formative and summative, constructs that are useful in discussing the purpose of feedback but which lose relevance when applied in game-based contexts. It is notable that Shute later completely shunned the use of the term summative, focusing on cycles of feedback designed to improve subsequent play (Shute, Rieber, & Van Eck, 2011). In the context of feedback in multiplayer games,

Burgers, Eden, van Engelenburg, and Buningh's (2015) use of the labels 'evaluative feedback', focusing on team performance, and 'comparative feedback', contrasting and ranking player performance, are more useful for this study. These labels are further explored in the context of the relationship between types of feedback and player motivation.

3.5.4.2 Immediate feedback

Timeliness, or the immediateness, of feedback is often suggested as a reason why videogames are potentially powerful learning tools, as feedback can be presented to the player right at the point of need (Kickmeier-Rust, Marte, Linek, Lalonde, & Albert, 2008; Tsai, Tsai, & Lin, 2015). Tsai et al. (2015) attempted to quantify the impact of providing immediate in-play feedback in comparison to delayed feedback after an event had passed. As predicted, they found that immediate elaborated feedback was more effective for knowledge acquisition than not providing it. Kickmeier-Rust et al. (2008) suggested the reason for such findings is that immediate feedback is meaningful, allowing the player to identify their precise error and usually allowing them to immediately implement this knowledge and attempt the challenge again. This is of course not true of all games, but it is something that is important to be mindful of when selecting games for an intervention.

3.5.4.3 Source and purpose of feedback

One of the most controversial aspects of DGBL is the positioning of the game in relation to the classroom teacher. The immediacy and meaningfulness of feedback is often at the centre of a debate surrounding whether teacher-based or game-based feedback is more effective. Videogames used as part of a lesson or intervention can be positioned to complement teachers by providing an additional source of feedback to the player (Kickmeier-Rust et al., 2008; Wang, 2011) or to even replace them altogether (Yang, 2017). Kickmeier-Rust et al.

(2008) and Wang (2011) suggested that classroom teachers are often unable to provide timely and meaningful feedback when administering traditional assessment tasks, such as tests or written reports, simply due to the student-teacher ratio and the time required to analyse the students' work.

Kickmeier-Rust et al. (2008) and Yang (2017) cautiously position the game as being theoretically capable of replacing the teacher in providing instruction and feedback on unfamiliar content and skills, although importantly feedback is only possible on events occurring in the virtual environment. Particularly interesting were the findings of Yang (2017) that there were no significant differences on the students' learning achievements, learning attitudes, or cognitive loads in the game between the game providing minimal feedback and the one with elaborated corrective feedback. Yang (2017) surmised that this was because in order for the students to progress they needed to be able to demonstrate an understanding of a concept or a skill. When students received minimal feedback from the game they would most often refer to their learning materials in the material world (Yang, 2017). In other words, they were motivated to seek out an elaborated explanation of where they went wrong and how to address this in the next attempt. Connecting players to their peers was important for this research project but Yang (2017) provided little evidence that games-based feedback could completely replace the role of the teacher when the intended social skills outcomes are occurring primarily in the physical world.

Tsai et al. (2015) alternatively positioned their serious game as a practice tool and complementary avenue for feedback, with the teacher still providing the primary feedback on the player's performance outside of the game environment. Despite Kickmeier-Rust et al.'s (2008) theoretical support for the idea, they cautioned that games are not value free and inherit the biases of their designers. Designers decide both the benchmarks that the game

uses to measure performance and the messaging that is used to communicate this to the players (Kickmeier-Rust et al., 2008). It was important for this study to ensure that the values that the developers impart into their game feedback systems aligned with the objectives of this research and the needs of the participants.

3.5.5 Constraints caused by poor game design

The poor design of some serious games designed to teach specific areas of the curriculum create barriers for teachers. Jarvin (2015), Resnick (2004), and Kirriemuir and McFarlane (2004), have raised some of the issues found in their research of 'edutainment' games. These issues include: the simplicity of these games compared to their commercially-developed counterparts, the repetitive and demotivating nature of 'drill and practice' games, the poor design and progression of tasks, the focus on just one skill to the detriment of the integration with other skills the player might possess, and the patronising nature of some games that try to coerce the player into learning in an artificial manner (Jarvin, 2015; Kirriemuir & McFarlane, 2004; Resnick, 2004). Many of these issues are not in accordance with Gee's (2007a; 2013) previously discussed principles of good game design. Some of Kirriemuir and McFarlane's (2004) issues were addressed by Bidarra et al. (2013), who were particularly critical of the lack of empirical evidence supporting the use of 'drill and practice' games to improve student learning outcomes. They suggest that the ineffectiveness of many 'edutainment' titles might be a result of the lack of expert design knowledge found in many commercial games. This final point is pertinent also to serious games with limited budgets (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005), and should be considered when deciding between the use of targeted serious games or the repurposing of commercial games that are fit for the intended purpose of an intervention.

3.6 Different ways of playing videogames together

The methods in which people play together can have a dramatic influence on the social interactions between the players in a game (González-González, Toledo-Delgado, Collazos-Ordoñez, & González-Sánchez, 2014; Harteveld & Bekebrede, 2011; Salen & Zimmerman, 2004). Despite player collaboration being well explored in the field of games studies, there is limited research into the relationship between physical proximity and game interactions. Hainey et al. (2011) suggested certain methods of playing together in a game might be better suited to collaborative learning, with this section examining the social implications for the people playing games together in a shared physical space. Recalling previous discussions of social models of learning, the ways in which social interactions occur are critical to the processes of learning (Kim, 2010; Susaeta et al., 2010).

3.6.1 Local multiplayer gaming

Current forms of 'local' multiplayer gaming, also referred to as 'co-located gaming', can be divided into two overarching categories: 'single screen' games, where the all the players share a common screen or monitor; and 'multiple screen' games, where players in a common space each have their own individual screens or monitors (Kröger & Quandt, 2014). Although there is limited literature on how the distinguishing features of these modes of play might impact upon social interactions, there are inferred connections between the types of interactions between players and these features. Different systems for single screen play afford different game features that impact on how players interact with each other, as shown in Table 3.3.

Table 3.3. Subcategories of single screen local multiplayer games.

Subcategory	Distinguishing features	Impact upon social interaction & communication
'Hot-seat' multiplayer	Games are turn-based, with multiple players taking turns to use a single input device (Freyholtz, 2014).	• Students practise taking turns (Squire, 2005). • Provides time for student reflection and consolidation of ideas (Salen & Zimmerman, 2004).
Simultaneous single screen multiplayer	Games where multiple players each have their own controller but share a single screen with the other players (Kröger & Quandt, 2014; Kvasbo, 2007).	• Provides for real-time planning, negotiation and reflection upon performance (Gee, 2013). • Provides opportunities to develop verbal and non-verbal communication skills, such as interpreting facial expressions (Gee, 2013).
Split screen multiplayer	Players are allocated their own portion of a divided single screen, often for the purposes of competitive play (Kröger & Quandt, 2014; Kvasbo, 2007).	• Provides opportunities for developing appropriate winning and losing behaviours, and reflection upon performance (Gee, 2013). • Allows students to observe other players and reflect upon their own strategies/performance (Squire, 2005).

This research focused on exploring the performance of social skills in the physical and virtual environments, so co-locating players in a shared space was paramount. As such, it was imperative that this research focused on using local multiplayer games as the vehicles for creating the conditions for collaboration. The reviewed literature suggests that the affordances of simultaneous single screen modes of play are particularly well suited to promoting the types of interactions that allow for the target social skills to be used.

3.6.2 Online multiplayer gaming

Although this research used local multiplayer games where players shared a common physical space, the majority of multiplayer gaming is now conducted 'remotely' or 'online' (Bidarra et al., 2013; Suárez, Thio & Singh, 2013). This reflects both the proliferation of videogame consoles with integrated online services (Pitts, 2013) and the adoption of high-speed Internet connections (Livingstone, Bober & Helsper, 2005). As such, much of the research examining social interaction in multiplayer videogames has been conducted with online games (González-González & Blanco-Izquierdo, 2012; Lisk, Kaplancali & Riggio, 2012; Voulgari & Komis, 2010). Lisk et al. (2012) interestingly claimed that distributed teams in online environments may be more effective in developing player leadership skills than co-located teams, but there appear to be no supporting studies to confirm this assertion. Notably for this research project, none of the reviewed studies directly compared the impact of local multiplayer modes upon social interaction or learning, and this is an area requiring further attention.

3.6.3 Exploring the relationship between physical proximity and social interaction

Different methods of multiplayer play often include the same in-game activities, but the behaviours and skills required for engaging in these activities in an online environment are very different from when players are sharing a common space. Infante et al. (2010) and Hainey et al. (2011) suggested playing together in a common space allows for non-verbal social interactions, such as the use of facial expressions to express emotion and giving a thumbs-up for when a player is satisfied with the performance of another player. A shared physical space also allows for a concurrent display of skills and behaviours in both the real

and virtual worlds (Ackermann, 2014; Infante et al., 2010), and allows for 'instrumental coordination' through pointing and gesturing. Studies of naturalistic play outside of a gaming context have placed an important emphasis on these non-verbal forms of social interaction, as they may provide context or even an alternative meaning to what is being verbally communicated (Whitebread, Coltman, Jameson, & Lander, 2009).

Garzotto (2007) conducted one of the few comparative investigations into student perceptions of collaboration through local and remote multiplayer gaming. Interestingly, this study found that while the older fourth grade participants enjoyed interacting with other players exclusively through remote play, the majority of younger participants did not. There are several reasons why this might be the case, such as the requisite literacy skills required for communicating via a chat window. Using a text-based messaging system meant that younger players, who typically have a lower speed of typing, were less likely to be able to communicate and coordinate their actions due to time limitations placed on each player's turn in the game. Given that Garzotto's (2007) research was conducted in a period of time before voice over Internet communication was prevalent (Bidarra et al., 2013), it does not address whether real-time voice chat would have led to an increase in cooperation in younger players. Just over half the groups reported some conflict, largely attributed to the use of a hot-seat style of multiplayer gaming. Participants reported that they "did not want to alternate in the control of game interaction" (Garzotto, 2007, p. 35). This study also found that the required element of cooperation in both the local and remote forms of multiplayer gaming was not as highly appreciated by the participants as the aesthetic elements of the game design. When developing an intervention using multiplayer games, the physical location of the players is an important consideration, particularly when wanting players to develop verbal and non-verbal means of communication.

3.7 Promoting social interaction through game design

Multiplayer games can be used to develop the skills necessary for students to engage in effective collaboration in both the game environment and in the real world (Bernardini et al., 2014; González-González & Blanco-Izquierdo, 2012; Kröger & Quandt, 2014; Voulgari & Komis, 2010). While many of these studies were conducted in classrooms or extracurricular programs, there is limited research focused on participants with social-emotional disabilities or challenges.

3.7.1 Games designed specifically for neurodiverse players

Only relatively recently have games been designed specifically to assist neurodiverse players in acquiring and practising social and communication skills. These serious games have focused on expressive and receptive language, recognising facial expressions and body gestures, turn-taking and imitation of peers (Grossard et al., 2017; Malinverni et al., 2017). They provide insights into game design mechanics that can support the development of these skills. One serious game developed for children with autism is *ECHOES*. Using a two-dimensional plane of play, much like a traditional 2D platform game such as *Super Mario Bros.,* players explore a sensory garden alongside a virtual co-player controlled by artificial intelligence (Bernardini et al., 2014). This co-player was programmed to initiate and respond to bids for interaction and engage in turn-taking by combining verbal and non-verbal methods of communication. While Bernardini et al. (2014) claimed that artificial intelligence can simulate a credible social partner for children with autism, this initial study importantly noted that there was no significant transfer of these skills to real-world contexts, contradicting their claims about effectiveness. In a subsequent analysis of the ECHOES project, Porayska-Pomsta et al. (2018) reported that anecdotal observation from classroom teachers suggested

that there was indeed some transfer beyond the game. Such a contradiction suggested that either the teachers were experiencing some form of placebo effect, or that the instruments being utilised to ascertain transfer were not correctly calibrated for a school context. This highlighted the importance of generating multiple forms of data and for considering the potential limitations inherent in each of my instruments.

Another games-based intervention program, *The Secret Agent Society,* sought to address questions of transfer by combining a game with group intervention sessions (Beaumont, Rotolone, & Sofronoff, 2015; Beaumont & Sofronoff, 2013). This single player adventure game focuses on teaching skills for understanding verbal and non-verbal communication, such as recognising facial expressions. Regular intensive intervention sessions were conducted alongside use of the game, with groups of autistic students practising the performance of skills in real-world settings. Beaumont et al. (2015) found that structured group intervention sessions are vitally important to students being able to perform these skills independently of the game, although there are still questions regarding the maintenance of the skills developed through this type of intervention.

Bossavit and Parsons (2018) provided an interesting example of an unnamed educational game that was co-designed with autistic students. While the small sample size of six students makes it difficult to generalise any conclusions, Bossavit and Parsons (2018) found that player collaboration in the game encouraged the sharing of knowledge and peer coaching of the targeted geography content knowledge. This case study suggests the value of including neurodiverse individuals in the game design process, particularly when phrasing explanations of the rules and systems being employed by the game and in considering the design of the user interface. These three examples provided valuable insights into how serious games have been developed for and used with neurodiverse populations. However,

there was limited discussion in this literature on the impact of specific components of game design on the ways that players can be encouraged to socially interact in a positive manner in both the physical and virtual environments. Identifying these components required examining research investigating collaborative problem-solving and social learning with broader populations.

3.7.2 Literature exploring how design can foster collaboration and social learning

Much of the literature focusing on collaborative learning in games emphasises the role of game design in facilitating the development of social skills. Findings from González-González and Blanco-Izquierdo (2012), Zea, Sánchez, Gutiérrez, Cabrera, and Paderewski (2009), and Voulgari and Komis (2010), all present connections between different types of affordances provided by cooperative multiplayer games and the ways in which players interact with each other. Despite the emphasis primarily being on the game rather than the students, these studies offer some crucial insights into game design mechanics that can support the development of collaborative social skills.

González-González and Blanco-Izquierdos (2012), and Voulgari and Komis (2010), examined the components required for a multiplayer game to foster collaborative learning, while Zea et al. (2009) investigated how multiplayer games were being used in classroom settings with an emphasis on collaborative problem-solving. Unlike González-González and Blanco-Izquierdo's study, Zea et al. (2009), and Voulgari and Komis (2010), considered both the designed components of a game, such as built in communication tools, and components of the metagame, such as the conventions for written communication when using these tools. All three sets of authors curated lists of characteristics found in effective multiplayer

collaborative experiences. While each list contained unique characteristics, some commonalities relating specifically to the objectives of this research project were identified. These three shared characteristics are summarised in Table 3.4 and are discussed below in relation to this research project.

Table 3.4: Characteristics found in effective multiplayer collaborative experiences agreed upon by González-González and Blanco-Izquierdo (2012), Zea et al. (2009), and Voulgari and Komis (2010).

González-González and Blanco-Izquierdo (2012)	Zea et al. (2009)	Voulgari and Komis (2010)
1. Positive interdependence		
Positive interdependence: the existence of a common goal that all participants are working towards, which is only evaluated and scored on a team basis.	**Positive interdependence:** common game-assigned goals, team accountability, individual and team evaluation and individual and team scores.	**Collaboration is an essential prerequisite for succeeding in the game:** games should include tasks with high risk penalties and that cannot be completed without the participation of more than one character.
2. Responsibility to the group		
The building of trust: the game has to place players in situations in which they have to depend on their team members to achieve the common goal. This raises the commitment to the common goal and promotes systems of team decision-making.	**Personal accountability:** each group member has to perform to the expected standard for them to learn individually and to enable them to assist their fellow team members in accomplishing the common goals.	**Establishment of links and affinity among players:** games should encourage social chat; online friends should be considered as real-life friends and there should be severe penalties for breaking trust within the clan.
3. Individual social skills are required for effective team management		
Learning social skills: the game needs to promote situations that require "group planning, strategizing, negotiations, debates" and promote the development of "group decision making systems" (González-González and Blanco-Izquierdo, 2012, p. 255).	**Social skills:** the game has to introduce players to situations and challenges where team negotiation and reflection is not only possible but essential in order for everyone to progress.	**Features for the facilitation of collaboration:** games should ensure the audibility of voice, should support verbal as well as non-verbal communication and there should be close physical proximity of the players.

All three sets of authors in Table 3.4 highlight that effective multiplayer collaborative experiences promote *positive interdependence* (González-González & Blanco-Izquierdo, 2012; Zea et al., 2009; Voulgari & Komis, 2010). Games create positive interdependence between players through designing problems that require the coordinated actions of multiple players, forcing player interaction (Romero, Usart, Ott, Earp, & de Freitas, 2012; Zea et al., 2009). One such mechanism for fostering positive independence is through the creation of a high level of challenge. Game designers insert common threats or objectives that are specifically designed to be almost impossible for a single player to complete, with progress relying on players assisting each other in order to move forward (Ducheneaut & Moore, 2005). The risk of using games with a high degree of difficulty for participants with social emotional challenges is that these players might not recognise the need for assistance. As this research project also involved participants with varying levels of playing ability, the level of difficulty required careful consideration.

Some games combine substantive levels of difficulty with the inclusion of complementary and co-dependent characters, with the game more overtly prompting the players to engage in constructive real-world social interaction in order to achieve a shared goal (Bodin, Marty, & Carron, 2011). Metz (2018) suggests *Donkey Kong Country Tropical Freeze Switch* (Nintendo, 2018) as an example of a game providing a high level of difficulty for players working individually but one that becomes less challenging when players coordinate their co-dependant characters. An example of in-game coordination between two co-dependent characters in *Donkey Kong Country Tropical Freeze Switch* (Nintendo, 2018) is shown in Figure 3.1.



Figure 3.1. Donkey Kong receiving assistance from Diddy Kong in the game *Donkey Kong Country Tropical Freeze Switch* (Nintendo, 2018).

In this game, the character Donkey Kong is stronger than the other characters, which is represented both visually and through his unique ability to lift heavier items that the other characters cannot. However, Donkey Kong also has the shortest jump. In order to improve the distance of his jump, Donkey Kong requires assistance from Diddy Kong, a slighter character wearing a jet pack. Diddy Kong can jump on Donkey Kong's back and help propel the heftier character. This is an illustration of both positive interdependence (González-González & Blanco-Izquierdo, 2012; Zea et al., 2009) and designed cross-functional team activity (Gee, 2007b), highlighting how careful game design can manipulate individual players into coordinating their actions. As the purpose of videogames in this study was to maximise

the opportunities for players to interact with each other, selecting games that were designed in such a way as to require player coordination was essential for this research project.

Responsibility to the group is another characteristic shared by González-González and Blanco-Izquierdo (2012), Zea et al. (2009), and Voulgari and Komis (2010), although there are different perspectives on how a sense of responsibility should be developed. Whereas Zea et al. (2009) outlined the need for games mechanics that encourage players to be personally accountable for their roles within the team, González-González and Blanco-Izquierdo (2012) discussed the allocation of roles as an opportunity for trust to build. It might seem like a subtle difference in language, but there are important ramifications for understanding the contexts in which responsibility can be developed. These differences can be summarised as using game feedback to encourage personal accountability when things go wrong during play, compared with designing regular opportunities for players to experience team success when working effectively together. Voulgari and Komis (2010) proposed a middle ground, emphasising the need for experiences that build affinity between the team members in instances of success, and the need for individual accountability in instances of team failure. While all three perspectives discuss the role of the game in promoting individual responsibility within the team, there is almost no mention of whether these are applicable when relationships already exist between the players.

Viewing trust and accountability through the lens of an existing ecology is very different from an online gaming community. For example, the assertion by Voulgari and Komis (2010) that effective multiplayer communities require online friends to be considered ‘real-life’ friends could be problematic when using the assumptions of affinity spaces theory. The affinity spaces perspective positions online communities as allowing open participation (Abrams & Lammers, 2017), with relationships as temporary and transactional in nature (Gee, 2018).

This highlights the challenges of applying a theory developed for online communities to classrooms, where players cohabit a physical space and bring established relationships into the game. Given the objectives of this study, where familiar peers were playing together to practise performing skills, real-life friendships existed prior to this intervention. While game design can implement measures to encourage personal accountability and build team trust, it is also important to recognise that play occurred in an established ecology. As such, analysis of the role of game design mechanics on the social interactions of the student participants in this study had to consider the existing relationships between the players.

Performance of *individual social skills for effective team management* are also seen by González-González and Blanco-Izquierdo (2012), Zea et al. (2009), and Voulgari and Komis (2010), as essential for effective collaboration in multiplayer videogames. Due to the focus on game design in their research, González-González and Blanco-Izquierdo (2012) explored connections between components of the game and the desired social skills that they want players to develop. They adopted Gee's (2003) position that games can artificially manufacture situations, such as requiring the use of social skills, in ways that conventional teaching cannot. This is where the utility of these studies becomes problematic for this research project. Although González-González and Blanco-Izquierdo (2012) and Voulgari and Komis (2010) used 'mutual engagement' in gameplay as an indicator of successful collaboration, there was very little detail about the specific social skills observed during play. As social skills were central to this research project, this was a significant gap in the literature with only a few studies providing detailed lists of specific skills.

Ducheneaut and Moore's (2005) study is one such example that sought to offer a pathway for community maintenance and the development of 'basic social skills' through the play of massively multiplayer online role-playing games (MMORPGs). They argued that there is a

division between the activities in the game, and the skills and behaviours that are required to complete these activities. Ducheneaut and Moore (2005) concluded that social learning is derived from three categories of social interactions that are found in MMORPGs: players' small group self-organisation; interpersonal coordination; and cooperation and downtime sociability. Table 3.5 is organised using these three categories of social interaction, and lists the game activities, game knowledge and basic social skills observed by Ducheneaut and Moore (2005) being used by players in a MMORPG.

Table 3.5. Activities, knowledge and basic social skills by types of social interactions (Ducheneaut & Moore, 2005, p. 98).

	Small-group organisation	**Instrumental coordination**	**Sociability**
Activities	• Soliciting invitations with "looking for group" announcements • Identifying best potential group members • Inviting individuals to join the group	• Pointing out a potential target to the group • Coordinating combat actions with other group members • Looting defeated opponents	• Initiating small talk • Telling jokes • Being sensitive to personal talk
Game knowledge	• Level matching • Class balancing • Grouping commands	• Combat roles: tank, healer, caster or melee • Pulling • Power levelling • Combat commands	• Chat commands
Basic social skills	• Approaching strangers • Recruiting • Small-group formation	• Cooperation • Playing team role • Team coordination	• Politeness • Humour, wit • Empathy

Of particular relevance for this study is the *basic social skills* row presented in Table 3.5. If the objective of introducing DGBL is to provide a means by which students can independently

practise targeted social skills, then Ducheneaut and Moore (2005) provided a useful list of social skills performed during independent play of MMORPGs. Importantly for this research project, as their study involved no teacher intervention during play, this suggests that the design of the games had a role in facilitating these social interactions. The *activities* category shown in Table 3.5 provides examples of how games can facilitate opportunities for students to perform these social skills when working towards common objectives. Ducheneaut and Moore (2005) suggested linking social outcomes in the game to tangible real-world incentives, such as a 'credits-based achievement system', where positive social interactions in the game and outside are connected by a common reward system. This final finding had important implications for this research project, as it suggested a system for positively reinforcing the performance of targeted social skills during play in order to increase their frequency of use.

3.7.3 Maintaining social skills beyond the game

Skill maintenance and transferability is a concern for every social skills intervention (Bond et al., 2016). A number of studies extend their focus beyond identifying the social implications of game design to examining how these social skills can be maintained in contexts beyond the game. These studies are particularly interesting, as they provide guidance on how they could best position the games in their classrooms to develop social competencies beyond the game environment.

Extending interactions and social learning in the game environment to the real world is important in Lee, Eustace, Fellows, Bytheway, and Irving's (2005) research. These authors developed and implemented an educational MMORPG in an Australian high school history classroom. While the intention of the research was to accomplish academic learning goals,

Lee et al. (2005) observed increased social learning both within the game and in real-world conversations discussing the game. Lee et al. (2005) found in practice they did not require a real-world incentive system as described by Ducheneaut and Moore (2005), as the game was designed in such a way that the students were already motivated to engage in group planning, strategising, negotiation, and the debate of ideas in order to develop their in-game avatars. This is a practical illustration of González-González and Blanco-Izquierdo's (2012) broad assertion that good design can actively improve social interactions in the real world.

Connecting collaborative social skills development in the virtual environment to the changes in behaviour in the physical environment is examined in more depth by Voulgari and Komis (2010). They investigated collaborative problem-solving in the MMORPG *Linage 2*. Through analysing interactions in the game world and student interview data, they found that mutual understanding, dialogue management, information sharing, and consensus building all increased following the introduction of *Linage 2* to an afterschool club. This is consistent with the findings of similar studies into MMORPG collaboration by Ducheneaut and Moore (2005), and Ang and Zaphiris (2008). Unfortunately, while establishing a conceptual framework for identifying social learning in MMORPGs, they do not suggest how educators might transport skills demonstrated during play beyond the game environment.

These studies demonstrate the interest that researchers have in exploring the use of games to develop collaborative learning experiences. In many of the reviewed studies, the social learning was either incidental or secondary to academic objectives such as developing content knowledge (McCall, 2016; Papastergiou, 2009; Wu, 2015; Wu, Richards, & Saw, 2014) or practising the performance of particular academic skills (Gil-Doménech & Berbegal-Mirabent, 2019; Vasalou, Khaled, Holmes, & Gooch, 2017). Despite not always detailing the specific socials skills being performed, the vast majority of the reviewed literature often did

detail the optimal game conditions in which students would most effectively cooperate or collaborate in solving common problems. In studies focusing on the performance of specific skills in interactions between players, it was often highlighted that designed *interdependence* was key to increasing the performance of these skills. Games with carefully designed avatars and rules promoted the development of cross-functional teams, which was found to create a sense of positive interdependence between the players (González-González & Blanco-Izquierdo, 2012; Romero et al., 2012; Zea et al., 2009). An area requiring further research is the extent to which these positive interactions continued to occur when the participants were no longer playing the game. This is a significant question for any intervention looking to develop and maintain a set of targeted social skills.

3.8 Motivating students to socially interact through gameplay

There is a broad base of research into how DGBL can motivate students to engage in the processes necessary for social interaction (Eseryel, Law, Ifenthaler, Ge, & Miller, 2014; Suárez et al., 2013). Understanding the role of game design in motivating students to engage in social interaction was of vital important for this research project. There are a number of perspectives on the role of game mechanics in enticing and encouraging students to persist with social interactions, even when they find these interactions difficult. In order to understand how games can do this, it important to consider the nature of motivation in a games-based context.

Self-determination theory (SDT) is a popular lens used to explore motivation in DGBL (Eseryel et al., 2014; Hess & Gunter, 2013; Wu et al., 2014). This theory contends that the degree of player motivation is determined by three fundamental requirements:

1. the autonomy provided to the learner in determining which tasks to complete and actions to take,
2. the competence of the learner in performing the task, and
3. relatedness of both the present task to tasks they have previously successfully completed and 'relatedness' to their social environment (Ryan, Rigby, & Przybylski, 2006; Ryan & Deci, 2000).

When using SDT to consider the motivation of players, the ways in which game-based tasks address these three determinants for the learner determines the level of motivation (Ryan et al., 2006; Ryan & Deci, 2000). While a popular lens for DGBL, there are intriguing questions surrounding the applicability of this model to neurodiverse populations. The perceived value of a task within a learner's social environment is considered central by Ryan and Deci (2000) in determining whether the task is motivating for a learner, but this assumes that a learner values and recognises the opinions of their peers. It is important to be aware of such neurotypical assumptions when analysing research that adopts the language of SDT to explore player motivation.

3.8.1 Videogames motivating students to participate in social learning

The other players in team-based multiplayer games appear to have an important role in player motivation and persistence, particularly in the face of perceived difficulty. Eseryel et al. (2014) investigated the relationship between learners' engagement with the game, motivation to persist with completing increasingly complex tasks, and multifaceted problem-solving outcomes using the lens of SDT. The key finding for facilitating sustainable game-based interventions is that the level of enthusiasm of individual players within the group determines the collective engagement with the game, in turn determining the rate at which players develop the targeted knowledge and skills (Eseryel et al., 2014). Building from these

findings, Eseryel et al. (2014) proposed a model addressing three levels of interactivity required to sustain the motivation and engagement of players:

(i) interface interactivity, which refers to the relationship between the player and the systems in the game,

(ii) narrative interactivity, which refers to the relationship between the player and story or scenario, and

(iii) social interactivity, which refers to the collaboration and shared experiences between human players.

This model is represented in Figure 3.2.

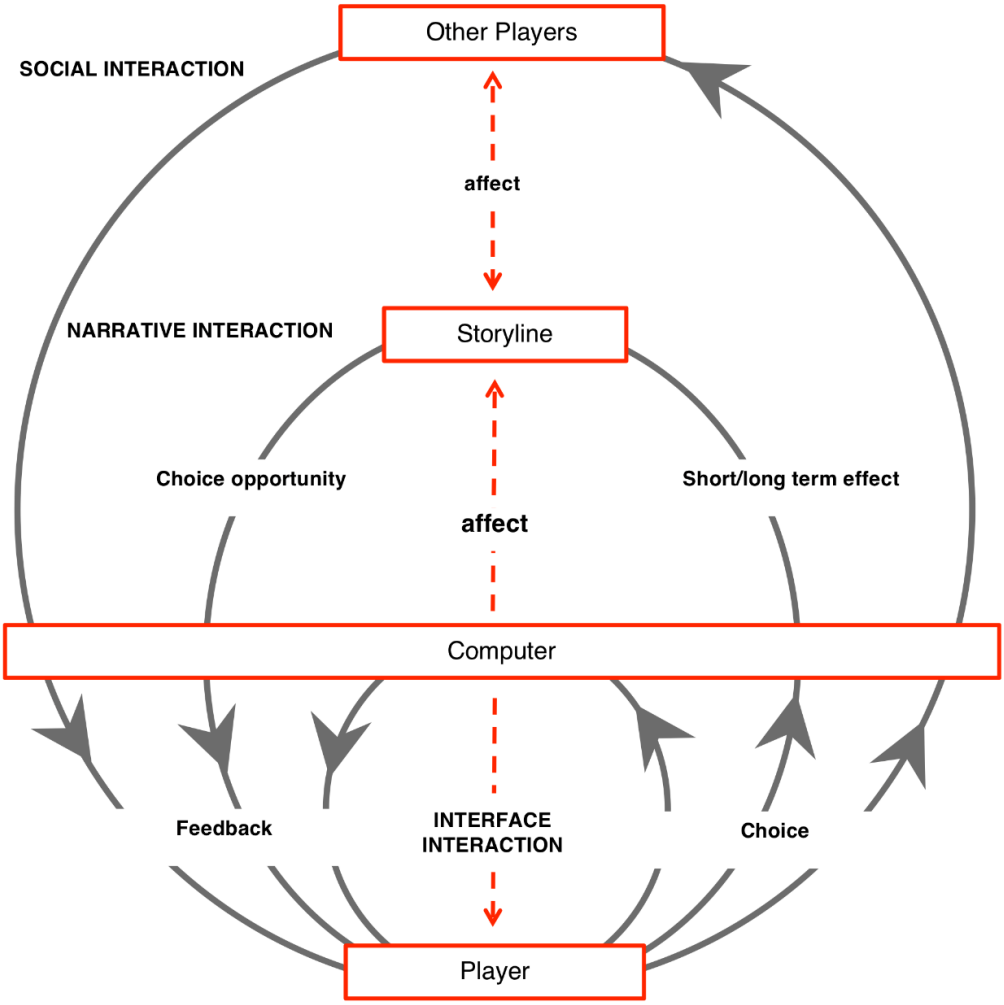


Figure 3.2. Three-levels of interactivity design for games to motivate players. Adapted from Eseryel et al. (2014, p. 50).

Some of the components of this model have already been explored in this review, including the forms and timing of feedback that players may receive in videogames, and the degree of player agency or 'choice opportunity'. This model is quite novel in mapping a motivational relationship between the ways that players interface with the game, interact within a set context or role prescribed by the game's narrative, and what the impact is between the player, the game and other players. The relationships between the player and other players, mediated by the affordances of the game, provide a lens for viewing the three components of SDT outlined by Ryan and Deci (2000) in game-based environments. Most important for this study is the role of the game in supporting players to create a meaningful social environment.

When considering some of the challenges that might be experienced by neurodiverse players, Eseryel et al.'s (2014) model brings to attention how the game through narrative interaction can help players to understand their role within a team. If the narrative arc in a game creates reasons for the player to value their team, this could foster Ryan and Deci's (2000) requisete 'relatedness to the social environment' and motivate neurodiverse players to work with the other players. Suárez et al.'s (2013) study seems to support this contention, finding that immersion in fantastical worlds was the main driving factor that motivated players to begin playing. Somewhat surprisingly, immersion outweighed other factors such as peer group participation (Suárez et al., 2013), which could suggest that narrative is an important motivating device for encouraging social interaction for both neurodiverse and neurotypical players. These findings from Eseryel et al. (2014), and Suárez et al. (2013), emphasise the importance of evaluating the 'narrative push' of games in using story and narrative signposting to motivate players to interact and work together.

Game-based feedback also has a role in motivating players. Eseryel et al.'s (2014) model contends that feedback from the videogame, represented in Figure 3.2 as being mediated by the 'computer', has a role in motivating players. Interestingly, Eseryel et al. (2014) only provided a very general description of computer mediated feedback, as their model pertains to online games, they completely ignore player-player feedback in the physcial environent. Burgers et al. (2015) addressed these gaps by examining the types of feedback that players provide each other during cooperative play and the effect each respective type of feedback has on player motivation. Of particular importance to this study are their findings pertaining to evaluative feedback and comparative feedback. Burgers et al. (2015) found that evaluative feedback, focusing on team performance, increases future gameplay. Comparative feedback, contrasting and ranking player performance, decreases future gameplay. Burgers et al. (2015) also found that negative feedback decreased players' feelings of competence, but also increased immediate gameplay. Positive feedback, in contrast, satisfied competence and autonomy needs, thereby boosting intrinsic motivation. Negative feedback appears to motivate players to repair poor short-term performances, while positive feedback is more powerful in fostering long-term motivation and play (Burgers et al., 2015). It is clear that the designed messaging of the feedback has an important role in maintaining player motivation.

Social environments play an important role in player motivation, particularly in ensuring that players persist when experiencing frustration (Chen, 2012; Hess & Gunter, 2013; Wu et al., 2014). Hess and Gunter (2013), and Wu et al. (2014), used the lens of SDT to explore the social contexts within educational MMORPGs, particularly in relation to the factors that contribute to players feeling motivated by their peers. Although these studies were conducted in online environments, a number of their respective findings could be applicable to multiplayer play in shared physical environments. An important common finding from Hess

and Gunter (2013), and Wu et al. (2014), was that the level of desire to continue playing is heavily influenced, both positively and negatively, by the types of interactions between group members in the previous session of play. Wu et al.'s (2014) descriptions of peers providing timely encouragement and correcting each other throughout the game sessions help to illustrate the characteristics of a supportive social environment, but beyond these examples, little mention is made of the specific social skills players required to motivate their peers. Given the social environment seems to have a significant role in motivating players when finding a task challenging, the presence of a teacher in a shared physical environment might serve an important function in positively shaping the social environment.

Players sensing a collective responsibility and purpose is also critical for motivating individual players within a team. A collective purpose was noted by Chen (2012) as an important motivating factor for players to persist with their respective *World of Warcraft* clans in the face of adversity. Mysirlaki and Paraskeva (2011) likewise found that the sense of community around common goals was the primary driver of intrinsic motivation for continued play of the game. This, in turn, had a positive effect on the level of performance in the game of the entire playing group. These findings by Chen (2012), and Mysirlaki and Paraskeva (2011), are consistent with Gee and Hayes's (2012) description of affinity spaces serving as 'self-sustaining' vehicles for motivation. Both Chen (2012), and Mysirlaki and Paraskeva (2011), argued that a sense of community is derived from the ability to form collaborative groups and reinforced the importance of a sense of belonging to a common cause with shared group goals. If teachers are to have intervening roles in DGBL experiences, it is vital that they do not disrupt the sense of community between the players. For teachers engaging in social skills intervention, this could be a difficult balancing act between positively shaping the social

environment towards desirable interactions and allowing students to feel a sense of community ownership.

Continuing this theme of maintaining an effective balance, the degree to which a game encourages competition and cooperation within a team can also have an effect on individual motivation. In team-based competitions within a class, Garzotto (2007) found that this element of peer competition significantly factored into player engagement and enjoyment. Unsurprisingly, the victorious team members reported feelings of elation, but significantly the players of the losing team also remained motivated, asking immediately for a rematch. Players monitored and reported upon the progress of both their team and their opponents, highlighting the performance of individuals on both teams. Through this team-based competitive play, Garzotto (2007) argues that competition actually fostered cooperation with lengthy exchanges about strategy and the relative progress of each team. The elements of competitive pressure also meant that some students took on defacto leadership roles, ensuring that all players understood the objectives, the play mechanics and rules, and their relative roles within the team (Garzotto, 2007). Interestingly, Lobel et al. (2017) found that competitive gaming was associated with decreases in prosocial behaviour among children who played videogames with a very high frequency. While this further reinforces the importance of using cooperative games in this study, it also suggests that a minor degree of competition between the players might also serve to motivate experienced players, such as those described by Lobel et al. (2017), so that they remain engaged. Game design could have a role here in ensuring that individual achievements are recognised and rewarded as secondary to group achievements, so as to not negatively impact the social environment.

While there are disagreements as to the degree of influence of various factors for engaging and motivating players in multiplayer games, all of the reviewed studies suggest that no single

factor will motivate all players all of the time. Games need to provide compelling worlds for players to explore (Suárez et al., 2013), peers should be coached how to support their team members in the physical and virtual environments (Hess & Gunter, 2013; Wu et al., 2014), and games should allow for individual players to have some form of independent agency and recognition of skill (Garzotto, 2007). An intervention that considers these factors offers a greater likelihood of motivating players to persist in practising the performance of targeted social skills.

3.9 Judging the effectiveness of videogames as intervention tools

While the effectiveness of commercial and serious games has been measured and analysed in terms of achieving academic outcomes (Young, Schrader, & Zheng, 2006), there has been very little research into the effectiveness of commercial videogames being used specifically for targeting the development of social skills. This could reflect the relative immaturity of DGBL as a pedagogical approach, with many education systems still only beginning to experiment with the use of videogames as intervention tools (Bidarra et al., 2013; Chang & Hwang, 2019). Bellotti, Kapralos, Lee, Moreno-Ger, and Berta (2013) seemingly recognised this slow translation from research to classroom practice, arguing that a substantial amount of the research into DGBL since the new millennium has remained focused on how the game may be positioned in a classroom, as opposed to measuring the effectiveness of such videogame-based interventions. Even finding a common definition for what 'effectiveness' means in a digital game context can be challenging. All, Castellar, and Van Looy (2015) sought to address both of these concerns through the development of a conceptual framework that could be used to measure seven desired outcomes in three broad categories:

(i) learning,

(ii) motivational, and

(iii) efficiency outcomes

These desired outcomes, as shown in Table 3.6, presented different understandings of the effectiveness of DGBL from the perspectives of a range of stakeholders, including game designers, students, educators and school administrators. Not surprisingly, these different voices focused on competing priorities when assessing the effectiveness of DGBL.

Table 3.6. Desired outcomes of DGBL interventions (All et al., 2016, p. 36).

Operationalisation of DGBL effectiveness		
Learning outcomes	*Motivational outcomes*	*Efficiency outcomes*
Situational interest DGBL stimulates interest in the content matter discussed in the game.	**Enjoyment** DGBL succeeds in creating an enjoyable game experience.	**Time management** DGBL succeeds in reducing the timeframe required to teach a certain content matter. This is a judgement of relative worth compared to other instructional methods.
Performance DGBL succeeds in achieving learning goals as defined by the game developer/the client who ordered the development of the game.	**Motivation towards DGBL** Learning with the game-based method is motivating. This is a judgement of relative worth, compared to other instructional methods.	**Cost-effectiveness** DGBL succeeds in reducing the cost of the intervention with regard to: • The number of learners that can be reached, and • The time required to teach the target group certain content. This is a judgement of relative worth, compared to other instructional methods.
Transfer DGBL stimulates application of learned content matter in the game to real-world situations.		

Critically for this study, All et al. (2016) found that all stakeholders considered effectiveness using a range of desired outcomes for success, extending beyond measuring student *performance* from a baseline assessment to a post-intervention assessment. While it would be an oversimplification to present these results as indicating teachers were only interested

in *learning outcomes* and students only concerned with *motivational outcomes*, there were some common themes amongst these two categories of respective stakeholders. Teachers and researchers defined effectiveness primarily in terms of *situational interest*, *performance* and *transfer*, but students primarily viewed *performance* and *enjoyment* as being the measues that should be used in determing the effectiveness of DGBL (All et al., 2016). The value of these findings for this study is that it draws attention to a broader criterion for assessing the effectiveness of a games-based intervention and reiterates that the objectives of the teaching staff might not automatically align with those of the student participants. It is important to note that All et al.'s (2016) desired outcomes all pertain to measures of effect upon the stakeholders, rather than defining effectiveness in terms of the game containing specific design features or mechanics. This is important to consider, as this model does not allow educators to analyse the design of specific games critically for suitability within a social skills intervention.

An alternative model is required to examine effectiveness in terms of game-level affordances. Garzotto (2007) categorised the factors that he found contributed most to the educational effectiveness of games within four key themes: usability, content, enjoyment, and social interaction, as shown in Table 3.6. As opposed to All et al.'s (2016) model, which considers a range of stakeholder perspectives, Garzotto (2007) examined factors that can be controlled almost exclusively by game designers.

Table 3.7. Four interdependent factors that contribute to the educational effectiveness of a multiplayer gaming experience (Garzotto, 2007).

Usability	Content	Enjoyment	Social Interaction
Controls	Target/goal appropriateness	Clear goals	Connection
Interface	Integration	Concentration	Cooperation (remote or co-located)
	Scaffolding	Challenge	Competition
	Extensibility	Feedback	
	Media matching	Immersion	

Of these four themes, 'social Interaction' is of particular interest in developing a social skills intervention. This is the only reviewed model for assessing the effectiveness of games for DGBL that considers the role of other players in achieving learning outcomes, although this is the least explored theme in Garzotto's (2007) report. The other three themes shown in Table 3.6 are also useful in describing facets of play both within the game and in the physical environment. For example, a game requires both an easy to understand interface within the game and an intuitive physical control scheme in order to be deemed effective using Garzotto's (2007) model. This model helps to establish a common vocabularly that DGBL researchers have at their disposal to discuss the impact game design and playing conditions might have on the learning outcomes of the players.

The majority of the studies examined in this chapter focused on the effectiveness of DGBL for improving either student motivation in terms of participation, or content-specific learning

outcomes. Quantifiable data in a number of studies seem to suggest that the use of games can provide students with a more in-depth knowledge of targeted learning content compared with other methods of instruction (Suh, Kim, & Kim, 2010; Sun et al., 2015). There appears to be a need for further research into the effectiveness of using games to improve *motivational outcomes* and *efficiency outcomes*. Only Hess and Gunter (2013) seem to have evaluated the effectiveness of DGBL from these perspectives, beyond the use of instruments gauging student attitudes or teachers perceptions. Although All et al. (2016) were correct in recognising that student and teacher voices should be at the forefront of evaluating the implementation of DGBL, there is also a need for a tailored model that draws upon the language of game design when appraising potential games for use in DGBL (Garzotto, 2007).

3.10 Challenges and limitations of using videogames as educational tools

While the reviewed research into targeted DGBL interventions is either overwhelmingly positive or exploratory in tone (Prensky, 2006; Suh et al., 2010), there are a number of concerns pertinent to this study. Concerns include the unintended consequences of introducing commercial games into classrooms, issues around equity of experience within diverse classrooms, and contexts where DGBL might be inappropriate. These concerns give pause to the sometimes-unadulterated enthusiasm found in some literature and require careful consideration, particularly when using DGBL for interventions with vulnerable populations.

3.10.1 Controversy surrounding commercial game pedagogy

Commercial games are designed primarily for entertainment (Charsky & Mims, 2008; Lacasa et al., 2008), and as such there are naturally questions pertaining to their suitability as learning tools. One minority dissenting critique of integrating commercial games into school curricula centres around the misalignment between their designed purpose and their repurposing by educators. Van Eck (2006, p. 7) succinctly summarised this argument as commercial games not being "designed to teach, so topics will be limited and content may be inaccurate or incomplete". He cautioned that the use of these games might cause confusion or misunderstandings when the content of the game does not align with the content of the curriculum. For example, many games with an entertainment focus do not emphasise instructional or interpretive information that is important in developing a player's understanding of events and therefore inhibits any subsequent transfer of knowledge to contexts outside of the game (Masson, Bub, & Lalonde, 2011; Sun et al., 2015).

There is also a very limited of body of evidence regarding whether social skills developed within the confines of a game environment can be transported, or generalised, beyond the game context. For example, Lobel et al. (2017) found that cooperative gaming alone was not associated with changes in prosocial behaviour, although it is important to note participants in this study did not receive any teacher instruction or support. These are important cautions that need to be considered in the development of any intervention using DGBL.

3.10.2 Issues around equity of access to DGBL

There are also concerns around the equity of DGBL, particularly in terms of the financial ability of schools with low socio-economic populations to have the same quality DGBL experience as students from wealthier populations. The financial commitment to invest in the

required infrastructure can be considerable for these school communities (Allsop & Jessel, 2015; Bidarra et al., 2013; Collins & Halverson, 2018) and DGBL might not be a priority (Collins & Halverson, 2018). The quality of a school's infrastructure can also have an impact on student motivation. Suh et al. (2010) found that when students were confronted with poorly performing gaming sessions, there was a significant drop in player motivation, which carried over to subsequent sessions. This makes sense as sporadic graphical frame rates and system crashes can reduce player immersion in the world and take away their control and agency within the game. Suh et al.'s (2010) findings suggest that DGBL intervention using videogame consoles with an established set of specifications is preferable to using personal computers with variable specifications, as game developers can more easily optimise their software for consoles.

3.10.3 Contexts where game-based learning can be inappropriate in isolation

A number of educational contexts might be seen as inappropriate environments for the implementation of DGBL. Even the most enthusiastic DGBL proponents acknowledge the importance of blended learning, and that there are a number of skills that are best developed by experience in the real world as opposed to the simulated realities found in game environments (Gee, 2012; Wood, 2011). Bidarra et al. (2013) provided the example of contexts that might require a real-time tactile response for the student. One such situation could be instructing how to perform surgical procedures, which require a tactile element that might not be possible to replicate using a default game controller (Bidarra et al., 2013). This issue is also applicable to the science classroom, where simulated dissections hold some

educational value, but the students might not receive the benefit of the tactile response from using tools such as scalpels (Vate-U-Lan, 2015).

Much like these tactile experiences being a central component of learning during scientific dissections, practising social interactions with peers in the physical environment is central to developing non-verbal skills such as reading facial expressions (Winner, 2007; 2013). Bidarra et al. (2013) raised concerns as to whether specialised social skills programs that focus on building capacity for face-to-face interactions can be delivered effectively through entirely online means. As discussed in *Chapter 2*, most existing social skills interventions are conducted in shared physical spaces. Bidarra et al.'s (2013) concerns further reiterate the importance of use in this study of co-located multiplayer games.

3.11 Chapter conclusions

One avenue for social skills intervention that has received limited attention is DGBL. *Chapter 3* has examined the defining traits of videogames and identified the complexities in finding a universally accepted definition that is appropriate for such interventions. Of particular interest to this research project is the literature surrounding cooperative multiplayer games. Alongside the games themselves, this literature review shows that gamer culture is a consideration that runs parallel to the cultural dimensions of disability discussed in *Chapter 2*. Some tensions relating to undesirable content and the risks of overexposure to screen time are acknowledged, but opportunities to use the metagame provides a useful means to engage participants in this study in conversations surrounding the skills they use when they play together.

This chapter also examined research positioning videogames as pedagogical tools in formal and informal settings. Gee's (2007a; 2013) principles offered a starting point for considering

the features of game design that might be important in creating the conditions for collaboration. One reason why some videogames may be effective learning tools is the way that these games allow for the personalisation of player identity within the game. The selection of characters might afford representation of the players personality and preferences within the game (Kowert et al., 2015), or character selection might be a more strategic choice based the capabilities of each class of avatar (Brown, 2008; Newman, 2002). The literature also emphasises the importance of the rules of play and the means of feedback in eliciting certain actions from players. The genres of game used in an intervention may be important, but there is very little research surrounding the relationship between genre conventions and types of social interactions observed in these types of games.

The different ways of playing videogames together can have a significant impact upon the opportunities for developing different types of social skills. While there is a wealth of research examining the most popular mode of multiplayer gaming, online play, there is less research examining the social affordances of local multiplayer games. This is particularly true in the limited number of studies examining physical proximity and the types of social interactions between players. Most of the studies focusing on the promotion of social interaction through game design examine online play, and although they offer insights into designed interdependence, there remains many questions about how this would impact players in co-located spaces.

DGBL is an emerging area that is only beginning to be considered for use within interventions. Figure 3.3 highlights the implications of this analysis of the existing digital games-based literature for this research project. While this literature review highlighted the limited amount of research into digital games-based social skills interventions, it also brought to attention the

potential afforded through the positive elements of gamer culture and game design in developing effective and engaging interventions for the participants in this study.

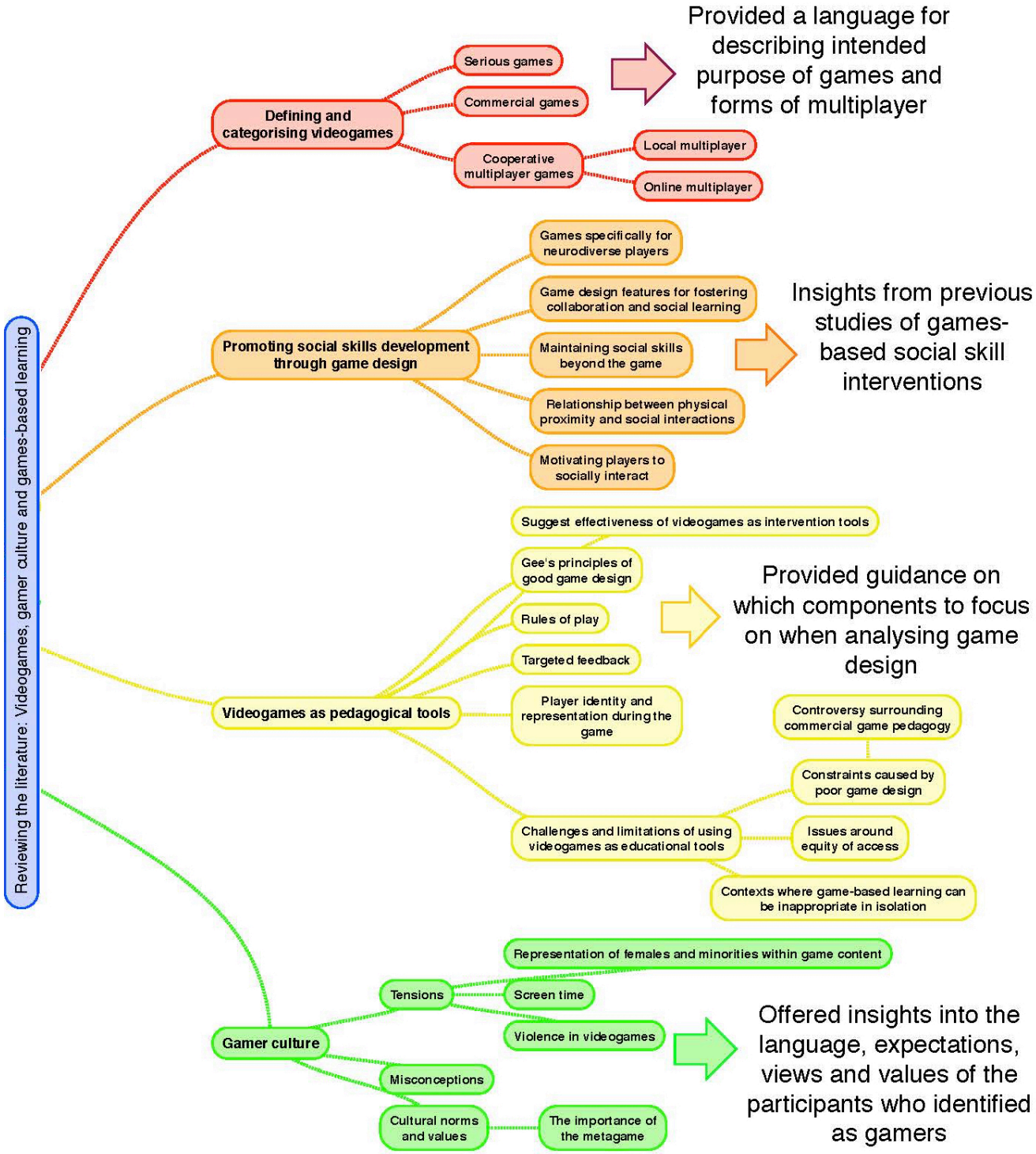


Figure 3.3: Implications of the reviewed literature in Chapter 3 for this research project.

Chapter 4: Methodology

4.1 Introduction & structure

The purpose of this study was to design a set of guidelines for a social skills intervention using cooperative videogames. Additionally, this research project sought to develop a set of game design recommendations that can be used to create the conditions for collaboration. Design research methodology provided a means of developing and concurrently studying both a prototype of an intervention and the principles of game design. *Chapter 4* introduces a particular model of design research, the *Compleat model* (Middleton et al., 2008), that was used to guide this research project. This model provided a tested structure and a sense of rigour that afforded valid, evidence-based conclusions to be drawn from the resulting data.

Within the context of implementing this model, this chapter outlines the setting, participants, and the videogames used in this study. This leads to a discussion of the approaches to data generation and analysis that were utilised, exploring the affordances and challenges of using video observation and participant interviews. The chapter concludes with an interrogation of the ethical considerations of this research project. Developing an intervention for a particularly vulnerable population of children requires careful consideration of the comfort and welfare of participants. Given the nature of autism and Down syndrome, the decision was made to work with the teacher-researcher's own students in his regular classroom setting to ensure stability and to minimise disruption and discomfort to the participants.

4.2 Qualitative study – design research

To understand the value of design research in addressing the objectives of this project requires recognition of the methodology's socio-political origins and defining characteristics. Projects using this methodology are a "subprocess in the larger cycle of design" (Middleton

et al., 2008, p. 14). An intervention is first developed through iterative cycles in a single ecology (Plomb, 2013, Dolk, Widjaja, Zonneveld, & Fauzan, 2010), but with an eye on developing broader theory (McKenney & Reeves, 2012) through the subsequent testing of the emerging design and theory in other contexts (Middleton et al., 2008, Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003).

Testing an initial intervention design in a single context was vitally important for this research project. Moving immediately from the theoretical design of an intervention to wide scale testing with participants with social-emotional disabilities is a risky proposition due to the potential disruption caused to the students' routines, as well as the financial costs. These challenges can be managed through the introduction of an additional step, where the theoretical design can be tested and refined on a smaller scale in order to increase the likelihood of success during larger randomised controlled trials (RCTs) (Cobb et al., 2003). This is the value of design research in developing an educational intervention: a pre-clinical cyclical process of prototyping, localised field-testing and refinement before wider testing through RCTs. The additional step provides five defining characteristics, or affordances, for design research projects that were instrumental in achieving the objectives of the study.

4.2.1 Five defining characteristics of design research

McKenney and Reeves outlined five defining characteristics of design research. First:

1. *Design research is **collaborative**, conducted in partnership with stakeholders* (McKenney & Reeves, 2012, p. 14).
2. *It is **responsively grounded**, shaped by literature but situated within a living ecology and contextualised using participant expertise and field-testing* (McKenney & Reeves, 2012, p. 15).

These first two characteristics were central to the selection of this methodology, as a goal of this study was for participants to be pivotal in shaping the intervention design. This would be achieved through creating regular opportunities for them to provide feedback, as discussed in the results chapters of this thesis. The next of McKenny and Reeves' (2012) characteristics are:

3. *Design research is **interventionist** in nature, striving to impact practice* (McKenney & Reeves, 2012, p. 14).
4. *It is also **theoretically orientated**, using existing theory to both inform the initial inquiry and to shape the solution, alongside other sources of data generated through the process* (McKenney & Reeves, 2012, p. 13).

These two characteristics speak to the dual purposes of this study, developing a design for a practical social skills intervention using cooperative videogames, and to broaden theoretical understandings of how game design might promote social interaction. The final characteristic outlines the process through which design research achieves these goals:

5. *Design research is **iterative**, as theoretical insights and interventions evolve over time through multiple cycles of investigation, development, testing and reinforcement* (McKenney & Reeves, 2012, p. 15).

As this research methodology is relatively new, it is worth highlighting the divergence of labels used to refer to it, including 'educational design research' (McKenney & Reeves, 2012), 'design experiment' (Middleton et al., 2008) and 'design-based research' (Kelly, 2013; Widjaja, 2018). To maintain consistency throughout this thesis, the term 'design research' will be used to describe this methodology. The underlying goals and assumptions of this methodological lens align well with the objectives of this study.

4.2.2 The 'two-fold' yield of design research

Considering the word 'design' is useful in illustrating the products of this design research project. Plomp (2013) highlighted how design research generates both artefacts and theory, known as the 'two-fold yield' of design research, shown below in Figure 4.1.

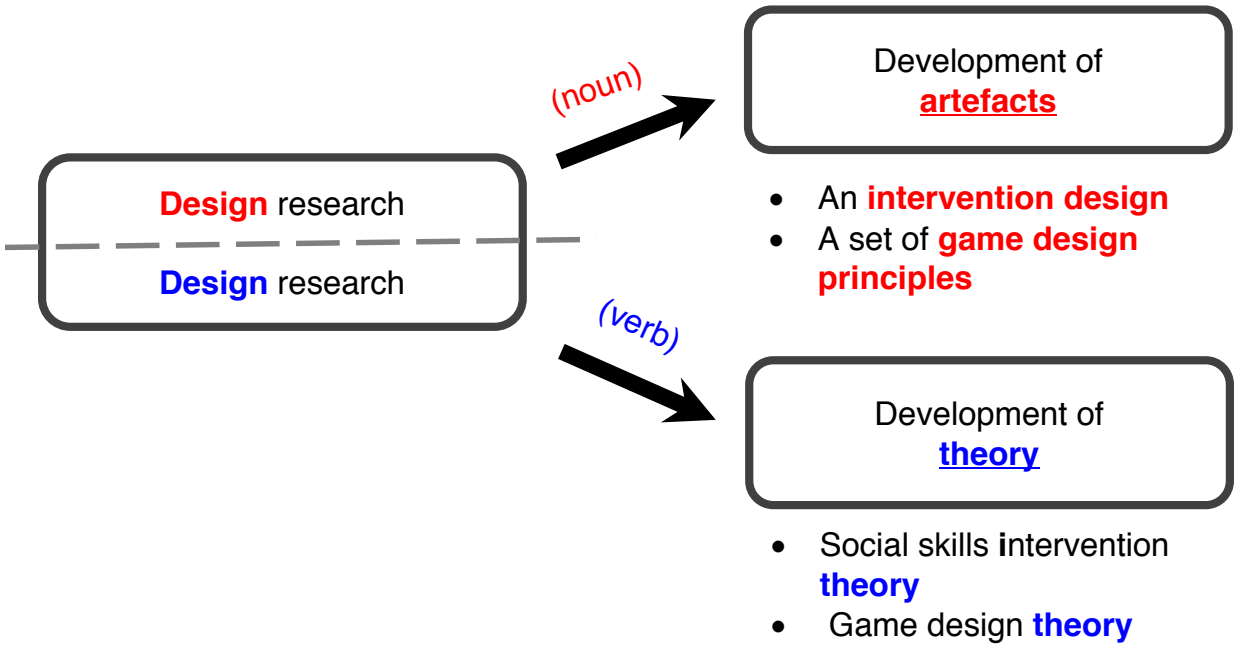


Figure 4.1. The 'two-fold yield' of design research. Adapted from Plomp (2013).

When the word 'design' is used as a noun, it refers to the hypothetical solution itself, or the blueprint for the features of a social skills intervention that uses cooperative videogames in conjunction with complementary intervention strategies. However, when the word 'design' is used as a verb it refers to the creative process of considering a problem and constructing a hypothetical solution. This in turn tests established theory and potentially generates new theory. In drawing upon the established theory of social skills intervention and DGBL, the processes of design research also allow for the development of theory through the testing of the boundaries of when components of an intervention are effective (Middleton et al., 2008).

An example of this was seen in testing the boundaries of the theoretical underpinnings of video modelling in this research. By using video modelling in a new context, this study tested the theoretical boundaries of when this intervention strategy was effective and when it stopped being effective. Through such testing, this study generated new theory, as reported later in the results chapters of this thesis.

4.2.3 Participant voice within a complex learning ecology

The human variables were particularly important within this design research project for understanding other variables within the classroom ecology. McKenney and Reeves (2012) highlighted the importance of the 'ground level instincts' of local actors who understand this ecology, and who can help to read the 'state of play' of these variables at any given time. This was epitomised in this study by the inclusion of the teaching assistants in the decision-making processes at every step of the intervention design. These two adult participants were familiar with the students, their strengths and their challenges, and could interpret their emotional states and understand the subtilties of their non-verbal modes of communication in a way that complemented the researcher's understandings of these students. Knowledge of such details for each student participant was painstakingly constructed over a number of years, harnessing the experiences and expertise of the project participants as described by McKenney and Reeves (2012). While this was useful in analysing the data, what was truly powerful was the ability of the teaching assistants and the teacher-researcher to elicit student opinion on the form, function and direction of the intervention design. This was only possible because of the meaningful relationships that they formed with the participants over a number of years.

The learning ecology was engineered through:

1. the setting of particular tasks or problems that the students were asked to solve together,
2. the kinds of discourse the teaching staff encouraged,
3. the established norms of participation that had been set through the teacher-researcher's history of working with these students,
4. the use of video modelling and videogames as tools for manufacturing discourse and interaction, and
5. through the interactions between the participants.

It was the study of the interactions between these different variables within the ecology that was most valuable in addressing the central research questions. Cobb et al. (2003) emphasised that the study of complex learning ecologies precludes the complete specification of everything that happens, regardless of how effective the research methods might prove to be. Therefore, it is vital "to distinguish in the specification of the design between elements that are the target of the investigation and those that may be ancillary, accidental, or assumed as background conditions" (Cobb et al., 2003, p. 9). This is where the use of the targeted behaviours and the elements of game design outlined in the literature review became essential in specifying what exactly it is this study was seeking to explore, and how these objectives fit within the learning ecology of this classroom setting.

4.3 Using the *Compleat model* to structure design research

The *Compleat model* of design research provided a structure to put McKenney and Reeves' (2012) five defining characteristics of design research into practice, resulting in research that

was collaborative, responsively grounded, interventionist, theoretically orientated and iterative.

Originally outlined by Middleton et al. (2008) as a series of seven phases, or steps, the *Compleat model* systemises the features of design research described by Cobb et al. (2003) and Horowitz (1997). Figure 4.2 presents the Middleton et al.'s (2008) visual representation of these seven phases.

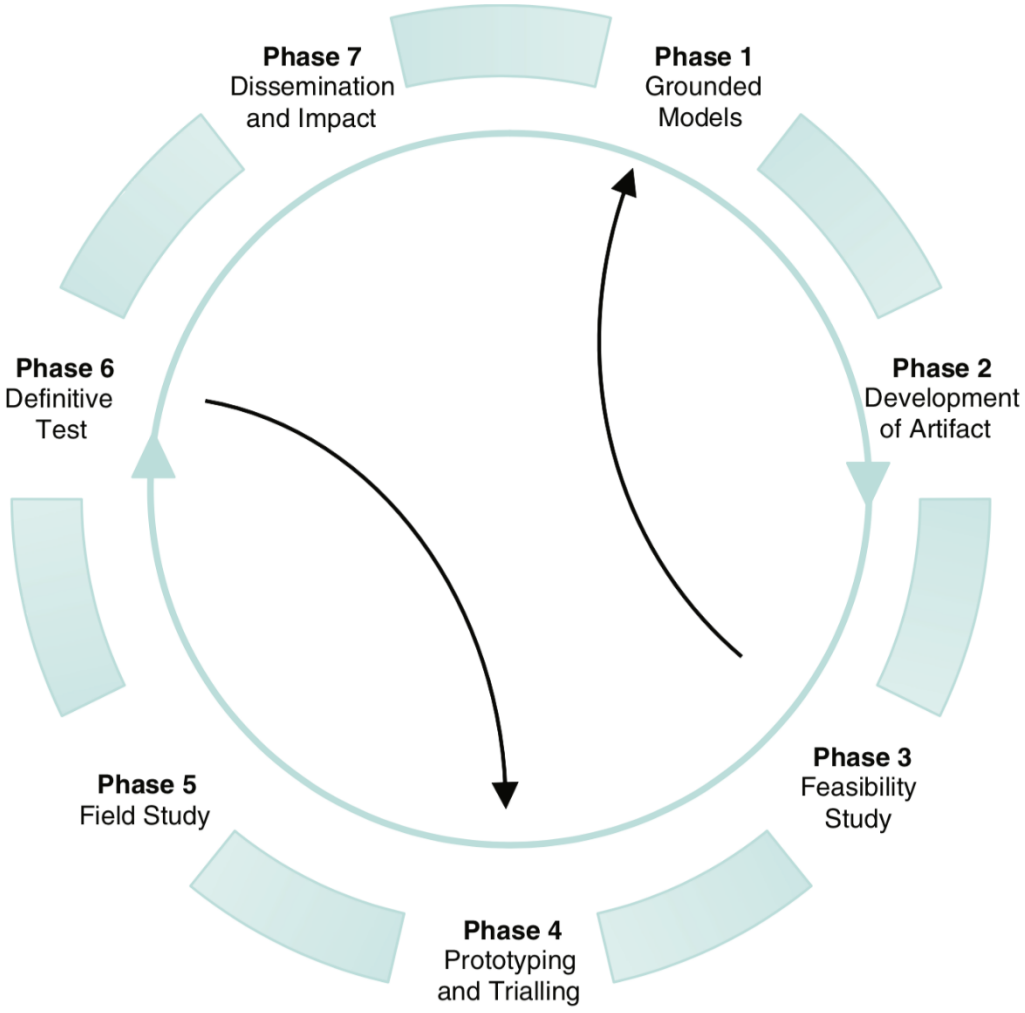


Figure 4.2. Visual representation of the *Compleat model* of design research. Sourced from Middleton et al. (2008, p. 34).

Lamberg and Middleton (2009) subsequently utilised these seven phases, making minor alterations to the original language to meet the needs of their research. The original model

shown in Figure 4.2 was augmented to use this more useful language, as shown in Figure 4.3. This new version of the *Compleat model* organises the seven phases into three key stages that describe the implementation of this model: **the initial design of the intervention**; the **design experiment;** and the **clinical testing and dissemination of results**. These stages are denoted respectively in Figure 4.3 by the green, yellow or blue headings for each of the phases. Augmenting Middleton et al.'s (2008) original model with visual representations of the three key stages represents a contribution of this thesis to the theory of design research.

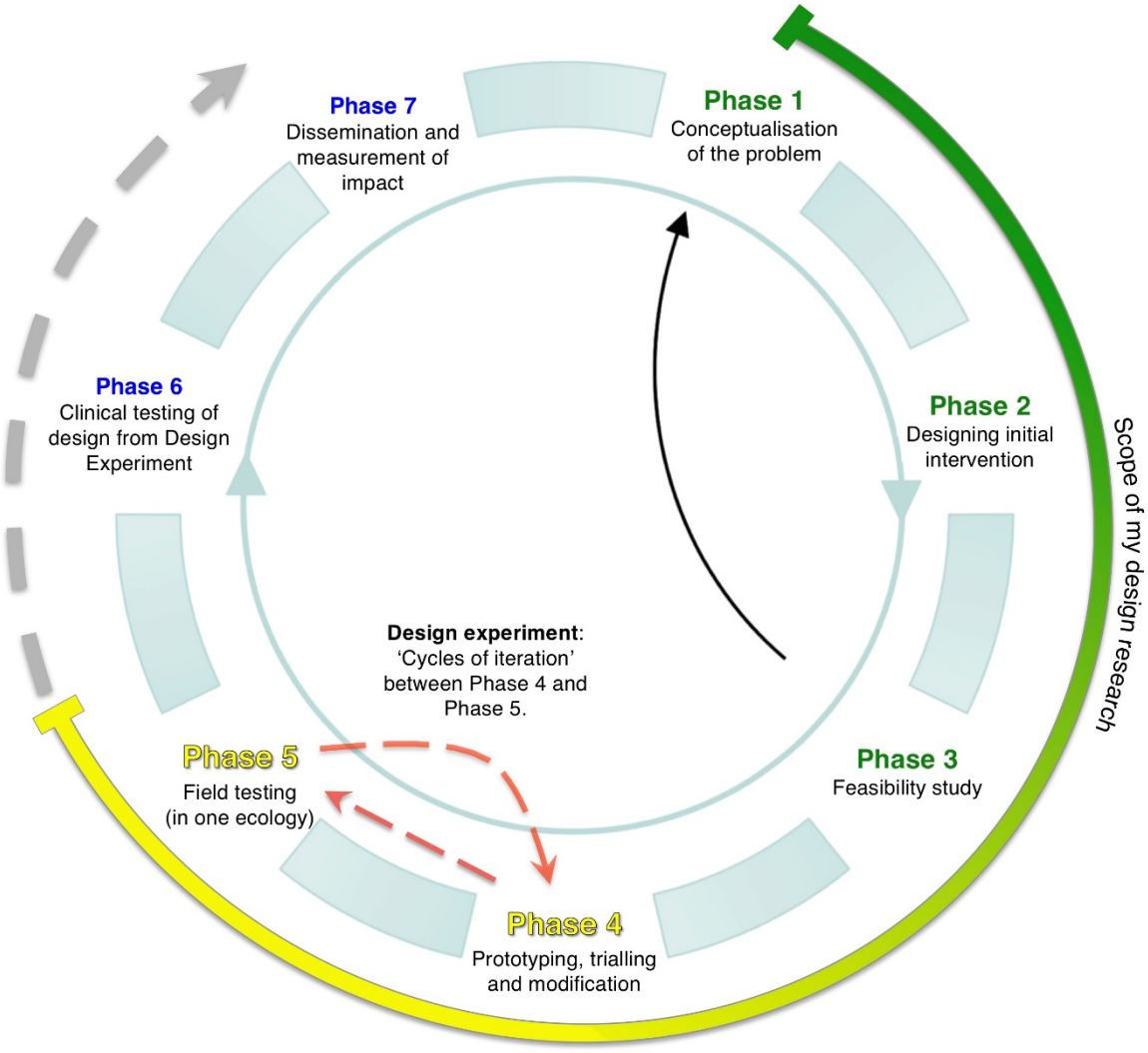


Figure 4.3. Visual representation of the *Compleat model* of design research combining the language of Middleton et al. (2008), and Lamberg and Middleton (2009).

The original visual representation of the *Compleat model* was further adapted with an outer arrow indicating the scope of this research project, as shown in in Figure 4.3. As this arrow illustrates, the research focused on phases one to five, with phases six and seven of the *Compleat model* providing a roadmap for further investigation in subsequent studies.

4.3.1 Initial design of the intervention

The **initial conceptualisation of the intervention** comprised Phases 1 to 3 of the *Compleat model* of design research. Conceptualisation of the problem, including the collection and analysis of initial data, was essential to understanding the problem and the variables present in the ecology (Lamberg & Middleton, 2009; Middleton et al., 2008). Once the problem and ecology were understood, Phase 2 allowed for the generation of an initial design through the use of current theory. Identifying how aspects of the intervention might work also brought to attention potential barriers, and promoted the consideration of possible alternative means through which an intervention could be implemented. Once an initial design had been developed, Phase 3 involved testing the intervention through a feasibility study. Cobb et al. (2003) noted that early trials of an intervention do not represent comprehensive evaluations, but rather establish the acceptability of the intervention to potential participants. Results of the feasibility study determined whether the intervention should proceed to the iterative design phases, or whether it was necessary to return to the initial phases to reconsider both the problem and the initial solution (Lamberg & Middleton, 2009; Middleton et al., 2008).

4.3.2 Design experiment (iterative cycles)

Phases 4 and 5 of the *Compleat model* illustrate the process of iteration between testing and modification, working towards a final version of the intervention that could be tested on a scale beyond the single ecology. In this thesis, this is referred to as the **design experiment**

stage, a subprocess within design research. While the *Compleat model* effectively presented a comprehensive overview of the broader research process, the language used by Dolk et al. (2010) provided a more nuanced illustration of the design experiment process. This is shown in Figure 4.4.

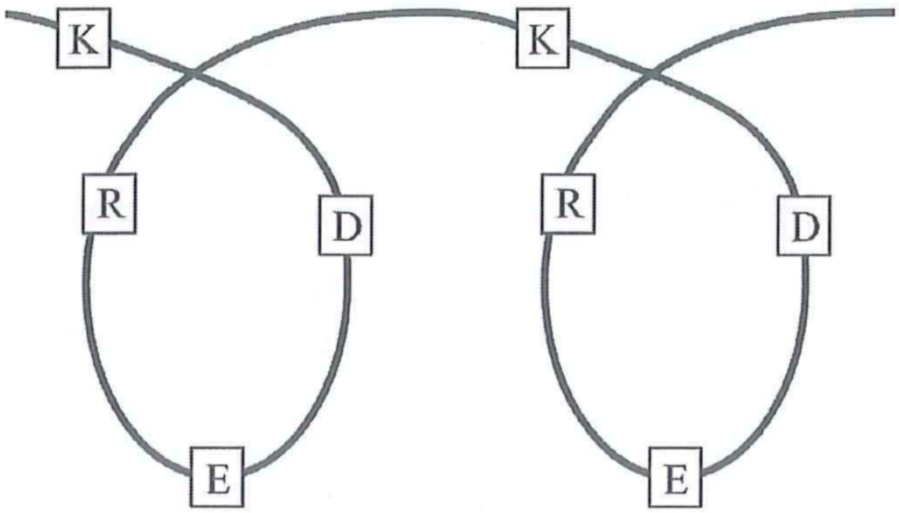


Figure 4.4. Dolk et al.'s (2010, p. 177) cyclical process of knowledge (K), designing (D), experimenting (E) and retrospective analysis (R).

Phase 4 of the *Compleat model* involved developing a new prototype, described by Dolk et al. (2010) as involving a **retrospective analysis** of the implementation of previous iterations of the intervention in the ecology. Analysis informs the **knowledge** the researcher has of the participants, the anticipated opportunities of possible modifications, as well as the potential challenges. Beyond researcher analysis, knowledge is also generated through insights from the available literature and feedback from stakeholders. These sources of evidence are explored in depth in the subsequent section of this chapter, which focuses on the methods of data generation. New knowledge informs the **design** of a revised iteration of the intervention.

Once a new version of the intervention had been developed, Phase 5 saw the design being tested in the field on a small scale, referred to as **field testing** (Lamberg & Middleton, 2009)

or the **experiment** (Dolk et al. 2010). This primarily involved observing the areas where the intervention was effective in this context, the areas requiring further modification, and the manner in which the intervention was implemented. Using data obtained from the field testing, the teacher-researcher returned to Phase 4 to further analyse and modify the design to address areas requiring adjustment. This would create a more effective intervention designed to achieve its goals. Data generated during these iterative cycles of development informed many of the modifications to the intervention design, reported in the results chapters of this thesis.

4.3.3 Using the *Compleat model* to structure this thesis

The adapted *Compleat model* also provided a structure for this thesis, aligning the phases of the design research project to the chapters of this thesis, as shown in Table 4.1.

Table 4.1. Alignment of the first five phases of the *Compleat model* within this thesis.

		Phase:	Thesis section:
Initial intervention design	1	• Conceptualisation of the problem using current theory.	✓ The literature surrounding the social skills challenges and existing interventions were explored in *Chapter 2.* ✓ The participants and learning ecology are presented in this chapter, *Chapter 4*.
	2	• Using current theory to design an initial intervention (hypothetical solution)	✓ Using the literature review (*Chapters 2* and *3*) to develop the initial prototype presented in *Chapter 5.*
	3	• A feasibility study of the initial design	✓ Reported and analysed in *Chapter 5.*
Design experiment (iterative cycles)	4	• Prototyping, trialling and modification	✓ The modification of key components through ten cycles of iteration are presented in *Chapter 5*. ✓ The frequency and duration of social interactions and key events are presented in *Chapter 6*. ✓ *Chapter 7* discusses the final design of the intervention, developing the performance of the targeted skills, while *Chapter 8* discusses game design recommendations that create the conditions for social interaction.
	5	• Field testing	
Clinical testing and dissemination	6	○ Clinical testing of emerging design	○ Potential considerations for clinical testing are discussed in *Chapter 9*, but enacting this testing is beyond the scope of this study.
	7	○ Dissemination and measurement of impact (if clinical trials show sufficient impact)	

Phase 1 (conceptualising the problem) and Phase 2 (developing an initial version of the intervention) occurred prior to any data being generated as part of this research project.

These procedural phases are reported in this methodology chapter. Phases 3 to 5 actively tested and iteratively refined this initial intervention, with the analysis of the data generated forming the results of this research project. As such, these three phases are discussed in the results chapters.

4.4 Compleat Phase 1: Conceptualisation of the problem

Phase 1 involved understanding the nature of the problem. Middleton et al. (2008) described this phase as being a starting point. In this phase, the initial design is conceived using current theoretical understandings but interpreted in a way that is 'grounded' in the ecological context of where the intervention is to be further developed. Learning ecologies are constantly in flux, shifting in response to the complex interplay between various components. In order to 'ground' or 'localise' the theory, there is a need to understand these ecological conditions at the time of the initial intervention design. This includes the current theoretical understandings of the area of need and understanding the learning ecology, including the participants and the setting.

4.4.1 Understanding the school setting

The complexities of placing boundaries around a learning ecology become obvious when examining the school setting for this study. Hyrule School (pseudonym) has multiple campuses located in a metropolitan city in Australia, and has a diverse range of contextual considerations that were important in this study. This school provides formal education for students with disabilities aged between five and eighteen years. Close to 60% of the students attending the school have a diagnosis of autism, although as highlighted through the literature review, many of these students have comorbidities that further complicate their learning

needs. The school community encompasses a range of socio-economic and ethnic backgrounds, with more than 25 different nationalities represented in the school population. Approximately a third of the students attending the school come from backgrounds where English is a second language, with an above average number having indigenous heritage in comparison to other schools in the area.

Supporting the learning of these students are classroom teachers and specialist teachers. There are also Educational Support Staff (ESS), including teaching assistants, speech pathologists and occupational therapists. As the teacher-researcher conducted this intervention as part of his professional role at the school, the scheduling and duration of each lesson was driven by school-level considerations, such as the current curriculum priorities of the school and the allocated time and setting for classes. This research project was designed to fit within these constraints.

4.4.2 Understanding the learning ecology: Student participants

A significant variable within the learning ecology were the participants in the classroom environment. The participants included five students, two education support staff members, and the teacher-researcher. The homeroom teacher and a speech pathologist also provided advice. Using interviews with the teaching assistants, previous assessment data generated through SWANs (described in *Chapter 2*) and the teacher-researcher's professional knowledge of the students, student profiles were developed. The profiles summarised below focus on what the students were ready to learn as well as identifying areas of strength and interest that could be harnessed as part of this intervention. All of the students in this study can use verbal communication when they choose to do so. These co-developed profiles served as the baseline data for developing the first iteration of the intervention. They also

provided the initial goals for each student until further data was generated from the first lesson of the intervention.

4.4.2.1 Student A – 'Falcon'

Twelve-year old Falcon identified as a gamer and engaged with a wide variety of activities associated with gamer culture. This included playing games, watching live streams of games on social media and watching videos of 'fan fiction', stories created by fans in the fictional universes of these games. Falcon often enjoyed spending time by himself, particularly on the computer. Falcon had been diagnosed with autism and found it difficult to engage in activities in which he was not interested. The main justification for his enrolment in a special school program was his underdeveloped social and communication skills. He had very limited written communication skills but had shown a high level of visual recall. If Falcon was not interested in a topic, he would often disengage and was easily distracted. His classroom teacher had expressed her strong belief that Falcon would thrive in a mainstream high school, a goal shared by his parents.

4.4.2.2 Student B – 'Link'

Link, also 12 years old, was best friends with Falcon and had an interest in gaming. They belonged to the same ethno-cultural community, and their parents were close friends. He often spent time with Falcon on weekends playing games. Link had his own YouTube channel, where he would regularly discuss his favourite games. Although he was placed in a specialist school setting due to a diagnosis of autism, Link had strong literacy and numeracy skills and is what Attwood (2016) would classify as high-functioning. Link had a more diverse range of interests than Falcon, but was not as confident in asserting himself, and he could become highly anxious when in unfamiliar situations. He could become fixated on rules of

play and often became upset when other students did not comply with his interpretation of these rules. Link's interest in rules though was also seen as a positive by the teaching staff:

Teaching assistant A:	[Link] is very rules focused. And he's good at also reminding the other students about the rules as well, which is really good.

This study was conducted in Link's last semester in the satellite campus, and his teacher believed that he was best suited to a mainstream high school.

4.4.2.3 Student C – 'Banjo'

Ten-year old Banjo had a high level of social confidence and enjoyed participating in a range of activities, including playing games. Banjo attended out of school hours care, and this had allowed him to develop a strong network of friends in the broader mainstream school. A group of friends would often visit at lunch times and they would play games together on the iPad. Banjo's verbal communication was still developing and he could have difficulty in verbally expressing himself, which his classroom teacher partly attributed to his autism. Amongst this group of student participants, Banjo appeared to be the most aware of the relative social capital of each participant in this study.

4.4.2.4 Student D – 'Pit'

Pit was also 10 years old and also had a strong interest in gaming. He regularly played videogames at home and at school, and engaged in other activities often associated with gamer culture, such as watching live streams of games that interested him on *Twitch*. Pit had be diagnosed with autism, and often disengaged with the class and began reciting lines or scenes from his favourite movies and games. This is a phenomenon known as echolalia (Neely, Gerow, Rispoli, Lang, & Pullen, 2016). During this time he would often wave his hands

in front of his face for sensory stimulation, known as 'stimming'. Interestingly, when he was playing or watching others play videogames this did not occur.

4.4.2.5 Student E – 'Samus'

Ten-year old Samus was also an avid gaming fan. His favourite game at the time of this research project was *Mario Kart 8* on the Nintendo Wii U. He had a strong interest in interacting with his peers, but sometimes found it difficult to take turns or to understand the rules of more complex games. Samus had been diagnosed with Down syndrome. His speech was sometimes difficult for other children and unfamiliar adults to understand, but he was extremely physical in using his whole body to provide supporting gestures alongside his verbal communication.

4.4.3 Understanding the learning ecology: Teaching assistants & teacher-researcher

Two teaching assistants participated in this study. Their role was to work with the students under the direction of the teacher. Although teaching assistants at Hyrule School require no formal qualifications, these educational support staff had extensive experience in working with children diagnosed with autism and Down syndrome. They had developed relationships with the students over a number of years. Both staff members had received training in positive behaviour support and demonstrated an intimate knowledge of the formal and informal policies of the school. The teacher-researcher had worked with both teaching assistants for a period of three years. Across the ten lessons of data generation, the two teaching assistants alternated roles within the school so that at least one assistant was present for all ten lessons.

4.4.3.1 Teaching Assistant A – 'Tetra'

Tetra was an experienced teaching assistant who had been working at Hyrule School for five years. During this period of time she had work with Falcon for all five years, Link for four years, Banjo and Pit for three years and Samus for the two years he had been attending Hyrule School. Tetra did not describe herself as a gamer but had taken an interest in the videogames that the students played at lunchtimes and during ICT classes at school.

4.4.3.2 Teaching Assistant B – 'Marin'

Marin was also an experienced teaching assistant that had been working at Hyrule School for three years, with all of this time spent working in the satellite room. She had worked with Falcon, Link, Banjo and Pit for all three years, and with Samus for the two years he has been at the school. Much like Tetra, Marin said that while she did not have a personal interest in videogames, she was familiar with some of the games in which the students were interested.

4.4.3.3 Teacher-Researcher – 'Matt'

One of the defining traits of design research is the interventionist role of the teacher-researcher, who was an active participant in the study. He had eleven years teaching experience, with three years being spent at Hyrule School. At this school, Matt taught the subject 'Digital Technologies' as a learning area-specific teacher, working with the students for two hours every week. He had worked with both teaching assistants regularly over this period of time. As noted in *Chapter 1*, the teacher-researcher was also an avid gamer and was very familiar with the elements of gamer culture, as described in *Chapter 3*.

4.5 Compleat Phase 2: Designing the initial intervention

In the second phase of the initial intervention design, the theory and research identified in the literature review was used to design an initial intervention. This included incorporating both the broader characteristics of successful social skills interventions identified in *Chapter 2*, as well as the specific research surrounding the effective use of multiplayer videogames identified in *Chapter 3*. These were used to develop the theory-based 'alpha version' of the intervention prototype, to be trialled in the following phase, the feasibility study.

4.5.1 Structure of the lessons

The purpose of this study was to work with participants to co-design an intervention that centres around the use of cooperative games as tools for the development of social skills. These targeted skills were determined by the teaching staff and guided by the social dimensions of the *Collaborative problem-solving empirical progressions* (see Appendix A). This study also sought to identify the elements of game design that promote social interactions and identify instances where the students apply and demonstrate these skills. This is intended to provide educators with a set of design recommendations to look for when evaluating the potential of other commercial games to be incorporated into a social skills intervention.

This study was conducted over a period of ten lessons, with each lesson representing a new prototype of the design. Each of these lessons was divided into three key activities (Stages, A, B and C). The broad structure employed within each lesson is displayed in Figure 4.5.

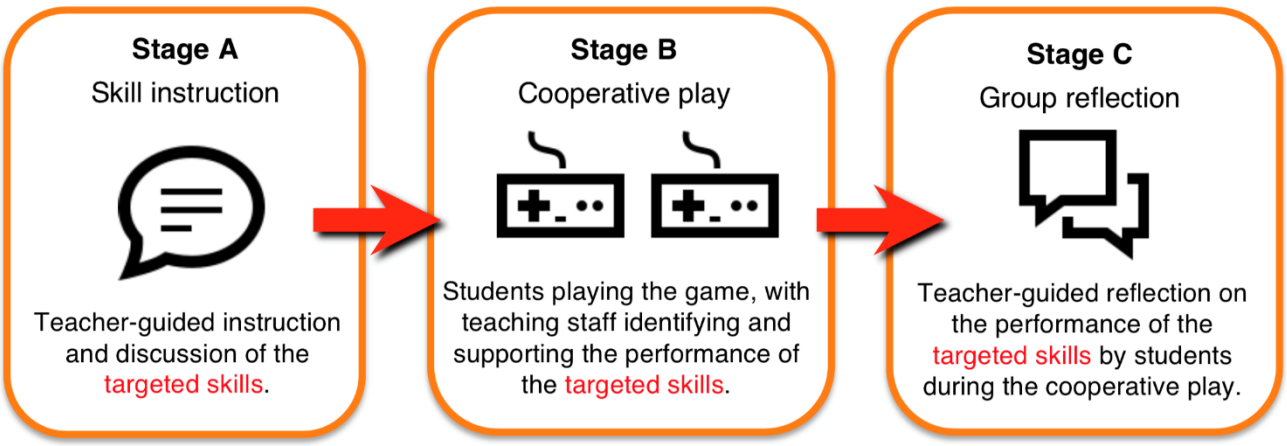


Figure 4.5. The structure utilised within each of the ten intervention lessons.

It is important to note that although many of the components of the intervention changed from one version of the prototype to the next, the basic three-stage structure remained constant throughout the process. The duration of each stage was guided by the results of the pilot study conducted in Phase 3 and the practicalities of fitting within Hyrule School's timetable. The decision to use a consistent structure was based upon the strong emphasis in the literature on the need for students with autism to have a sense of routine, with a predictable structure in their instruction design (Lindsay, Proulx, Scott & Thomson, 2014; National Autistic Society, 2016). The conclusions of this research align with the teacher-researcher's professional experiences working with these students, and hence the three-stage structure was retained throughout the ten cycles of iteration. Each lesson was conducted in three different but connected physical spaces, aligning with the needs of the three stages of the intervention. The students were familiar with these spaces, as they regularly used them with their classroom teachers prior to this study.

4.5.2 Design of **Stage A**: Skill instruction and video review

The first stage shown in Figure 4.5 involved the teacher-researcher providing explicit instruction by defining the skills to be addressed in the lesson, explaining why they are

important, and when and how these skills would be used. As this stage required the students to review video footage of themselves playing the games and viewing the supporting prompts displayed on a screen, the participating students sat in front of an interactive whiteboard. The teacher-researcher and the teaching assistant sat to the sides of the whiteboard, as represented below in Figure 4.6.



Figure 4.6. The skill instruction and video review.

There is an assumption drawn from the literature that the actual aquistion of the social skills and behaviours was developed through direct instruction and modelling in this first stage, prior to engaging in the gameplay. As demonstrated in *Chapter 3*, there is a wealth of research findings that support the effectiveness of the approach of explicit instruction and modelling when conducting social interventions with children with autism (Beaumont &

Sofronoff, 2013; Bellini et al., 2007; Hattie, 2009). An interactive whiteboard was used to display supporting visuals and prompts for the students, to help facilitate and structure the discussion. Images of the avatars in the game being played at the time were also incorporated in the supporting visuals, with the aim of familiarising the players with these playable characters, their capabilities and the mechanics for controlling them. An example of these supporting visuals can be seen in Figure 4.7, with each the avatars shown next to their respective game controllers.



Figure 4.7. An example of the supporting visuals to assist with communication.

Beginning in the second week, these materials were augmented with the embedding of video footage of the students playing a game together, collected in the previous week's lesson. This served as a form of self and peer video review, where students were shown instances of them applying the desired skills, as well as opportunities where they could have applied these targeted skills. Video review was intended to be a significant instructional aid within this intervention. Additional examples of these materials are presented in the following chapter, alongside the results from each prototype of the intervention design. These materials evolved in response to the data generated in each lesson.

4.5.3 Design of **Stage B**: Cooperative gameplay and monitoring of skill performance 

The second stage of the lesson shown in Figure 4.5 involved the students playing a cooperative videogame, with regular breaks to evaluate and analyse both the skills that the students had been using and the skills the game mechanics required the players to use to work together. The playing of the games required a space where all of the participating students could view the screen but also one that was secure enough to leave the equipment set up for the following lesson. This is because the hardware used to capture the video of the virtual environment required extensive time to set up and configure, so the practicalities of limited time meant having everything ready to go when required. Fortunately, a vacant office was available to be transformed into the game playing space. This is represented in Figure 4.8.

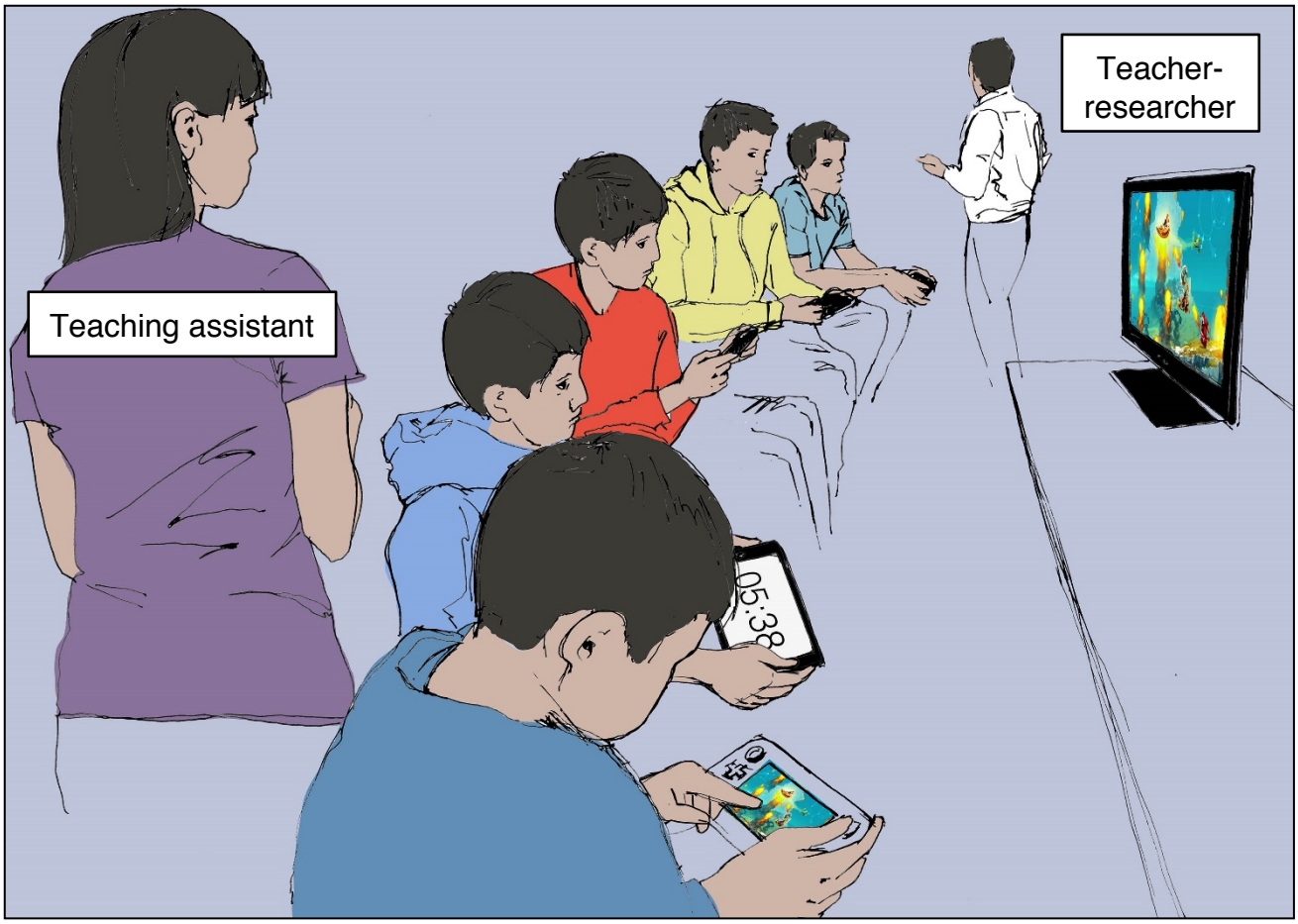


Figure 4.8. Cooperative gameplay and monitoring of skill performance.

Depending on the mechanics of the game, students were either encouraged or required to collaborate in order to progress and achieve a common goal. Using these games was intended to provide a space for the student participants to practice the application of these social skills, with the game design manufacturing situations to promote social interactions in both the physical and virtual worlds. This distinction between skill instruction using video review and the practice of skill performance through gameplay acknowledges the scepticism explored in *Chapter 3* regarding the instructional benefits of commercial games, particularly the contention that "commercial games are not designed to teach" (Van Eck, 2006, p. 7). Although numerous advocates challenge this contention (Gee, 2013; Prensky, 2006; Schrader & McCreery, 2008), for the purposes of this study, the game was conceptualised as a tool promoting opportunities for skill and behavioural application.

Stage B served as the central source of video data generation. All stages provided qualitative group dialogue data, but this stage was also coded for the frequency and duration of performance of the targeted social skills. During cooperative gameplay, the teacher-researcher collected informal notes of events of interest to the teaching staff or the students, which served as a form of indexing for the video review in **Stage A** (skill instruction) in the following lesson. The methods of data generation and analysis are further discussed later in this chapter.

4.5.4 Design of **Stage C**: Reflecting on the use of skills and the intervention design

The third and final stage of each lesson, as shown in Figure 4.5, involved the students reflecting upon their application and understanding of the targeted social skills in the context of the game they had just played. This is shown in Figure 4.9.



Figure 4.9. Reflecting on the use of the skills and the intervention design.

Stage C (group reflection) consisted of two key components: a teacher-led reflection on the skills that had been used and *not* used during the lesson; and a group interview focusing on the design of the intervention. It is important to note that this research project is more than a disembodied case study of an existing program. It sought to be responsive in incorporating the feedback and suggestions of the participants.

This active participant role provided an avenue for them to steer the direction of the intervention. This was vitally important in ensuring their voice was heard in each iteration of the intervention design. In order to afford student reflection, careful thought had to be given to using a physical space that minimalised distractions (e.g. from other screens and/or students) and provided the participants with the optimal conditions to engage with the conversation and have their voices heard. Modifications to optimise the methods used in the teacher-led reflection are discussed as part of the results in *Chapter 5*. The processes for eliciting participants' feedback on the design of the intervention and suggested adjustments for the following prototype, are also discussed in relation to generating interview data.

4.5.5 Overview of the gaming hardware & software

An objective of this study was to identify how two tools, cooperative videogames and video instruction, could be used together as part of an intervention design to assist the participants in developing the social skills required for effective collaboration. This section focuses on one of these tools, collaborative videogames, and examines the gaming hardware and software used in this study.

4.5.5.1 Gaming hardware - Nintendo Wii U

In this study, players used the Nintendo Wii U videogame console (as shown below in Figure 4.10). The Wii U offered a number of affordances to the students. This console allows up to

five players to play simultaneously on a shared screen, an option supported by many games designed for the system. It offers a range of input options, which was an important consideration for the students as some of them had under-developed fine motor skills. This included the touch screen-based Wii U Gamepad or a 'Wiimote' controller (Hollensen, 2013; Jalink et al., 2015).



Figure 4.10. Photo of the Nintendo Wii U console **(1)**, the Wii U Gamepad **(2)** and Wiimotes **(3)**.

The option of a touch-based controller, such as the Wii U Gamepad, removes a potential access barrier for students who find using analogue controller difficult. This gamepad screen can also display a different image from that of the main screen, allowing players to have an alternative perspective of the game. Finally, this screen can be used with a stylus, which can assist students in being more accurate with which part of the screen they make contact. Both the Wii U Gamepad and the Wiimotes provide 'force feedback' or 'rumble', providing players

with additional feedback in the form of physical vibrations. Depending on the software, this physical feedback can be used to notify the player when they have been hit by an enemy or that their actions have triggered an event in the level.

4.5.5.2 Collaborative videogames considered for this study

Design research uses the results from one prototype to inform the design of the following version of a prototype, with the selection of software being an important variable within the prototyping of this intervention. This highlights a tension between the methodology and the practical realities of conducting this research project. Design research requires flexibility in selecting the best tool to respond to any perceived deficiencies or limitations uncovered in the game used in the previous intervention. The Wii U has a software library consisting of a large number of games with local multiplayer modes (Plunkett, 2016). The practical reality is that videogames can be expensive and an ethics application was required before any data generation could commence. In order to minimise the costs and to provide the appropriate information for the ethics application, a shortlist of ten possible games was developed using the games already owned by the teacher-researcher.

A selection criteria was used to assess the suitability of these games for the participants in this study. Criteria included an appropriate age rating for the game by the Australian Classification Board (ACB), a collaborative mode of play for at least two simultaneous players, and support for multiple means of control input. A preference was given for 2D platform games, due to all of the students' familiarity with the conventions of this genre, and for games that were requested by the students. Table 4.2 provides an overview of the ten shortlisted games, including the genre and goals of each game, the number of simultaneous players possible at one time, and the distinguishing multiplayer design features.

Table 4.2. Overview of the ten shortlisted games considered for this intervention.

Game	Genre	Possible simultaneous players	Distinguishing multiplayer mechanics
Affordable Space Adventures (2015)	2D adventure	**3 players** (2 players using Wiimotes + 1 player on Wii U Gamepad)	• Up to three players control a single spaceship. • Each player controls a different system (steering, weapons or auxiliary functions).
Donkey Kong Country Tropical Freeze (2014)	2D platform	**2 players** (1 player on Wiimote + 1 player on Wii U Gamepad)	• Each player controls an independent avatar. • Characters can combine to perform special moves. • Both players are required to be close together to scroll the screen in a direction. • Players have independent health bars but share lives.
Guacamelee! (2013)	2D action	**2 players** (1 player on Wiimote + 1 player on Wii U Gamepad)	• Each player is an independent character. • Both players are required to be close together to scroll the screen in a direction. • Players have independent lives and scores.
Kirby and the Rainbow Paintbrush (2015)	2D platform	**4 players** (3 players on Wiimotes + 1 player on Wii U Gamepad)	• Player one *(Kirby)* must use the paintbrush function to move her/his character. • Player one *(Kirby)* can use the paintbrush function to draw platforms for other characters or protective walls. • If player one dies, the level restarts. • Players have independent health bars but share lives.
Minecraft (2015)	3D sandbox	**2 players** (1 player on Wiimote + 1 player on Wii U Gamepad)	• All players can create and remove objects by placing or removing blocks. • Characters can move throughout the world independently.

New Super Mario Bros. U (2012)	2D platform	**5 players** (4 players on Wiimotes + 1 player on Wii U Gamepad)	• All players control independent characters. • Player one (using the gamepad) can place blocks that the other players can use as platforms or can be used as protective walls.
Rayman Legends (2013)	2D platform	**5 players** (4 players on Wiimotes + 1 player on Wii U Gamepad)	• Player one controls *Murfy* using the Wii U touchscreen and takes on an assistant role by interacting with the game environment to help the other players. • This includes distracting enemies and activating difficult to reach switches. • This character *Murfy* is invulnerable and can move anywhere on the screen but must stay with the other players to progress through the levels.
Super Mario 3D World (2013)	3D platform	**4 players** (3 players on Wiimotes + 1 player on Wii U Gamepad)	• Each player can choose their avatar, with each character having a common move set but differing areas of strength within this. For example, Toad has the fastest movement speed but the shortest jump. • The player with the Wiimote is required to complete some special actions, such as blowing into the controller's microphone to activate a platform. • The camera follows the player at the front of the pack, placing players that fall behind into a bubble that carries back to the group.
Star Fox Zero (2016)	3D action/on-rail shooter	**2 players** (1 player on Wiimote + 1 player on Wii U Gamepad)	• Players share control of a spaceship, with one player steering the ship around the screen while the other controls the main weapons systems. • The player with the Wiimote looks through the small screen on the controller to aim their weapons turret. • The action moves at a forced speed with the general direction of the ship largely being controlled by the game, much like a virtual rollercoaster. This is referred to as being 'on-rails'.
Yoshi's Woolly World (2015)	2D platform	**2 players** (1 player on Wiimote + 1 player on Wii U Gamepad)	• This is a traditional 2D platform game where players independently control their character. • This game plays exactly the same with two players as it does with one player.

As the final selection of the games used in this intervention occurred through the processes of the design experiment stage, the iterative cycles of prototyping, trialling, modification and field study, and detailed descriptions of the games played by the students are provided in *Chapter 6* of this thesis. The games are presented as tools in the intervention and embedded within the ecology. As such, each game needs to be discussed in the context in which they were used by the players.

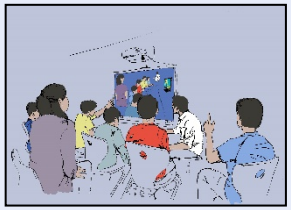
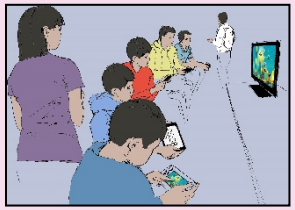
4.6 Methods of data generation and analysis

In order to be able to engage in the cycles of iterative design, careful consideration needed to be given to the methods of data generation and analysis that informed these modifications. Data was generated through two primary methods:

- **Method A**: Video observation
- **Method B**: Group and individual interviews with participants

Data was generated throughout the period of the design experiment, with each of the ten classes serving as a single intervention lesson. Using the three-stage structure previously explored, Table 4.3 shows the methods for data collection, and setting and analysis for each stage.

Table 4.3. Methods for data generation and analysis.

Point of data generation	Method for data generation	Method for analysis	Tools for data generation
Stage A: Skill instruction & video review 	• Video observation (Method A)	🔍 Inductive thematic coding of transcribed footage using computer assisted qualitative data analysis software	• Physical space: GoPro Hero Session • Virtual space (Interactive whiteboard): Voila screen capture software
Stage B: Cooperative gameplay & skill monitoring 	• Video observation (Method A)	🔍 Coding of instances of the performance of targeted skills in the physical environment; 🔍 instances of interaction in the virtual environments; and 🔍 instances of interaction between the students and the teaching staff	• Physical space: GoPro Hero Session • Virtual space (Game): HD Game Video Capture Recorder
Stage C: Reflections on skill performance & intervention design 	• Video observation (Method A) • Group semi-structured interviews (Method B)	🔍 Inductive thematic coding of transcribed footage	• Physical space: GoPro Hero Session
Post-lesson interviews with students and teaching assistants	• Individual semi-structured interviews (Method B)	🔍 Inductive thematic coding of transcribed footage	• Physical space: GoPro Hero Session

Of particular interest is the integral role that the data collected during each lesson played in informing the design of the subsequent version of the intervention. This was an actioning of the model of iterative intervention design as conceptualised in the *Compleat model*. Discussion and reflection in **Stage C,** at the conclusion of each lesson, informed the skills targeted and the instructional methods in **Stage A** for the following week, as represented in Table 4.3 by the red arrow. Careful consideration therefore needed to be given to the combination of methods for data generation, as each method held both affordances and challenges.

4.6.1 Method A: Generating video data

Video observation provides an ideal means for capturing a detailed record of the social skills and behaviours that students display when playing cooperative games, both in the real world and in the virtual environment. As a tool for data collection, video provides a specific incidence of interpersonal interaction (Clarke, 2011; Patton, 2005) and some sense of 'time' and 'place' (Miller & Bell, 2002). Further, Rebstein (2012) suggested that the use of video might enable a more nuanced analysis of social interactions. Video data of the students' interactions in the real world, and their actions in the game, allowed for the analysis of the relationship between the game and the player. Additionally, video data allowed for a comparison between the displayed knowledge of the skills and behaviours in this pre-play component of the lesson, and the students' ability to perform these skills in the gameplay. This data can assist in monitoring skill performance, as it "records and preserves" events and context (Patton, 2005, p. 4), and allows for an examination of the conditions in which these social interactions occur (Erickson, 2011; Heath, Hindmarsh, & Luff, 2010; Komarova & Martina, 2014).

Video also provides affordances to simultaneously capture and connect visual and verbal stimuli and interactions between participants at a level of depth that other methods of observation might not be able to offer (Heath et al., 2010; Thomas, 1998). The interpersonal interactions can be situated in the setting, or the environment, in which these interactions have taken place; this is possible because recorded footage allows for additional time to focus on the background events as well as the participants in the physical and virtual environments (Merriam, 1998). Given the emphasis upon the learning ecology within design research, this a valuable affordance. This is further enhanced by the ability to replay footage, increasing the detection of more subtle interactions between components of the ecology that can be missed in 'real-time' observation (Thomas, 1998).

The collection of video footage was complemented by a process of informal note-taking during the lessons, recording the time and description of events of interest during cooperative play. These notes were used to identify points of interest quickly, to review during the post-lesson reflections with the students and the interviews with the teaching assistants. They were also used for the subsequent group review of the previous week's gameplay footage. In order to address concerns about the changing of their behaviour as a result of the GoPro being present (Dowling & Brown, 2010; Miller & Bell, 2002), students were 'pretend filmed' before the intervention began for two lessons. Cameras and game recording were present during group gameplay, but this footage was discarded. The students were also given the opportunity during these lessons to familiarise themselves with the recording equipment, and were encouraged to ask questions.

4.6.2 Method A: Analysing video data from cooperative gameplay

The video data of the cooperative gameplay was analysed through the inductive development and application of a coding scheme as part of the design experiment phase. Yin (2011) suggested that inductive methods for coding data "lead to the emergence of concepts" (p. 94), as opposed to deductive methods that confine the analysis of data to predetermined categories. While both inductive and deductive methods had a role to play in this study, the identification of new concepts, represented during analysis by the creation of new codes, provided the most fruitful avenue for addressing the objectives of design research (McKenny & Reeves, 2012) and this research project.

Attempting to discuss these methods of data analysis in the design research process without touching upon the findings is challenging, as what is being analysed evolved based on the retrospective analysis of the previous cycle (Dolk et al., 2010). For example, as a result of the post-intervention analysis, new target skills were identified by the participants, which then became a focus of subsequent iterations of the intervention. As such, a brief overview of the process used to code the data and the tools of analysis is presented here. A more detailed analysis of the development of the coding scheme is presented in the context of the results of this research project in *Chapter 7*.

Utilising an established method (Strauss & Corbin, 1998; Yin, 2011), data was coded in three passes, or levels of analysis. The first and second passes of analysis occurred during the ten cycles of iterative design, with the third pass occurring in analysis subsequent to the data generation phases of this project.

4.6.2.1 First pass coding: Coding initial categories

An initial deductive coding scheme was developed by identifying the key types of interactions that needed to be analysed in order to address the research questions. Four broad categories of interactions were identified:

- Verbal or non-verbal interactions between the students in the physical environment.
- Interactions between the students' avatars in the virtual (game) environment.
- Verbal and non-verbal interactions between the students and the teaching staff.
- Instances where the game design required players to work together.

The application of these four codes constituted the first pass of data analysis, which allowed for the pinpointing of key events during each lesson of cooperative play.

4.6.2.2 Second pass coding: Developing subcategories

Whilst the initial deductive scheme assisted in finding these events, it did not aid in describing the nature of the interactions and the relationship between the players, game and the teaching staff. In order to address the research questions, further coding was necessary. During the second pass, specific indicative behaviours or game-level events within these interactions were inductively identified and they became the focus of the analysis. Instances of the indicative behaviours outlined for each of the target social skills were identified by observing interactions between students. When examining interactions between the students and the teaching staff, it was determined which party initiated the interaction, as well as any reference to the targeted social skills. Interactions within the game were further analysed for instances of student in-game assistance and communication, and whether the game design required these interactions to progress.

4.6.2.3 Third pass coding: Integrating and refining codes

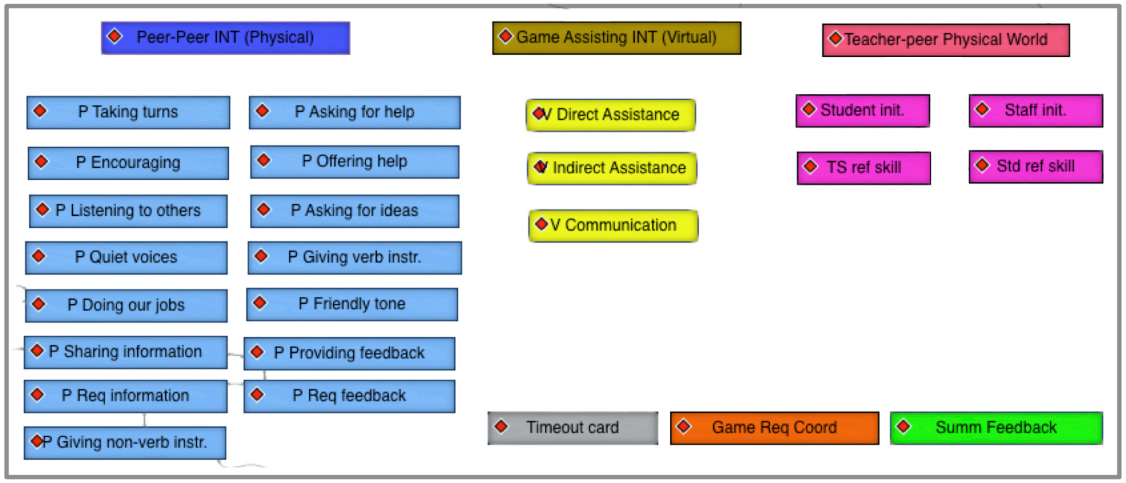
Other events of peer interaction that fell outside of this coding scheme were also identified. During the third pass, occurring after the completion of the ten lessons of data generation, these instances of non-coded interaction were analysed. Through this process, the scheme was modified both in terms of the definitions of the original targeted social skills, and the identification of previously unidentified social skills. This is discussed at length in the following chapter.

The coding of these three phases was facilitated through the use of Studiocode™, a software package specifically designed for the coding of video data (Clarke, Mitchell, & Bowman, 2009). This coding allowed for analysis of the frequency and duration of the different forms of interaction, as well as the mapping of the relationships between these interactions. An example of the Studiocode™ user interface, including the coding timeline, can be seen in Figure 4.11.

Footage of physical and game environments



Codes



Event timeline

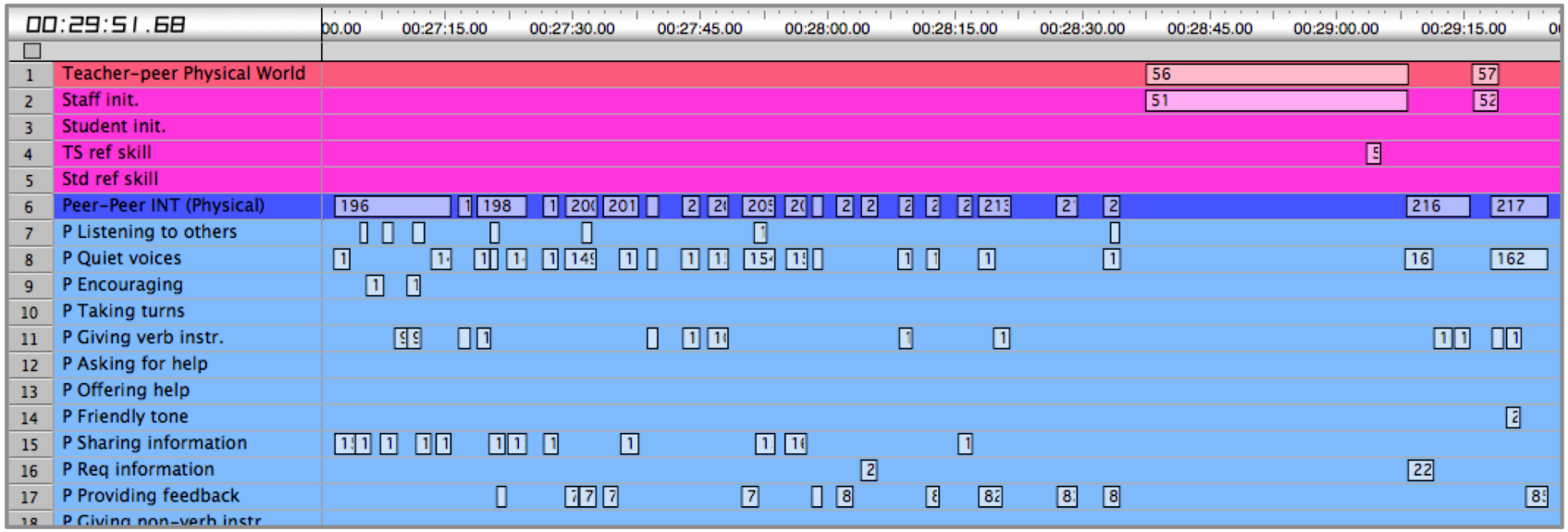


Figure 4.11. Layout of the Studiocode™ user interface.

Chapter 5 presents an overview of the indicative behaviours inductively developed and refined during this stage of analysis, while *Chapter 6* details the frequency of duration of these behaviours. The coding of this data provides one source of information, which can be verified with the information garnered through the post-lesson interviews with the students and teaching assistant.

4.6.3 Method B: Generating individual and group interview data

When describing participatory methodologies, both Yin (2009; 2013), and Dowling and Brown (2010), emphasised the need for multiple sources of evidence when conducting small-scale research, such as in this study. Video data served as the primary source for analysis of the interactions within the cooperative play, while interview data provided both texture to this analysis and an avenue for participant voices to be included in the design process. This is shown in Table 4.4.

Table 4.4. Timing of the participant interviews.

		Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6	Lesson 7	Lesson 8	Lesson 9	Lesson 10
Students	Group interview	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Individual interviews										✓
Teaching assistants	Individual interviews	✓				✓					✓

Group interviews were formally conducted with the student participants during the intervention design, as part of the reflection in **Stage C**, but also less formally during the video

review in **Stage A**. The way this second category of interviews evolved incidentally is described in detail below. Individual interviews were also conducted with the teaching assistant participants at key points during the development of the intervention, and with all participants at the conclusion of the ten lessons. Ideally, individual interviews with both the teaching assistants and the students would occur at the conclusion of every lesson, but this, unfortunately, was not possible due to the structure of the school day and the time allocated for their Digital Technologies classes. This is discussed further later in the thesis with reference to the limitations of this study.

All interviews were semi-structured to ensure that certain themes, such as understandings of the targeted social skills, were discussed while also being flexible enough to allow the discussion to move in new directions (refer to Appendix D for a sample protocol). Students were always allowed to deviate from these themes and introduce their own topics, as their feedback and ideas for future directions served as an important point of data in shaping the intervention design.

Group interviews with the students, or focus groups, were conducted in the post-play group reflection in **Stage C**. The GoPro Session 4 camera was used to video record the physical environment during these discussions. These semi-structured group interviews explored the students' perceptions of the just completed lesson. This included their understandings of the desired skills and behaviours, whether they thought that other students and themselves successfully applied these skills and behaviours while playing the game, and their perceptions of the challenges and barriers in applying these skills when playing with their classmates. As reported in the following chapter, these insights proved crucial in shaping the direction of the intervention design.

A less structured form of group discussion emerged in **Stage A**. Although the video review was originally conceived as a teaching tool, it also provided an opportunity for students to share their interpretations of events and interactions. Originally introduced in response to research citing the unreliability of children self-reporting (Whitebread et al., 2009), the use of a video record was designed to help students recall the events of the previous week and for the teacher-researcher to highlight key events for co-analysis and group discussion. At times, students requested, and were granted, control of the video playback of the previous lesson, allowing students without the vocabulary to verbally describe phenomena to draw attention to certain events or interactions for discussion. This was pivotal in both checking their understanding of the targeted skills and also reframing the teacher-researcher's own thinking in the design of the intervention. This is another important source of data and is discussed in the results chapters of this thesis.

Semi-structured individual interviews were also conducted with participants at key points during the development of the interview. Thematic guides for interviewing were developed for conducting individual interviews with the teaching assistants during the design process (Appendix B) and at the conclusion of the project (Appendix C). Likewise, a thematic guide was developed for interviewing the individual students at the end of the ten lessons (see Appendix D). Visuals on the interactive whiteboard were also developed to support the students with their individual interviews, as some of the participants required visual cues to assist with understanding what they were being asked and to support the communication of their responses. An example of these supports can be found in Appendix E.

Utilising the professional knowledge of the teaching assistants allowed for important contextualisation in exploring the observed interactions between the students; the relationships between these students continued to evolve when the camera was switched off

between lessons. A number of post-lesson interviews were conducted with the teaching assistants to explore their understandings and observations from the lesson, and to draw on their broad wealth of experience working with these children in this context. When analysing participants with disabilities, it can be easy to generalise all observed behaviours as being a result of the manifestation of autism or Down syndrome (APA, 2013; Wing et al., 2011). Other factors within the learning ecology, such as the cultural norms of the home environment, can have a significant impact upon the behaviour of children (White, Oswald, Ollendick, & Scahill, 2009). The teaching assistants' familiarity with the students helped in providing an additional opinion on the extent to which the observed behaviours were primarily manifestations of the disability, as opposed to the influences of ecological conditioning (Clifford, Young, & Williamson, 2007).

4.6.4 Method B: Analysing interview data

The participatory nature of design research provides particularly powerful benefits in the analysis of data. As co-participants, the students, teaching assistants and the teacher-researcher were able to review the video footage collected from the lesson the following week and clarify their perceptions of events. This, in turn, generated the rich interview data described in the previous section of this chapter, which complemented the data generated through the video analysis. Once again, this analysis used the method for code development suggested by Yin (2011), and Strauss and Corbin (1998). The analysis of the interview data was completed in two passes, or levels:

- The first pass inductive generation of initial categories during the ten weeks of the intervention design.

- The second pass generation and refinement of subcategories following the completion of the data generation.

4.6.4.1 First pass coding: Generating initial categories for the interview data

In order to analyse this data before the next iteration of the intervention, the following steps were taken each week after the completion of a lesson:

1. The video data of all three stages was transcribed and included notes on non-verbal gestures.
2. The transcriptions were checked against the video record a second time, providing a validation check of the transcribed data.
3. If there was any audio data of the individual interviews with the teaching assistants, these were transcribed.
4. All transcriptions were scrubbed of references to each other by name or identifying features of other participants or themselves. Pseudonyms replaced the original names.
5. The transcripts for **Stage A** (skill instruction), **Stage C** (group reflection) and the individual interviews were imported into NVivo analysis software, where key phrases and themes where identified through inductive coding. This involved common themes being identified and sections of dialogue being tagged with one of these themes.
6. This process also allowed for the calculation of speaking time, although due to the non-verbal preferences of several students, this was not an entirely accurate measure of student 'communication time'.

NVivo provided an analytical means to reflect upon how the students engaged within the three stages of the intervention. It also allowed for calculating the percentage of dialogue

dedicated to discussing components of the intervention, such as the targeted social skills, the design and features of the game, and the students' feelings about various supports put in place. While the data generated through the video analysis in Studiocode™ provided a strong record of the interactions and events, interview data provided a strong record of student perceptions and opinions on these interactions and events.

4.6.4.2 Second pass coding: Generating and refining subcategories

The limited timeframe for conducting the ten lessons of data generation necessitated an initial preliminary coding of the interview data. While useful in the retrospective analysis of each iteration, a more detailed second pass coding of the data was possible once the sense of urgency had been removed. This additional coding allowed for the identification of new subcategories, which were then used to recode the original transcripts. The final categories and subcategories used in the coding of the interview data are provided below in Table 4.5.

Table 4.5. Categories and subcategories inductively identified through first and second pass coding of the interview data.

	Category: Purpose descriptors	**Category: Design of intervention**	**Category: Gaming**
Subcategories	Subcategory: Skills 🔍 Reference to **application of skill** 🔍 **Checking understanding** of skills 🔍 Defining **terminology** of skill 🔍 Setting an **individual skill goal** 🔍 Referring to past **skill goals** Subcategory: Events 🔍 Reference to an **event** in the **physical environment** 🔍 Reference to a **person** during an **event**	Subcategory: Designing 🔍 **Positive feedback** on design **component** 🔍 **Negative feedback** on design **component** 🔍 Suggesting an **alteration** 🔍 **Questioning** a design **component**	Subcategory: Referencing specific games 🔍 Rayman Legends 🔍 Kirby and the Rainbow Curse 🔍 Super Mario 3D World 🔍 Starfox Zero Subcategory: Gameplay 🔍 Establishing team **rules** or **systems** 🔍 Commenting on a **player's skill** at a game 🔍 Referring to a **game goal** 🔍 Referring to an **event** in the **virtual environment** 🔍 Referring to a **future event** 🔍 Setting **team** game **goals** 🔍 Reference to **strategies** to accomplish a goal

At this stage, the individual interview data was reduced by condensing down the full-length interviews. This was completed by retaining key quotes and text that directly represented expressions of the focus themes, while summarising the extraneous dialogue. These key quotes and text are vitally important in adding context to the analytical data provided through the analysis of the interactions.

4.7 Ethical considerations

Conducting research with vulnerable populations involves complex ethical considerations, particularly with students with whom a researcher has a professional relationship. This section of the chapter explores these issues and, where possible, explains how ethical dilemmas were resolved so as to mitigate any disadvantageous effects upon the participants in this study.

4.7.1 Researching the teacher-researcher's own students with disabilities and dependency issues

While researching students who one works with in a professional capacity can be ethically complex, it is important for a number of reasons. First, at the forefront of all educational research is a consideration for the welfare of the students (National Health and Medical Research Council [NHMRC], 2018). The literature review presented in *Chapter 2* brought to attention that a defining diagnostic characteristic of autism is that children exhibit some form of "restricted, repetitive patterns of behaviour" (APA, 2013). This is important because often this manifests itself in an insistence on "sameness" and an "adherence to routines" (APA, 2013). As such, having dualistic identities as both a familiar teacher and a researcher is not

just beneficial, but essential in creating a research environment conducive to the emotional wellbeing of the students.

This established relationship was particularly important in the minimising of anxiety and distress. The existing Digital Technologies classes were continued, with the established teaching staff still present (White et al., 2009). As highlighted in the literature review, it is commonly recognised that children with autism score higher on measures of anxiety compared to children with specific learning impairments, and children who have been identified as neurotypical (Gillott, Furniss, & Walter, 2001). The teacher-researcher established a strong rapport with his students and held valuable insights into potential situations and personal contexts that might cause distress to the students. If this research was conducted with unfamiliar participants in another setting, foreseeably this could be highly distressing for some of the students.

In his role as a teacher, the teacher-researcher was aware of:

- Potential triggers that could increase anxiety or provoke discomfort in individual students.
- Issues surrounding the effects of medication upon individual students, and any changes to their medication schedule. This insight was garnered through consultations with the students' classroom teachers, families and school support staff.
- The students' preferred modes of communication, and a knowledge of their verbal and non-verbal indicators of distress.
- A comprehensive knowledge of the students' circumscribed interests. Despite popular misconceptions, these evolve and change over time, and can be important in motivating and engaging with this population (Klin et al., 2007).

- The existence of comorbidities in some of the student participants. Mattila et al. (2010) suggest that behavioural disorders, anxiety disorders and tic disorders are the most common comorbid psychiatric disorders for children with autism. Additional diseases or disorders co-occurring alongside autism or Down syndrome have important implications for a wide variety of factors in this research, including issues around the control schemes used for the games, the attention spans of the students and the need for accessible toilets.

This professional knowledge was important in the protection of these children, and the teacher-researcher's fiduciary duty always superseded his role as a researcher. This meant that if in the event that the students were in distress or discomfort, the research would have been halted immediately. This did not occur. It was also explicitly explained to the students at the start of every lesson that they could request a break at any point throughout the data collection process by using the 'break card', as shown in Figure 4.12. This card is commonly used in Hyrule School, so the students were very familiar with using this device to request a stop to an activity. At this point, the research would have been halted, although it was never required.



Figure 4.12. The break card, as used throughout Hyrule School.

In addition to the break card, a full distress protocol was developed in partnership with the classroom teacher, the teaching assistants and the school's speech pathologist. This protocol can be seen in Appendix F, but like the break card, it was never required.

4.7.2 Obtaining participant consent in disproportionate power relationships

Obtaining informed assent from children with disabilities is particularly challenging due to their "unique qualities in regard to their developmental competencies and capacity" (Mudaly & Goddard, 2006, p. 46), their reduced social power and legal status, which both protects and limits their rights as participants, and their capacity to comprehend the research process (Miller & Bell, 2002; Mudaly, 2015; Mudaly & Goddard, 2006). As their classroom teacher, there is an added dimension of disproportionate power between teacher and student. This study instigated a number of measures to ensure that participation was both informed and voluntary as outlined below.

4.7.2.1 Student participants and legal guardians

As the student participants were below the legal age for consent, initial permission was sought from their parents through contact via the classroom teacher. The school has an established research policy that emphasises the right of parents to decide on their child's participation without any feelings of obligation or inducement to agree. A 'plain language' statement was provided detailing the nature of the project, including what the researchers were doing, the data that would be collected, the methods of collecting this data and the steps that would be taken to protect their privacy and welfare. The legal guardians had to provide written permission before the potential participants were approached by the classroom teacher.

In the cases where permission had been given, assent was then sought from the children. This was obtained using a specifically adapted plain language script that was read to the students by the classroom teacher, without the teacher-researcher's presence (see Appendix G). Student participants were given the opportunity to ask questions, examine the recording equipment and express any concerns. In order for students to participate in this research, written assent was obtained. Supplemental visuals helped explain the research project and were developed in conjunction with the school's speech pathologist.

The project was approved by the Victorian Department of Education and Training (DET) and the University of Melbourne Human Research Ethics Committee (HREC). Written permission was also sought from legal guardians and the school's principal. As some of the students had difficulties with written communication, visuals were provided alongside written text to ensure that there was a common understanding of meaning around the nature of the research.

4.7.2.2 Teaching assistants

The teacher-researcher was aware of the pressure that the teaching assistants might have felt to agree to being part of this study. In response to such potential reactions, a number of steps were taken to ensure that they could make an informed and free decision with which they felt comfortable:

- The teaching assistant was approached to participate by the regular classroom teacher, as opposed to anyone from the school administration or the teacher-researcher. This is because they work regularly with this classroom teacher and foreseeably would have a more comfortable relationship with them.
- Consent was also sought from the teaching assistants through a plain language consent form that clearly detailed the boundaries of their involvement in the study, the

measures in place to protect their anonymity, and an overview of their rights as a participant.

It was emphasised that participation was completely optional, and that they would be in no way personally or professionally disadvantaged by deciding not to join this study.

4.7.3 Ensuring the welfare of non-participants

It was important to ensure that the three students who did not participate in this study were not disadvantaged. These students still continued to participate in the ICT classes, as this is part of their regular school program, but they attended a lesson that was not recorded as part of the study. These three students did not participate due to the advice of their classroom teacher in consultation with the students' guardians. They agreed that the students were not developmentally ready to engage in the activities involved in this research, and so they continued to receive instruction appropriate to their developmental levels.

4.7.4 Protection of privacy

The participants' anonymity is of the upmost importance. Efforts were made to ensure that data was 'non-identifiable' at the point of collection, as opposed to retrospectively 'de-identified' in the analysis process. Both the Australian National Data Service (2015) and the National Health and Medical Research Council (2018) suggest that by minimising the collection of identifiable data as much as possible, the risk of re-identification is reduced. While there are some arguments for participant agency through the selection of their own pseudonyms (Barker & Weller, 2003), due to the vulnerability of the population, these were allocated by the teacher-researcher to avoid re-identification. The portability of digital data raises questions about the ethical safeguarding of the raw video data. Issues surrounding access to the recorded footage, the consensual sharing of footage, and the safe destruction

of unused or unauthorised footage, are all paramount considerations (Derry et al., 2010; Murthy, 2008; Shrum, Duque, & Brown, 2005). While the risk of privacy violations can never be fully mitigated, utilising the University of Melbourne's facilities to code the data offered protection to both participants and researchers, as there are strict ethical policies and accountability procedures in place (Melbourne Graduate School of Education Human Ethics Advisory Group [MGSE HEAG], 2016). Video data was stored on two encrypted hard drives, which were stored in two separate secured locations. The teacher-researcher and his doctoral supervisors were the only people with the passwords to access these drives.

4.7.5 Ensuring validity, reliability and trustworthiness of data

It was important to ensure the validity, reliability and trustworthiness of the data was maintained throughout the coding process to mitigate the risk of biases compromising the integrity of the data analysis (Elo, Kääriäinen, Kanste, Pölkki, Utriainen & Kyngäs, 2014; Huberman, Miles & Saldana, 2014; Rothman, 2007). *Validity* can be understood as "ensuring data represent the concepts of interest" (Rothman, 2007, p. 437). In this study, the validity of the coded behaviours in the physical and virtual environments was proactively ensured through the establishment of well-defined, directly observable 'indicative behaviours' (Griffin, 2018). As this research project uses a design research methodology, the development of the indicative behaviours is reported within the results. These definitions were developed using the reviewed literature in conjunction with the professional expertise of the school's teaching staff and the speech pathologist. Through this process the actions that constituted the performance and boundaries of each skill were clearly defined as to allow for a consistent coding of the data.

Developed alongside these carefully defined indicative behaviours were a set of examples and non-examples which provided clear illustrations of what constituted the performance of each indicative behaviour. Such examples helped to ensure the *reliability* of analysis, or the extent to which analysis is "consistent across cases and time" (Rothman, 2007, p. 437). Clear examples and non-examples were also important to ensure the *trustworthiness* of the analysis, or the degree that research findings are "worth paying attention to" (Lincoln & Guba, 1985, p. 290). Elo et al. (2014) argue that key to findings being established as trustworthy is the accurate reporting of the analysis process, particularly in cases such as this study which utilise inductive coding. In order for the coding process to be both consistent and transparent the indicative behaviours, examples and non-examples required testing by a secondary coder.

Important to both the reliability and trustworthiness of analysis was having one of the teacher-researcher's doctoral supervisors conduct a blind coding of sample data. Any discrepancies between the primary and secondary coder were identified and resolved through iterative refinements to the indicative behaviours, examples and non-examples. This helped to ensure that the targeted behaviours had been defined in such a way as to avoid ambiguity in the application of the coding scheme. While biases can never be fully mitigated (Huberman, Miles & Saldana, 2014), these measures served as safeguards for ensuring that the findings emerging from the data analysis were as valid, reliable and trustworthy as possible.

4.8 Chapter conclusions

Using the *Compleat model* of design research (Middleton et al., 2008) as a guiding framework, this study implemented ten iterative versions of the social skills intervention in order to develop a prototype of scaled testing. This thesis now presents the results of this

process. *Chapter 5* explores the modifications that were made as a result of this iterative process, while *Chapter 6* analyses the social interactions and skill performance during **Stage B** (cooperative play) that, alongside the participant interviews, informed these changes.

Chapter 5: Results A – Modifications to the focus skills, methods of instruction and game design

5.1 Introduction and structure

Chapter 5 is the first of two results chapters for this research. A feasibility study was conducted to determine the utility of the initial intervention design. This chapter details the results of this **feasibility study** and the significant modifications made through the **design experiment process**, using the framework provided by the *Compleat model* as a guide (refer to Figure 5.1).

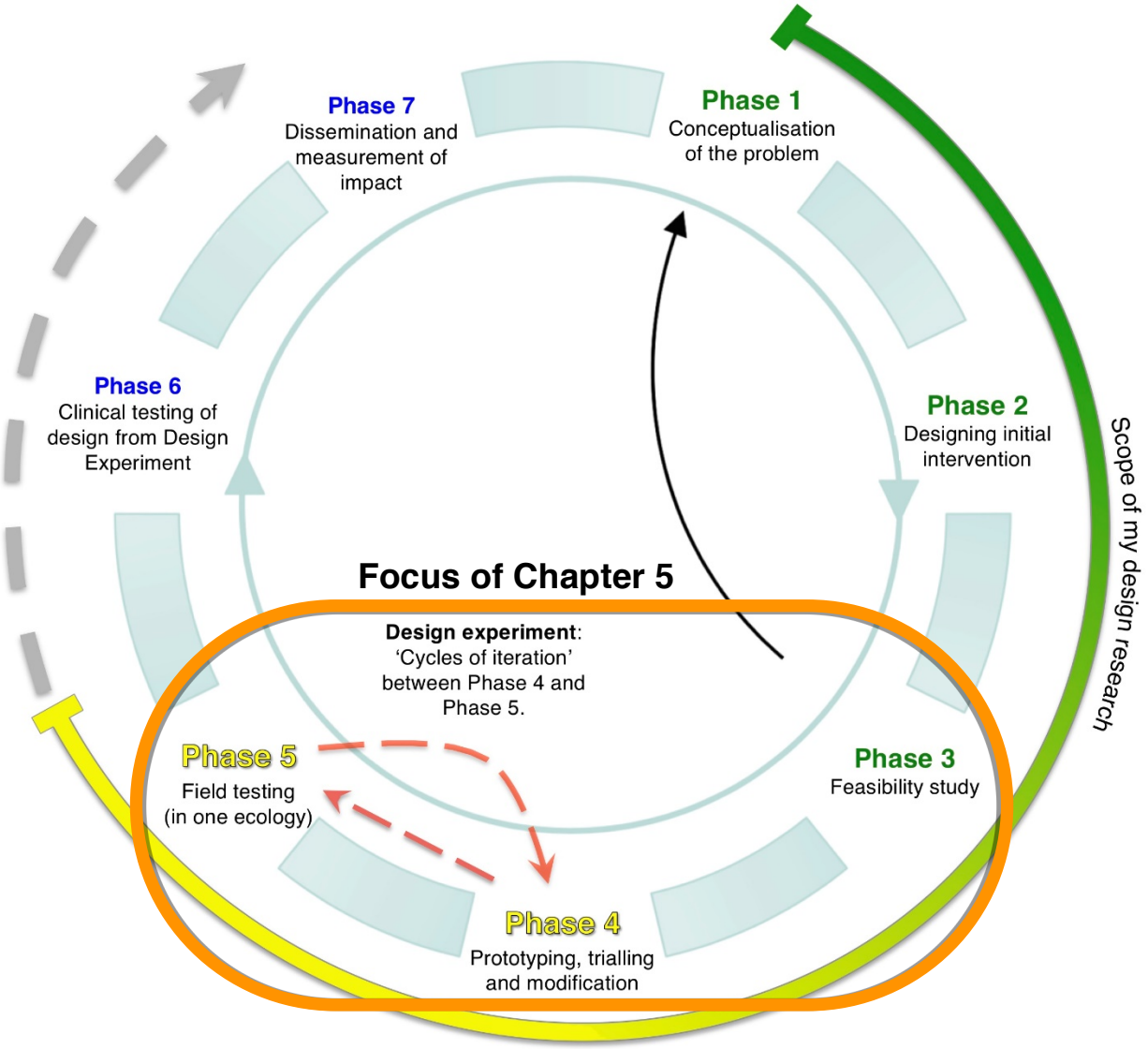


Figure 5.1. Chapter 5 examines Phases 3 to 5 of the *Compleat model*. Adapted from Middleton et al. (2008).

Following the feasibility study, ten iterations of the intervention were planned, implemented and evaluated, represented by Phases 4 and 5 in Figure 5.1. Since discussing every design modification and ecological change would be impractical due to the scope of this project, this chapter focuses on modifications to the three controllable components of design that are most central to the research questions. These are 1) the evolution of the targeted social skills themselves; 2) the modifications to the way these skills were taught; and 3) the effect of the design of the four games upon the students' application of the targeted skills.

5.2 *Compleat* Phase 3: Feasibility study

The purpose of the feasibility study was twofold: it was a safeguard for the participants, ensuring that the intrusion of conducting a full design experiment was justified, and it provided an intervention prototype for the design experiment process. The feasibility study utilised the following three-stage format of skill instruction, cooperative play and group reflection, as represented in Figure 5.2.

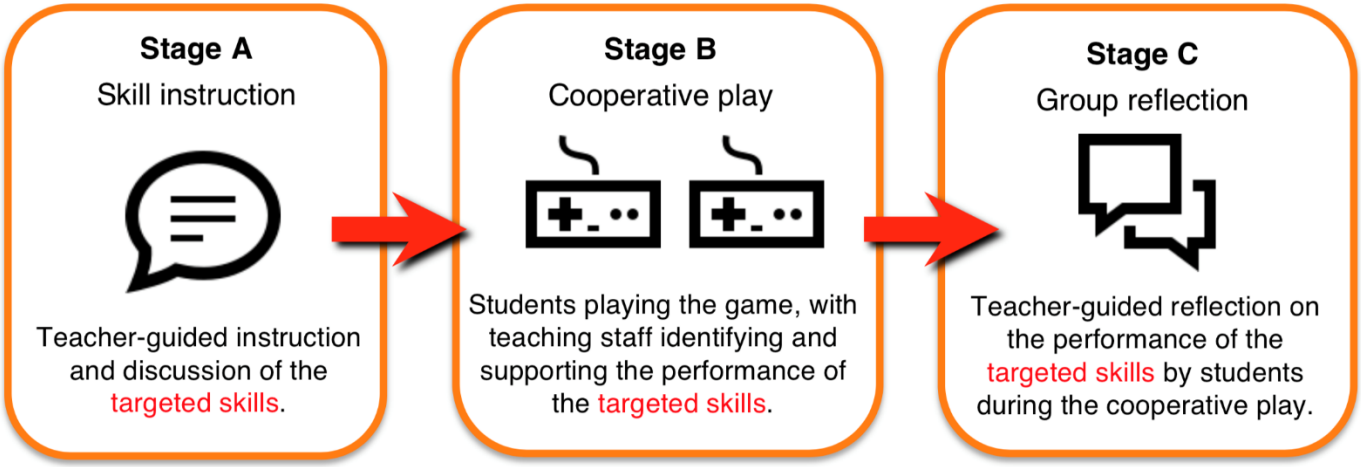


Figure 5.2. The structure utilised for the feasibility study.

5.2.1 Implementation and analysis

This feasibility study involved two students, Falcon and Link, as the other students were unavailable for this lesson. Visual icons identifying the social skills, 'taking turns' and 'listening to others', were shown to the students. The use of these two skills was suggested by the teaching assistants. Although the students found it difficult to define the skills, both provided appropriate examples of when they should perform these skills. Game footage of three adults playing *New Super Mario Bros. U* (Nintendo, 2012) was then shown on the interactive whiteboard, with the students asked to identify instances of the players performing these two skills. Following this discussion, the two students played the first three levels of *New Super Mario Bros. U*, a cooperative 2D platform game (as shown in Figure 5.3) that they had both played before. This game closely adheres to the genre conventions with which these students were very familiar.



Figure 5.3. New Super Mario Bros. U (Nintendo, 2012).

Following the gameplay, a post-lesson interview with the students was conducted to elicit their perceptions of their performance of 'taking turns' and 'listening to others' during play, other social skills used, the design features of their favourite videogames and their interest in further participating in this research project.

The video data generated during the lesson as part of the feasibility study was analysed using a trial coding scheme in Studiocode™, examining the frequency of social interactions between the students in the physical and virtual environments during gameplay. Results are shown below in Table 5.1.

Table 5.1. Frequency of interactions in the physical and virtual environments.

Type of interaction	**Instance count** (Mean duration of instance)	**% of total time playing** (total time = 4m 41s)
Interactions in physical environment	48 instances (3.16s)	53.92%
Interactions in virtual (game) environment	26 instances (2.95s)	27.25%

Analysis of this data shows that the students were interacting more than half the total time spent playing together in the physical environment, although the average mean duration of each coded instance was relatively short. The students were observed interacting within the game around a quarter of the play time. These physical and virtual interactions suggest that playing the game created conditions for social interaction, but these interactions were simple in nature. Given the profile of the learners, this was the expected baseline result.

5.2.2 Findings from the feasibility study

A number of indicators supported proceeding with the design experiment:

- **Participation in the intervention**: That the students were communicating about a common goal demonstrated that the structure of the intervention created the necessary conditions for social interaction. The *Collaborative problem-solving empirical progressions* conceptualise 'participation in the task' as a prerequisite to the application of other social skills in collaborative tasks, which aligns with the teacher-researcher's professional experiences.
- **Reported increases in social interaction**: The teaching staff observed an increase in interactions between the students in the physical environment while playing the game. While these observations were anecdotal in nature, the coded timeline shown below in Figure 5.4 shows sustained interactions between the two participants. This demonstrated that the intervention could provide the stimulus for students working together towards a shared goal.

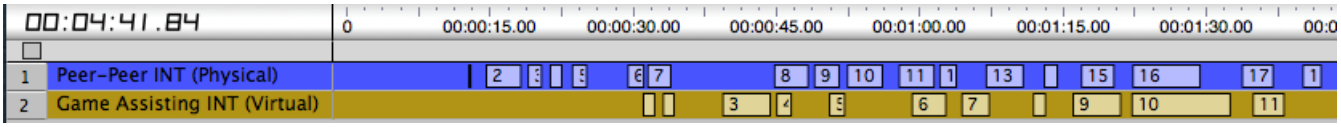


Figure 5.4. Timeline showing a representative sample of coded interactions in the physical and virtual environments during cooperative play.

- **A workable structure**: The feasibility study showed that the three-stage structure (skill instruction, cooperative play, group reflection) provided a practical system that allowed sufficient time for each of the components of the intervention. The teaching assistant Tetra noted that this structure was similar to Hyrule School's cooking class,

which provided the students with a point of reference and a sense of predictability within the intervention.

- **Opportunities for eliciting student voice**: Students' engagement with the task further supported the continuation of this study, as it provided a potential avenue for affording participant voice in the design of an intervention. This was highlighted by the students' enthusiasm in providing feedback on the intervention design during the group reflection, although this was also clearly driven by their desire to play more games.

Falcon:	I liked playing Mario, but [*I*] need more time.

Link:	Yes I want to play different games. Can we play [Nintendo] *Switch*?

It also became apparent that the students did not understand some of the vocabulary central to this study, and that explicit teaching of specific terminology would need to be an important part of any intervention:

Link:	I don't know. I don't remember the meaning of goal.

Data generated through the post-play discussions and the coding of the video of the gameplay indicated that the intervention demonstrated sufficient potential to justify proceeding to next stage of the *Compleat model*. This early analysis also provided the form and function of the initial version of the social skills intervention, which was then systematically developed through the design experiment processes.

5.3 *Compleat* Phases 4 and 5: Cycles of prototyping, trialling and modifying multiple interventions

Following the successful feasibility study, the design experiment stage of the research project commenced. This consisted of ten cycles of iterative design, trialling, and modification across ten lessons. Middleton et al. (2008), and Cobb et al. (2003), suggested selecting components of the design that are of particular interest, and analysing the relationships between these components and the outcomes, while being explicit in acknowledging the constraints of such an approach. In other words, any correlation between skill development and particular components of the intervention design needs to be presented as hypothetical localised theory and cannot be conflated with presenting evidence of a causal relationship. This approach aligns well with the scope of this study, as the role of the ecological variables outside of these areas of focus should become apparent in further clinical trials of the intervention. The following sections narrow the focus to exploring the cycles of iteration in relation to the **types of skills being taught**, the **methods of instruction** used for developing these skills, and the **role of the game design**. These are shown in Figure 5.5.

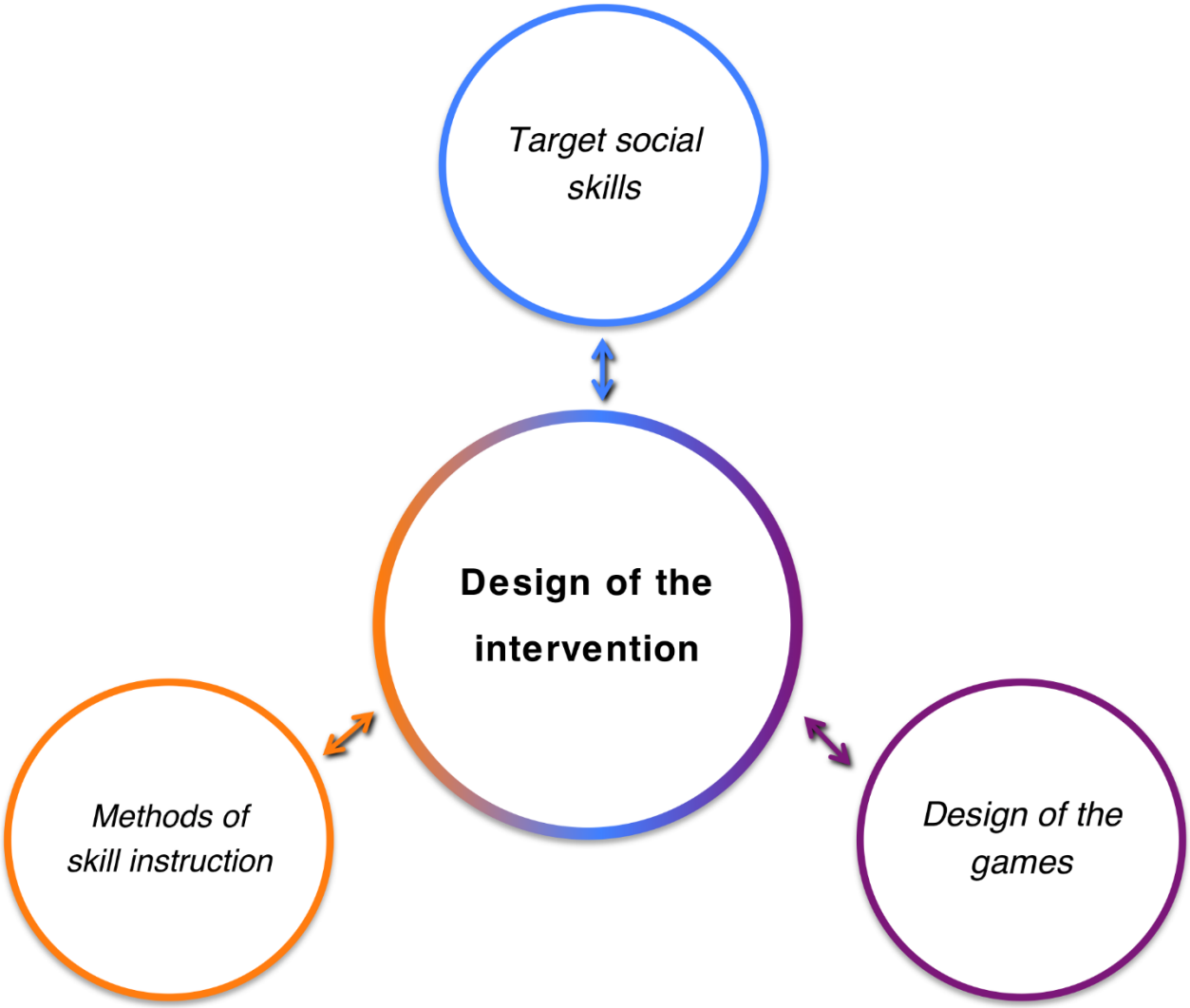


Figure 5.5. The three focus components of the intervention design.

These three components were iteratively developed over the course of the ten individual lessons of the design experiment. Modifications were made in response to the analysis of data generated from the previous versions of the intervention. These decisions were made as a result of:

- Coding and analysis of the dialogue in **Stage A** (skill instruction) and participant interview data (during **Stage C** – group reflection and post-lesson interviews), and identifying instances showing understanding or misunderstanding of the nature of the social skills and the contexts in which they should be performed.

- Coding and analysis of the participant interview data (during **Stage C** – group reflection and post-lesson interviews), identifying suggestions for improvements to the intervention design.
- Coding and analysis of the video data of each instance of social interaction in the physical or virtual environment during gameplay, identifying performance of the targeted social skills (**Stage B** – cooperative play).
- Subsequent analysis of specific events showing a higher frequency and duration of performance of the targeted social skills during gameplay, identifying the contexts in which these events occurred (**Stage B** – cooperative play). This included examining the interactions with the teaching staff and the game design during these events.

Some changes were made to variances in the learning ecology, such as unplanned student or staff absences. This chapter focuses on the modifications themselves, while *Chapter 6* explores the coded video data and the specific events of interest that partially informed these modifications.

5.3.1 A system for naming each iteration of the intervention

It is important to introduce a system for naming each iteration of the intervention when discussing the modifications from cycle to cycle. The versioning conventions of software engineering offer a system for progressively numbering each iteration of the intervention, which is often referred to as 'semantic versioning' (Preston-Werner, 2009). Software in the initial testing phase, or 'alpha version', typically begins at Version 0.1. Each new version incrementally increases by 0.1, working towards a public testing version, or 'beta version', at Version 1.0 (Preston-Werner, 2009). The adoption of this convention serves dual purposes in this chapter, as it both allows the reader to instantly recognise the number of iterations

informing the design of a particular version, and also provides for easy identification when discussing two different prototypes. The beta version of this intervention is then used as the basis for testing for Phase 6 in the *Compleat model* of design research. The term 'lesson' is still used to refer to a particular point of time, such as Lesson 6 being the sixth week of the data generation, in which Version 0.6 of the intervention was implemented.

5.4 Developing the focus social skills: Modifications to the focus skills being taught

The major purpose of this intervention was to assist the participants in developing an understanding of collaborative social skills, and to recognise when and how to apply them in one specific context. Participants needed to know what was meant by each of the focus skills, why it was important to use these skills, what each skill looked like when performed, and when they should use it.

5.4.1 Transporting the initial five focus skills

The language and meaning of the initial five focus social skills had been taught in the context of shared tasks, such as cooking or group discussions. In Version 0.1 the two focus skills from the feasibility study, 'taking turns' and 'listening to others', were used alongside 'encouraging', 'quiet voices' and 'doing our jobs'. It is important to note that although the students each had some understanding, the classroom teacher stated that they still found it challenging to consistently perform these skills and that these skills were within the ZPD (Vygotsky, 1978) for all five students. The school's speech pathologist developed the terminology used to label these skills, the definitions and the supporting visuals. These were

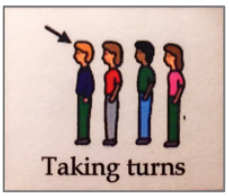
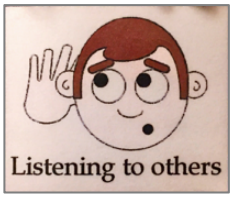
then refined in conjunction with the teaching assistant, the classroom teacher and the teacher-researcher prior to Version 0.1.

Alongside the definitions used to explain the skills to the student participants were a series of indicative behaviours. Building on Griffin's (2018) forms of directly observable evidence, the teacher-researcher rephrased the definitions as things that students 'do, say, make or write', indicating that they are performing each respective skill. These indicative behaviours reflected how the teaching assistant and the teacher-researcher envisioned the performance of these skills during cooperative play. Clearly defined skills were critical for this study, as shown below in the literal understanding of Pit of 'taking turns' as meaning waiting a specific amount of time.

Teacher:	What does that mean?
Pit:	Taking turns?
Teacher:	What does taking turns mean?
Pit:	If you wait 20 minutes and after that you change and now you pause it, change turn, and you do it 20 minutes again.

It was evident that the definitions still required further clarification and contextualisation for the students, which is why the methods of instruction proved to be so critical in the teaching of these skills. The initial five skills are displayed below in Table 5.2, alongside the definitions for explaining each skill and the indicative behaviours that were used to identify instances of the application of each respective skill.

Table 5.2. Initial five social skills used in prototype Version 0.1.

		Skill definition (for explaining skill to students):	**Indicative behaviour** (for coding instance of skill application):
Skill 1		➢ "Making sure that everyone has a fair turn." "Waiting for your turn to play the game." "Telling your friends that they can choose where to go in the game."	Voluntarily verbally or physically offering to relinquish control to another player. Verbally communicating that other players can make a decision.
Skill 2		➢ "Thinking about what someone else has said." "Waiting for someone else to finish talking before you talk." "Letting the other person know you have heard them."	Verbally or physically acknowledging that the student heard their peer. Changing actions in the game to comply with their peers.
Skill 3		➢ "Help everyone to feel good about themselves." "If they are playing well, tell them they are doing well." "If they are not playing well, tell them to keep trying."	Making a positive comment about the performance of a player. Verbally reassuring a player when they make a mistake.
Skill 4		➢ "Use a volume of voice so that everyone can hear, but also does not hurt anyone's ears." "If someone is making you feel upset, use the timeout card to pause the game."	Student is using a volume that allows other students to be heard.
Skill 5		➢ "Trying your best to help your team finish the game." "Think about how you can work towards the team goal."	Playing the game while attempting to accomplish the team goal.

Icon key: ➢ Definition (for students) "Example (for students) Indicative behaviour

5.4.2 Addition of a further five focus social skills

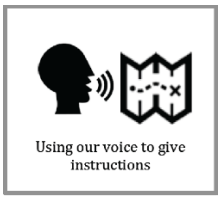
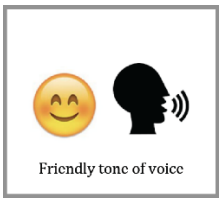
During the field testing of prototype Version 0.1 it became apparent that the students required a number of skills in addition to these first five skills. This oversight was recognised by the

teaching staff during the cooperative gameplay in **Stage B**. Following Version 0.1 of the intervention, a post-intervention interview was conducted with the teaching assistant where the need for additional skills was discussed. These fell into two categories of 'missing skills':

a) Skills that the students displayed during **Stage B** that were deemed important in successfully working together towards the team goal, but had not been explicitly discussed in **Stage A**.
b) Skills that were required to work successfully towards their goal, but that the students could not perform independently without direct guidance from the teaching staff.

In response to the agreed need for a number of additional skills, a potential list was recorded, with the teaching assistant Tetra contending that giving instructions was the first priority. She believed the largest oversight in the list of original five skills was the lack of importance placed on initiating verbal conversations, particularly giving instructions. This was rectified in Version 0.2, with the introduction of a number of new skills focusing specifically on verbal communication for different purposes. Based on the teaching staff's shared knowledge of the students, it was agreed that there should be no more than five new skills, as any more would result in the cognitive load being too great for two of the student participants. After prioritising the importance of the potential skills in terms of need for this cohort of students, a final set of five skills was decided upon. The teaching assistant believed that the students had been previously exposed to the language used to describe these skills, but not visual representations of these skills. In consultation with the speech pathologist, the terminology to label these new skills and accompanying visuals were developed. These five additional skills can be seen in Table 5.3.

Table 5.3. Five additional social skills introduced in prototype Version 0.2.

		Skill definition (for explaining skill to students):	**Indicative behaviour** (for coding instance of skill application):
Skill 6		➢ "Ask another person for help." ❓ "If you don't know what to do or how to do something, you should ask for help." ❓ "You can use your voice or a help card."	🔍 Verbally communicating to another player or the group that they need help with the mechanics of the game. 🔍 Picking up the help card.
Skill 7		➢ "If you see someone doing something wrong or not moving, you can offer them help." ❓ "You can use your voice to offer them help."	🔍 Asking another player or the group if they need assistance with the mechanics of the game. 🔍 Physically communicating to another player that they can help them.
Skill 8		➢ "Using your voice to tell the other players to do something." ❓ "Other players cannot read your mind, so you need to tell them using words."	🔍 Verbally communicating instructions to another player or the group.
Skill 9		➢ "Asking the other players for ideas or suggestions." ❓ "If you get to a puzzle or all the players are stuck, you can ask the other players as they might have an idea."	🔍 Verbally requesting from an individual or the group a solution to a novel puzzle or challenge within the game.
Skill 10		❓ "Using a friendly tone of voice to help the other players feel comfortable." ❓ "Take a deep breath and then speak slowly and keep your voice at the same volume."	🔍 Using a lower pitch and a slower pace of voice when speaking, while smiling when appropriate.

Icon key: ➢ Definition (for students) ❓ *Example (for students)* 🔍 Indicative behaviour

The significance of including these five additional skills was confirmed through the post-data collection coding of **Stage B** of Version 0.1. Table 5.4 records instances of the explicitly taught skills, and the instances of the additional skills that were decided upon after this first prototype had been implemented.

Table 5.4. The initial coding of social skills observed in gameplay during Version 0.1 of the intervention.

	Social skill	Instance count (Mean duration of instance)	Cumulative time (% of total time playing)
Explicitly taught skills	Doing our jobs	*All students participated for entire lesson*	24m 01s (100%)
	Encouraging	7 (2.13s)	14.97s (1.04%)
	Quiet voices	43 (4.84s)	3m 28.36s (14.46%)
Skills taught but not observed	Taking turns		
	Listening to others		
Additional skills observed during coding	Giving verbal instructions	44 (4.21s)	3m 5.36s (12.86%)
	Friendly tone of voice	25 (3.38s)	1m 24.73s (5.88%)
	Asking for ideas	5 (3.17s)	15.89s (1.10%)
	Total of peer-to-peer interactions:	76 interactions (6.56s)	8m 19.22s (34.64%)

The data highlights the skills the students were performing at a group level but does not address performance at an individual level or detail the degree sophistication with which these skills were performed. Skill performance by individual students and the sophistication with which each of these skills were used was examined by analysing six key events,

described in the following chapter. This initial analysis signified that the intervention had the potential to create the conditions that elicited the performance of these skills.

The data also provided some important insights into the nature of the skills that some of the students already possessed, as well as identifying some areas for further focus and development. Within the 76 recorded peer-to-peer interactions, instances of a number of skills being concurrently used by the students were observed. For example, some students could 'give verbal instructions' using a 'quiet voice' within a single interaction. When juxtaposing the number of instances and the cumulative time of the explicitly taught skills and the additional skills, the importance of these additional skills in social interactions between players became apparent. An excellent example of the presence of these additional skills is the prevalence of 'giving verbal instructions' and 'friendly tone of voice', both of which were used frequently by some of the students.

A high prevalence of instances of verbal instructions between players showed that the students were attempting to engage with each other, which confirmed the potential of using multiplayer games to encourage student participation in social activities. The absence of two of the skills that were explicitly focused upon in Version 0.1 ('taking turns' and 'listening to others') is noteworthy and has implications in terms of the methods of instruction. This is addressed in later in this chapter.

5.4.3 A final five skills identified through coding

Following the ten lessons, a comprehensive and detailed coding of the data began, using the indicative behaviours shown in Tables 5.2 and 5.3 to identify instances of application for each of the skills. As this process continued, it became apparent that there were other skills that the students were using that assisted with collaborative processes within the physical space.

A further five skills were identified through this inductive process, as shown below in Table 5.5. As these five skills were coded post-design experiment, the terminology used for these final five skills was derived from the language used in the literature and the *Collaborative problem-solving empirical progressions* (see Appendix A) rather than Hyrule School's speech pathologist.

Table 5.5. The final five social skills coded in the post-data generation coding.

		Skill definition (not used with students):	**Indicative behaviour** (for coding instance of skill application):
Skill 11	Sharing task information *(No visual)*	Communicating to the other players information about a goal, or how to play the game or solve a problem.	Verbally informing another player about the rules or mechanics of the game, or the team goal.
Skill 12	Requesting task information *(No visual)*	➢ Asking the other players information about a goal or how to play the game or solve a problem.	A question directed from one player to another player or the group about the rules or mechanics of the game, or the team goal.
Skill 13	Providing performance feedback *(No visual)*	➢ Evaluating their own or another player's performance. ➢ This can be performance within the game or application of social skills within the physical environment.	One player verbally communicating to another player or the group their perceptions of an individual or the team's level of performance, either within the game or in using the social skills.
Skill 14	Requesting performance feedback *(No visual)*	➢ Asking the other players to evaluate their own or another player's performance.	One player verbally asking another player or the group for feedback on performance (for example, "How am I going?").
Skill 15	Giving non-verbal instructions *(No visual)*	➢ Using body language or gestures to instruct another player.	Pointing at the screen or to the controller with a hand, head or foot gesture.

Icon key: ➢ Definition (for future versions of the intervention) Indicative behaviour

Skills such as sharing and requesting task information are central to ensuring that all participants understand the common goal, and what their role is within the team in accomplishing this goal. Providing and requesting feedback on performance is vital in allowing players to evaluate how well individuals within the group, including themselves, are performing their respective roles. More importantly, this feedback can also improve individual and team performance (Berman & Graham, 2018; Hattie & Timperley, 2007). Finally, while being able to provide verbal instructions is important, it is also important to recognise and harness some of the participants' preferences for non-verbal communication, as the literature review highlighted the importance of building from the students' respective areas of strength (Kircher & Dziobek, 2014; Kirchner et al., 2016; Dawson et al., 2007).

Skills 11 to 15 were never explicitly focused on during the skill instruction in **Stage A**, yet they were incidentally mentioned in conjunction with the discussion of other skills. For example, the teaching staff often reiterated the importance of 'sharing task information' when modelling how to perform 'using our voice to give instructions'. The teaching staff guided students to use these skills during gameplay as they were vital in the completion of the shared team goals assigned by the game. Despite the instructional focus being on the first ten skills, a substantial number of instances of Skills 11 to 15 being performed were observed.

A convenient consequence of the fact that Skills 11 to 15 were not explicitly taught to the students is that this allows for a comparison of the trends in observed instances of these 'incidental' skills and the skills that were explicitly taught. While not conclusive, this could suggest whether it is primarily the instruction driving the application of certain skills during gameplay, whether the performance of skills is more a consequence of the game design, or a combination of the two. In an effort to address this question, the following chapter examines the frequency, duration and situations of performance of these 15 skills.

The 15 social skills outlined in Tables 5.2, 5.3 and 5.5 form the basis of the focus skills explored in this project, and are presented together in Appendix K. Although social skills are constructs with ill-defined borders, Appendix L provides a list of examples and non-examples to clarify the boundaries between these skills as understood in this research project. The relationship between these skills and the levels of sophistication at which they are performed are explored in the following chapters. Returning to the three focus components of the intervention design, this chapter now examines iterative development of the methods used to teach these skills.

5.5 Modifications to the methods of skill instruction

In addition to refining the targeted social skills, the iterative processes of the design experiment resulted in modifications to the way that the skills were being taught. These changes were informed by analysis of the discussions during the skill instruction in **Stage A**, analysis of the performance of skills during cooperative play in **Stage B** and the feedback from students in the group reflections in **Stage C**, as reiterated in Figure 5.6. This evidence was used in conjunction with the literature reviewed in *Chapter 2* to formulate a series of modifications.

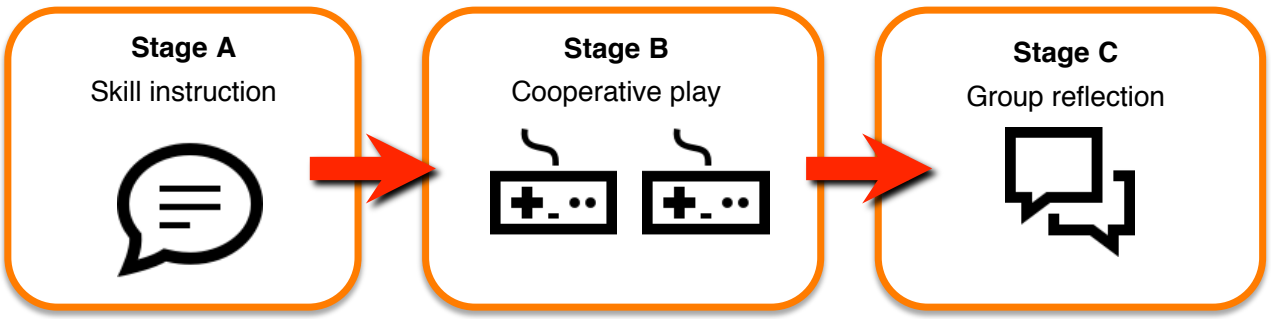


Figure 5.6. The three-stage structure used for all ten versions of the design process.

It is important to note that even though **Stage A** focused exclusively on instruction of the meaning and performance of the targeted social skills, instruction also occurred during **Stage B** (cooperative play) and **Stage C** (group reflection). Table 5.6 summarises the most significant modifications to the method of instruction through the ten versions of the intervention.

Table 5.6. Significant modifications to the method of instruction through the ten versions of the intervention prototype.

	Significant modifications to the methods of instruction
Version 0.1	⟲ Explicitly defined key terms 'collaboration' and 'goal', and provided examples of each (Stage A) ⟲ Explicitly defined and discussed familiar examples of first five focus social skills (Stage A) ⟲ Focused on strategies for one common group goal, 'taking turns' (Stage A) ⟲ Awarded skill stickers using a visual chart (see Appendix H) during gameplay (Stage B) ⟲ Reflected on the use of skills during gameplay using a visual chart (see Appendix I) (Stage C)
V 0.2	⟲ Explicitly defined and discussed familiar examples of five additional focus social skills (Stage A) ⟲ Reviewed video of gameplay from the previous week, searching for examples of the ten focus skills (Stage A) ⟲ Introduction to 'help' and 'time-out' cards, with explanation of how and when they should be used (Stage A), and placement for easy access during gameplay (Stage B) ⟲ Periodically paused gameplay and reviewed observed skills using visual chart shown in Appendix H (Stage B) ⟲ Introduced individual goals for each student participant (Stages A and B) ⟲ Reflected on the use of skills during gameplay using the revised visual chart shown in Appendix I (Stage C)

V 0.3	↻ Explained the difference between individual goals and team goals (Stages A and B) ↻ Discussed individual and team goals in two contexts (playing basketball and playing a cooperative videogame) (Stage A) ↻ Modelled the application of a focus skill ('using our voice to give instructions') through example dialogue to scaffold students (Stage A) ↻ During breaks in play reflected as a group on performance of individual goal skills using the visual chart shown in Appendix H (Stage B)
No modifications in Version 0.4	
V 0.5	↻ Discussed examples of transporting all target skills from use in one context (playing videogames) to another (playing basketball) (Stage A) ↻ Teacher modelling and peer role-play practising the use of help and time-out cards during video review (Stage A)
V 0.6	↻ Discussed the similarities and differences in individual and team goals between a familiar videogame and a familiar sport (soccer) (Stage A) ↻ Discussed how students could transport three of the target skills from use in one context (playing collaborative videogames) to another (playing soccer) (Stage A) ↻ Facilitated students to control the video playback to find instances of two targeted skills ('using our voice to give instructions', 'listening to others') in the video footage from the previous week (Stage A)
V 0.7	↻ Reviewed video footage of a challenging section of the game where the players fail to coordinate their actions and cannot achieve their goal (Stage A) ↻ Discussed examples of how you could use three specific skills in the context of a challenging section from the last week's gameplay (Stage A) ↻ Discussed why these skills are important in effective collaboration in the context of this section of the game (Stage A)
V 0.8	↻ Reviewed video footage of the same challenging section of the game where the players successfully coordinated their actions and achieved their team goal (Stage A) ↻ Asked students to identify the skills they used in this video footage (Stage A)
No modifications in Versions 0.9 and 1.0	

There were two significant instructional tools that remained consistent in their presence and use by the teaching staff throughout the course of the intervention:

- The sticker chart for reminding students of their goals, and recording the skills used, as seen in Appendix H.
- Two versions of the reflection chart, with the chart shown in Appendix I being used in Version 0.1 and the one shown in Appendix J being used for Versions 0.2 – 1.0.

These tools are important to this discussion as they were systems that were put in place to provide visual supports, aiding students in monitoring and evaluating their performance of the focus skills. These supports were modelled after similar systems used in their regular classroom for monitoring and evaluating student behaviour. Despite using these systems for learning rather than classroom management, the students were familiar and comfortable with the mechanics and visual layouts adopted for the sticker chart and reflection chart. As the primary concern was that students understood these tools, the teaching staff made the decision following Version 0.1 to minimise changes to their design. While the reflection chart was simplified after the first lesson, no further changes were made to either tool. These tools are referred to in the following discussion of instructional adjustments.

5.5.1 Overview of significant changes in methods of instruction

Five significant changes occurred in the methods of skill instruction from the first version to the tenth version of the intervention:

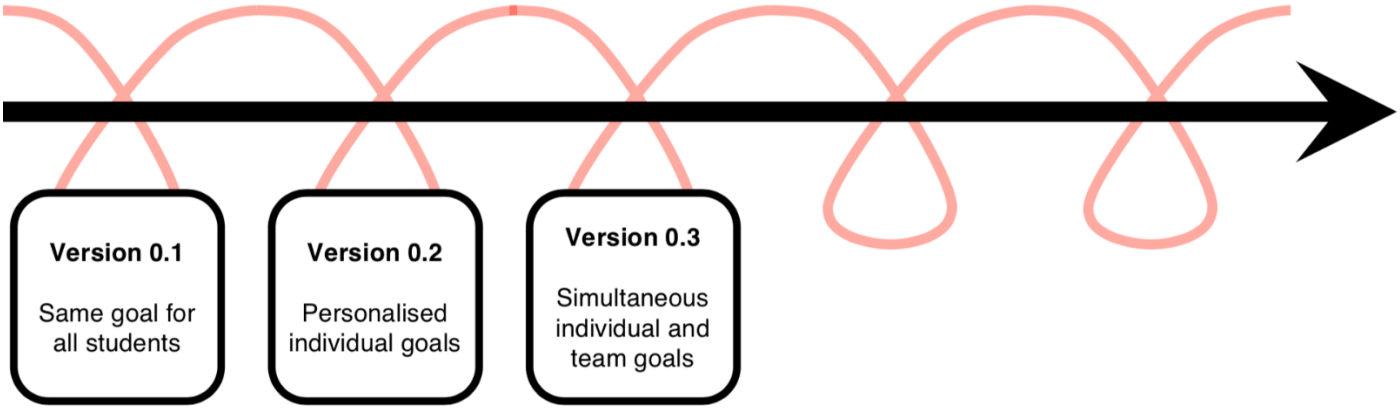
1. The introduction of individual goals alongside shared team goals.
2. The introduction and modelling of the help and time-out cards.
3. Planned, regular time-out pauses during gameplay to review goals and skill performance.
4. A shift in focusing on the definition of the skills using examples from other contexts to teach the definitions of the skills in the context of the gameplay.

5. A transition in the way that video footage was used. There was a shift from teacher-led self and peer video modelling of the skills being performed to teacher-guided review of the footage.

The following sections examine the data underpinning each of these five changes and the conditions in which these changes were implemented. It should be noted that the first three of these changes could have been implemented from the very first version of the intervention as they do not rely on any prior understanding from the students. In future interventions these design features should be incorporated in the intervention from the very first lesson. Changes in the types of examples being used to explain the skills and the use of video were reliant on experiences and video footage from previous lessons and so would not be possible in the first version of a future intervention.

5.5.2 Individual and shared goals

One of the most significant modifications to the methods of instruction used in this intervention was the introduction of individual goals alongside shared goals in all three stages of the intervention. Figure 5.7 shows that adjustments were made in the use of goals during the first three versions as a result of post-implementation evaluation.



Stage where this method of instruction was used:

Stage A (Skill instruction)	Stage B (Cooperative play)	Stage C (Group reflection)
✓	✓	✓

Figure 5.7. Modifications to the use of goals as a result of the iterative design process.

5.5.2.1 Personalised individual goals

In the first version of the intervention, the students shared game-determined 'team goals'. In addition to this, all five students shared a common social skill goal, 'taking turns' at controlling the different characters. Subsequent analysis of the video data of the five students identified that each student had different individual ZAD and ZPD (Vygotsky, 1978) in their social capabilities. In other words, they were at differing developmental stages and consequently were ready to focus on different goals. Therefore, the design needed to be responsive to individual students' needs. This is shown in the dialogue below, where Link demonstrates an understanding of the underlying purpose of using a quiet voice in a group interaction.

Teacher:	And what's this last one? Samus?
Samus:	*Shhhhhhh* (Making 'quiet' sound)
Teacher:	Yeah. Quiet-
Link:	Quiet voice?
Teacher:	Yeah, quiet voice.
	Why do we use a quiet voice when we're trying to work with a team?
Link:	So it's not loud?
Teacher:	It's not loud, yeah, why not?
Link:	Because it's noisy?
Teacher:	It's noisy, yeah. What happens when it's noisy?
Link:	It'll be very loud?
Teacher:	Yeah, it'll be very loud. What about other people?
Link:	They block their ears off.
Teacher:	Yeah, and then, when you're closing your ears, it's very hard to-?
Link:	Listen.

In stark contrast, Samus and Falcon could only connect 'using a quiet voice' to the positive reactions of the teaching staff, not connecting this skill with creating the conditions for more effective group communication.

Responding to these different developmental levels, students were assigned individual focus goals from Version 0.2. These goals were set by the teaching staff after reviewing the video footage of the gameplay and the behavioural instance reports generated through Studiocode™, as detailed in the following chapter. An unexpected change was that the students began independently to refer to the goals themselves during the cooperative play, using the language that had been taught and modelled by the teaching staff.

The results show that individual goals needed to be assigned as the students were operating at different developmental levels. When students understood the value of these individual goals in achieving the game-determined 'team goal', they adopted the modelled language of these individual goals to discuss their contributions to the group.

5.5.2.2 Simultaneous goals

As long as the meanings of the goals were understood by the students, simultaneous individual and team goals did not appear to create confusion. Beginning in Version 0.3, team goals and individual goals were discussed together with explicit connections being made between them by the teaching staff. This clarity may have been due to the sources from which these goals were being derived. Shared team goals were established for the students through the design of the game, while the teaching staff assigned individual goals. For example, in many of the 2D platform games the shared team goal was for all players to reach a specific finishing point within the level. Teaching staff used these game-assigned goals as a lens through which to explain the importance of each player's respective individual goal. Staff noted that, following Version 0.1, the students all understood this distinction between goals assigned through rules of the game and the goals assigned by the teaching staff, even if they did not understand the meaning of the goal social skills. As shown below, the five gaming enthusiasts could easily describe the game-based team goals.

Teacher:	All right, so, last week, we were collaborating in ... What game did we play?
Falcon:	Rayman.
Link:	Rayman Legends.
Teacher:	Yeah. Playing together, with each other to ... What was our goal?
Link:	Finish the labyrinth.

As this intervention was focused on developing the students' social skills, the instruction in **Stage A** focused primarily on the importance of performing these individual skills in order to achieve the team goal. As the students were being asked to focus on two goals, staff were mindful of reducing their cognitive load by using consistent visual icons, language and scaffolds, such as the sticker chart.

5.5.3 Introducing help and time-out cards

A significant modification to this intervention was the introduction of two cards that were placed in front of the students during gameplay. These two cards are shown below in Figure 5.8.



Figure 5.8. The help and time-out cards introduced in Version 0.2.

Figure 5.9 shows that although the cards were first introduced in Version 0.2, further instruction was required in Version 0.5 to increase the frequency with which the students used them to communicate with their peers or the teaching staff.

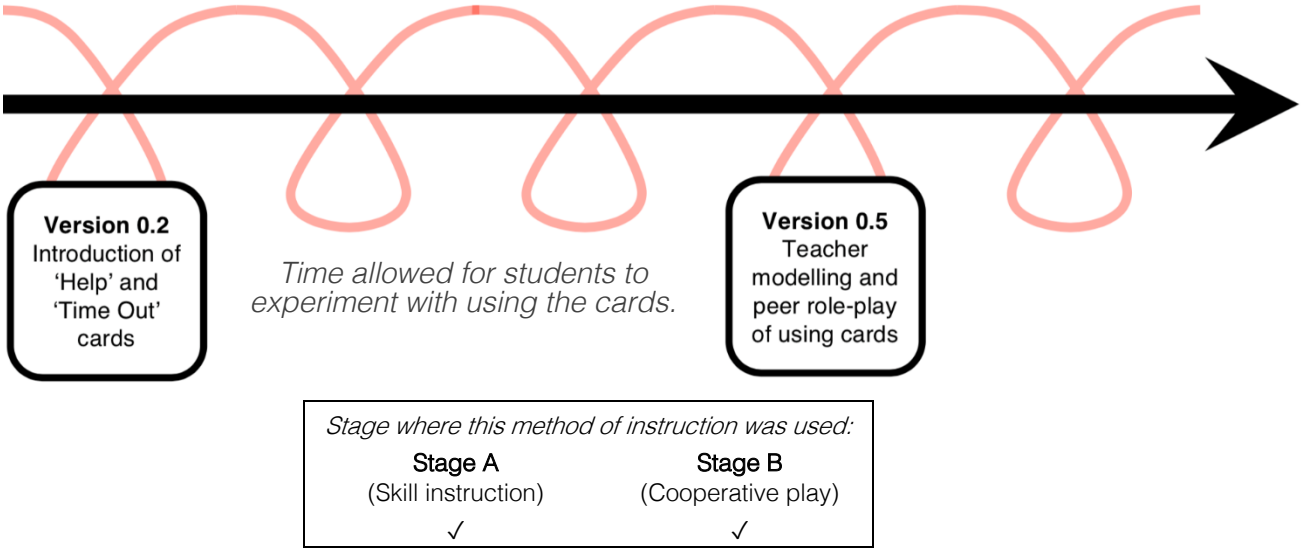


Figure 5.9. Changes to instruction in using the help and time-out cards.

The help card was intended to be used when students identified the need for assistance but did not know how to communicate this request in an appropriate or timely manner. Despite teaching and modelling the skill 'asking for help', the speed at which action occurred in the game created challenges for students with slower processing speeds who were not able to formulate a verbal request in a timely manner.

The time-out card was introduced so that students could request that the game was paused, which would allow for a group discussion with their peers or to allow additional time for processing events. The time-out card was often used as a precursor to a more skillful or knowledgeable student offering help to a peer.

5.5.3.1 Teaching the identification of situations requiring help and time-out

Repeated lessons of playing the game over subsequent weeks meant that some players became more skillful, creating a broader spectrum of abilities within the playing group. Additionally, self-identified gamers Falcon and Pit both commented that they had watched videos online of expert players playing two of the games following their use in this research project. This resulted in them having specialist knowledge of strategies and secrets within these games that the other players did not possess. Consequently, the teaching staff recognised that the less skilled and knowledgeable players needed to be able to recognise when they required assistance, how to communicate this need and for their experts to be receptive to these requests. To be able to do this, students needed to know what to look and listen for in both the physical and virtual environments, with footage of past gameplay again providing contexts from which the teaching staff could draw examples. This is illustrated below with Falcon watching a video of Banjo saying “Uh oh” during a difficult passage of play.

Teacher:	What do you think Falcon? If someone says “Uh oh” is that good or bad?
Samus:	Bad.
Teacher:	Bad? What might he want?
Falcon:	Help.
Teacher:	Yeah he might need help.

Beyond teaching the indicators for when help or a time-out might be required, the students were also taught how to use these two cards and how to react when another student requested assistance. To achieve this, Version 0.5 used video examples from the previous lesson in conjunction with video modelling. Students watched a sample of footage from the

previous lesson, identified when a player might require the use of these cards and then the teaching staff paused the video and performed the steps in using the cards at the point of need. Once three examples had been modelled, the students then performed their own peer models.

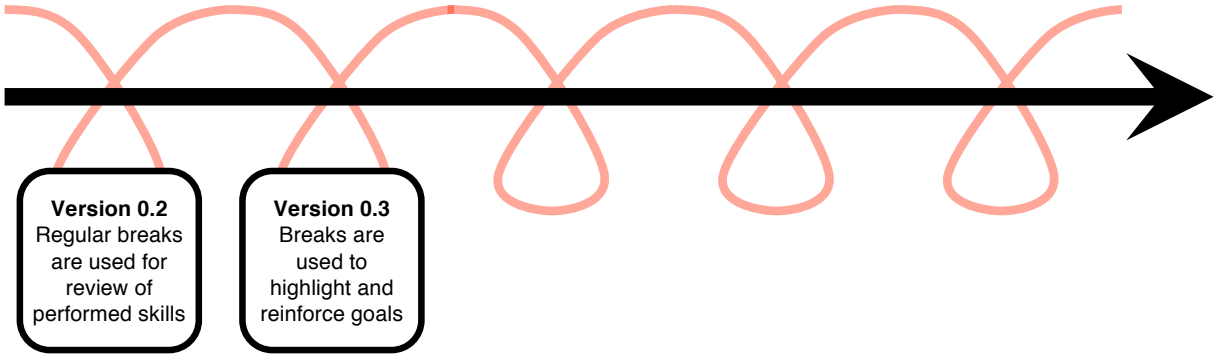
The introduction and instruction in the use of these tools provided the students with a mechanism for compensating for specific areas of challenge. It is important to note that these supports were not a replacement for the skill of verbally requesting assistance, but rather served as an intermediate measure that allowed these players to receive assistance at the point of need in order to continue participating in the intervention.

5.5.3.2 Teaching the steps in using the help or time-out cards

Once a need had been identified, the students had to know what to do next. The performance of the steps that required asking for help were first modelled by the teaching staff in Version 0.5. In Version 0.6 peer modelling was used, with all students given the opportunity to practise using a help or time-out card. When the students were practising the performance of these skills, they were coached by the staff through the required steps. This coaching continued into the cooperative gameplay during **Stage B**, where students would sometimes indicate they wanted to ask for help or a time-out, but appeared not to remember all of the steps in performing the skill, or their requests were ignored. This second point is important, as asking for help or a 'time-out relies on a receptive audience that understands the request. It became evident when teaching the performance of this skill that students also need to be explicitly taught how to respond when someone uses a help or time-out card.

5.5.4 Regular breaks for reflection during gameplay

Regular breaks during play were introduced during the cooperative play in **Stage B**, beginning in Version 0.2, as shown in Figure 5.10.



Stage where this method of instruction was used:
Stage B (Cooperative play) ✓

Figure 5.10. Changes in the way in which regular breaks were used during cooperative play.

5.5.4.1 Allocating time for reflection on skill performance during play

In the initial version of the intervention, the students shared a common focus social skill of 'taking turns', with Pit suggesting the use of the timer on the iPad as a way of monitoring that each player had an equal turn playing the game. The system agreed upon by the students had them changing controllers at regular intervals. In the post-lesson interview following Version 0.1 of the intervention, the teaching assistant Tetra suggested using these regular breaks as an opportunity to pause the game, removing a potential distraction, and reviewing the skills that the teaching staff had recorded the students using during the period of play via the sticker chart (see Appendix H). In Version 0.3, the sticker chart was also modified to include the individual goal 'focus social skill' under the photo of each student. The teacher-researcher made this change to provide a visual reminder for each student of their individual

goal, which could be referred to during this break in play. It was assumed by the teaching staff that the students would object to pausing the game, but this turned out to be incorrect.

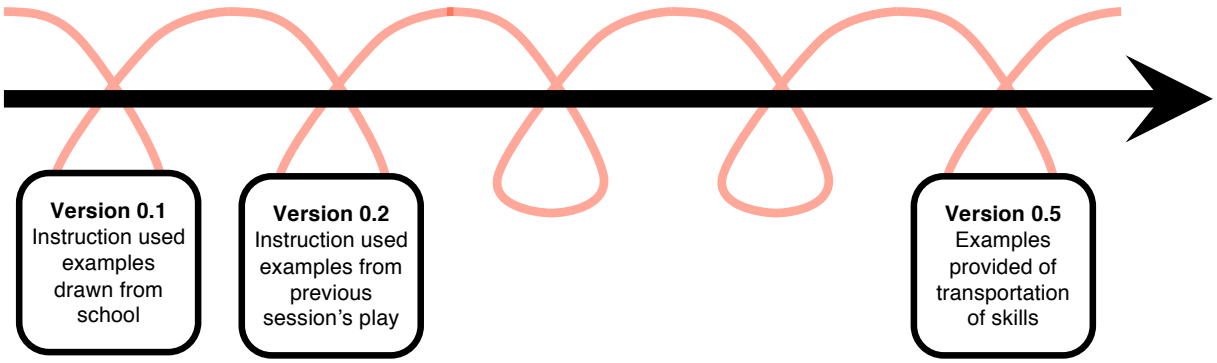
5.5.4.2 A safe space for peer instruction, group strategisation and emotional regulation

As these regular breaks became routine for the students over the lessons of intervention, in conjunction with the teacher-guided review of skill performance, the students themselves began to use these periods of time to fulfil a number of functions. In lessons where a new game had been introduced, analysis of the dialogue between the students during these breaks showed a high frequency of bilateral peer instruction. This typically involved discussing game controls or the mechanics of play, such as the effect of a particular item. In lessons where most of the players were already familiar with these aspects of a game, the conversations tended to be around group strategisation, such as how to defeat more complex enemies. These discussions were dominated by the more skillful players, and required intervention from the teaching staff in order to moderate the tone of conversation. A review of the tone of dialogue before and after these breaks indicated a pattern of students using a friendlier tone of voice. This could be due to the break in gameplay affording individuals the opportunity to implement strategies, with support from the teaching staff, that assisted them in self-regulating their heightened emotional states. This was an unintended but essential function of these breaks in play for students with social-emotional disabilities.

5.5.5 Developing a meaningful understanding of vocabulary through a games-based context

With the availability of video footage and as the students became more familiar with the games, there was a shift in the types of examples that were used by the teaching staff to explain the social skills. These were used in all three stages of the intervention. Analysis of

Versions 0.1 and 0.2 of the intervention suggested the importance of providing a meaningful context in developing student understanding of the key vocabulary. Consequently, changes were made to the types of examples being used, as shown in Figure 5.11.



Stage where this method of instruction was used:		
Stage A (Skill instruction)	Stage B (Cooperative play)	Stage C (Group reflection)
✓	✓	✓

Figure 5.11. Changes to the use of examples for explaining the use of the target social skills.

In Version 0.1, the students, with the exception of Link, found it difficult to discuss the term 'goal', as they could not imagine the contexts in which they might use this word. An understanding of this term was very important in order for the students to be able to discuss their own goals and their progress towards achieving their goals. Through questioning by the teaching staff in **Stage A** (skill Instruction), it became apparent that the students required an example that placed the term in context in order for them to understand that working towards goals required some form of action from them. This is evident in the following conversation.

Teacher:	Oh, okay. So we're working together as a group, as a team, with other people towards a common goal. What does goal mean? My goal is to help you learn. When I'm playing hockey, my goal is to score a goal. What would my goal mean?
Link:	I don't know. I cannot remember the meaning of goal.
Teacher:	Yeah? You want to check the meaning?
Link:	I don't know if it means, like, goal.
Teacher:	Goal? What do you think a goal is? Link? Don't know? All right, all right. My goal today is to make sure you're listening. What might goal mean?

What soon became apparent was that this context had to be both familiar and valued by the students. Drawing upon their knowledge of gaming language and game design conventions allowed them not just to recount the goals of the game played in the previous week, but also to share the goals of some of their other favourite games. Through these game-based examples, staff and students collectively began to develop a shared understanding of goals in this intervention, with this insight into the power of game-based examples being used from this point on to explain the focus social skills that became their individual goals.

5.5.6 Transitioning from video modelling to video review

There was a transition in the way video was used as an instructional tool during the skill instruction and group reflections. Figure 5.12 shows that these changes occurred incrementally over the course of a number of versions.

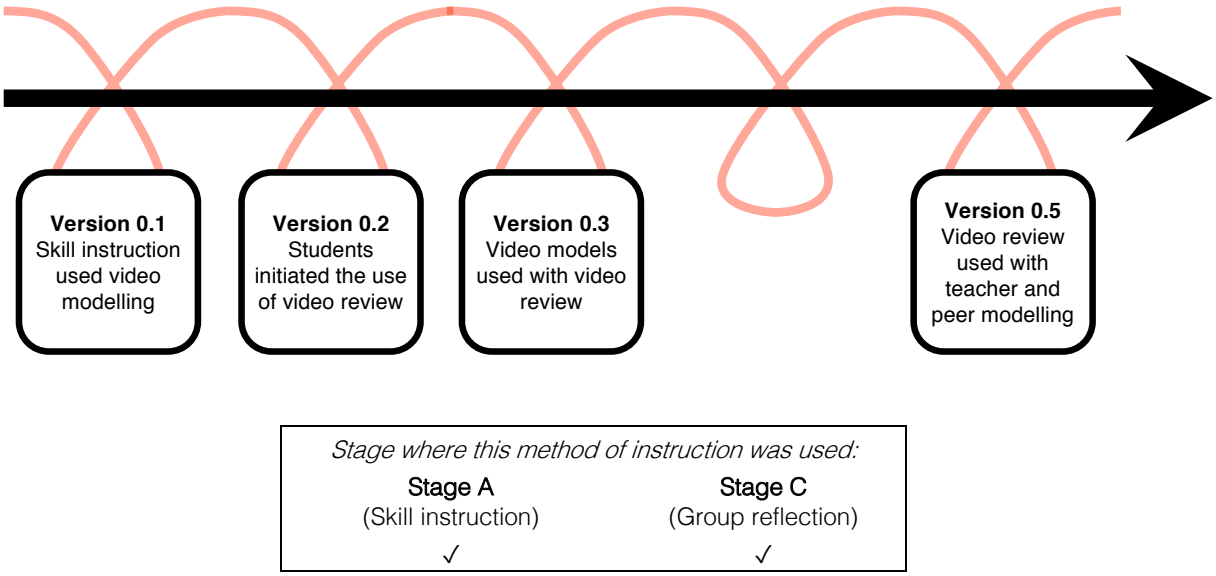


Figure 5.12. Changes to the use of video footage as an instructional tool.

5.5.6.1 Teaching the steps of skill performance using video modelling

In the first three versions of the intervention, structured video models of the focus skills were used to show examples of the students performing these skills step-by-step. These video models were edited to show only desirable behaviours and positive responses to these behaviours, providing clarity to the students by explicitly unpacking the steps involved in performing each skill. This was confirmed by most of the students being able to articulate verbally the steps involved in each skill in the video and the positive consequences.

5.5.6.2 Developmentally outgrowing passive modelling

Despite the instructional benefits in teaching what each skill looked like when being performed, there were two significant problems with the continued use of video modelling once the students had a fundamental understanding of each skill. The first was that the videos overly featured Link and Pit, as there were more examples of these two students performing the focus skills as they began the intervention with more sophisticated social understandings. The other issue was that the students wanted this experience to be interactive, where they

could control the playback of the video and show their own examples and non-examples. In other words, once the students had developmentally outgrown the video models, they transitioned to requesting the use of video review. The method of instruction needed to respond to this desire from the students to take a more active role in leading discussions around opportunities for the performance of social skills that would assist the team in accomplishing the game-determined team goal. It is interesting that the students, particularly Falcon and Pit, framed the importance of these skills in terms of being essential to success in the game. Relating individual skills to the game-based shared goal could have been an unintended consequence of teaching these skills through the use of game-based examples.

There was an eagerness from the students to see video footage of themselves playing the videogames together. Even in Version 0.2, Link and Falcon could identify the performance of the taught skills without the explicit structure provided by video modelling. This is evident in the dialogue below.

Teacher:	Yeah. And while you're watching this, think about what skills did you see us or hear us using.
Link:	Quiet voice. Listen to others.
Teacher:	Yeah. What's that one?
Link:	Encouraging.
Teacher:	Falcon? What's this one? (showing visual for ‘asking your friends for ideas’)

Interestingly, Falcon mislabelled ‘asking your friends for ideas’ as ‘think through’ but demonstrated that he still understood the purpose. While he did not use the taught language,

he still correctly identified the meaning of the skill and could provide an example of where this skill could be performed using the video footage of the participants playing the game.

This study highlighted the importance of having the teaching staff guide the students in the acquisition and performance of the targeted social skills. Optimising the systems of instruction was essential in supporting the students to use these skills with increased sophistication and independence. The ways in which these five significant changes aligned with or challenged the principles of effective intervention identified in the literature review are discussed later.

5.6 Sequencing and design of games

The first two components of the intervention design informed which social skills would be focused upon and how they would be taught, while the third dealt with the selection of the tool used to provide a space for the students to apply these skills. In total, four commercial games were trialled to explore the ways in which game design could create the conditions for social interaction and collaboration. Table 5.7 provides a broad overview of the game-level modifications for each game. A rationale for the selection of each of the four commercially developed games is provided in this chapter, but the decision to change the game being used was made in response to the data generated from the previous iteration of the intervention. This included analysis of the interactions between the students during play and the feedback from the participants during the group reflections.

Table 5.7. Overview of the four games used in the intervention.

Game		Version(s) used	Genre	Possible simultaneous players
Rayman Legends (2013)		v0.1 to v0.3	2D platform	5 players (4 players on Wiimotes + 1 player on Wii U Gamepad)
		Rationale for use: • Used familiar 2D platform game mechanics with which the students were experienced • Contained sections of each level that required player coordination • Provided a role for players who were not as skillful using a traditional analogue controller		
Kirby and the Rainbow Paintbrush (2015)		v0.4 to v0.7	2D platform	4 players (3 players on Wiimotes + 1 player on Wii U Gamepad)
		Rationale for use: • Adapted familiar 2D platform game mechanics, but added a unique design change (the titular *Rainbow Paintbrush*) • The game design forced students to stay in close proximity to each other, with one player controlling the screen scrolling • Defined roles for each player, with *Kirby* positioned as the leader, and his three assistants helping his progress		
Super Mario 3D World (2013)		v0.8 and v0.9	3D platform	4 players (3 players on Wiimotes + 1 player on Wii U Gamepad)
		Rationale for use: • This 3D platform game allowed for more complex levels, systems and puzzles • Contained both individual and team objectives, with the freedom for students to negotiate and prioritise these • Introduced game-level summative feedback on individual performance within the team		
Star Fox Zero (2016)		v1.0	Action/on-rail shooter	2 players (1 player on Wiimote + 1 player on Wii U Gamepad)
		Rationale for use: • Requested by one of the student participants • Requires players to co-pilot a common avatar (a spaceship), requiring coordination at all times for shared success • A different genre of game from the previous three games used		

Although the information provided in this table might imply that these games are very similar in design, particularly the three platform games, each of these games has a very unique design. The rules, systems and mechanics of each game had a significant impact on the way in which the students were required to interact with each other, as well the skills required to successfully navigate these designed interactions.

5.6.1 Game 1: Rayman Legends

Rayman Legends (Ubisoft, 2013), referred to as **Rayman**, is a cooperative 2D platform game (see Figure 5.13). Using the classic controllers, players work together to navigate their protagonists through the levels, adhering to the established genre conventions (Otero, 2013). However, there is a twist. These players receive assistance from another player using the Wii U Gamepad's touch screen to control the character *Murfy*, as labelled in the following screenshot.



Figure 5.13. The characters of Rayman in action (Ubisoft, 2013).

This character can move around the screen much like a mouse cursor and can manipulate the environment to assist the progress of the other players. Unlike the other characters, *Murfy* is not constrained by gravity and cannot lose life or hit points, but the successful completion of a section requires the other characters to scroll the screen and get to a designated check point intact. The effect of these design choices fostered situations where the players using the Wiimotes had to coordinate their actions with the player controlling *Murfy* in order to solve problems to move through the game. In this study, the role of *Murfy* allowed players with less developed playing skills to become central in the progress of the team by distracting difficult enemies, manipulating platforms and cutting ropes to clear a path to help the other players progress. Following Version 0.3 the decision was made to introduce a new game that used mechanics. This forced the more passive students within the group to take on more responsibility.

5.6.2 Game 2: Kirby and the Rainbow Paintbrush

Once the students had indicated that they could all access the play mechanics of **Rayman**, a traditional 2D platform game, the teaching staff perceived a need for a game that promoted a more constant level of player coordination but one that would still be familiar enough in its mechanics so that the players could quickly learn to play this game. **Kirby and the Rainbow Paintbrush** (Nintendo, 2015), referred to as **Kirby**, is another cooperative 2D platform game. Unlike **Rayman,** the protagonist *Kirby* is indirectly controlled by using the stylus and touch screen to draw a line from the character to where they want him to go, using the *Rainbow Paintbrush*, as shown in Figure 5.14.

In this game the player has a limited supply of energy to draw this line, and they cannot move *Kirby* while this supply is depleted and slowly recharging. This had the effect of leaving *Kirby*

prone and vulnerable to attack, which is where the other players had an important role. These characters played as *Waddle Dees* and served as protectors for *Kirby*. If these characters ran out of life, they were temporarily out of the game but were soon restored to full health. On the other hand, if *Kirby* lost all of his health then it was game over for everyone.



Figure 5.14. The playable characters in *Kirby* (Nintendo, 2015).

Only *Kirby* could progress the screen, so the other players had to ensure that *Kirby* could safely move forward. This resulted in an increase in frequency of interactions between the students. The player controlling *Kirby* could also use the *Rainbow Paintbrush* to paint temporary lines to shield other players from falling projectiles or serve as platforms for them to jump on and reach higher ground. This added an extra strategic dimension to gameplay and required the students to coordinate their actions to solve puzzles and defeat enemies while ensuring that *Kirby* was protected.

5.6.3 Game 3: Super Mario 3D World

As the students demonstrated an increased familiarity with the multiplayer mechanics of **Kirby**, the teaching assistant suggested trialing a new game where players had more individual agency. **Super Mario 3D World** (Nintendo, 2013), referred to as **Mario**, is a semi-cooperative 3D platform game (see Figure 5.15). Much like the previous two games, **Mario** tasks players with working together to defeat enemies, solve puzzles and reach the end point of the game. Certain sections of the game require the coordination of movement and activity, such as the concurrent flicking of switches.

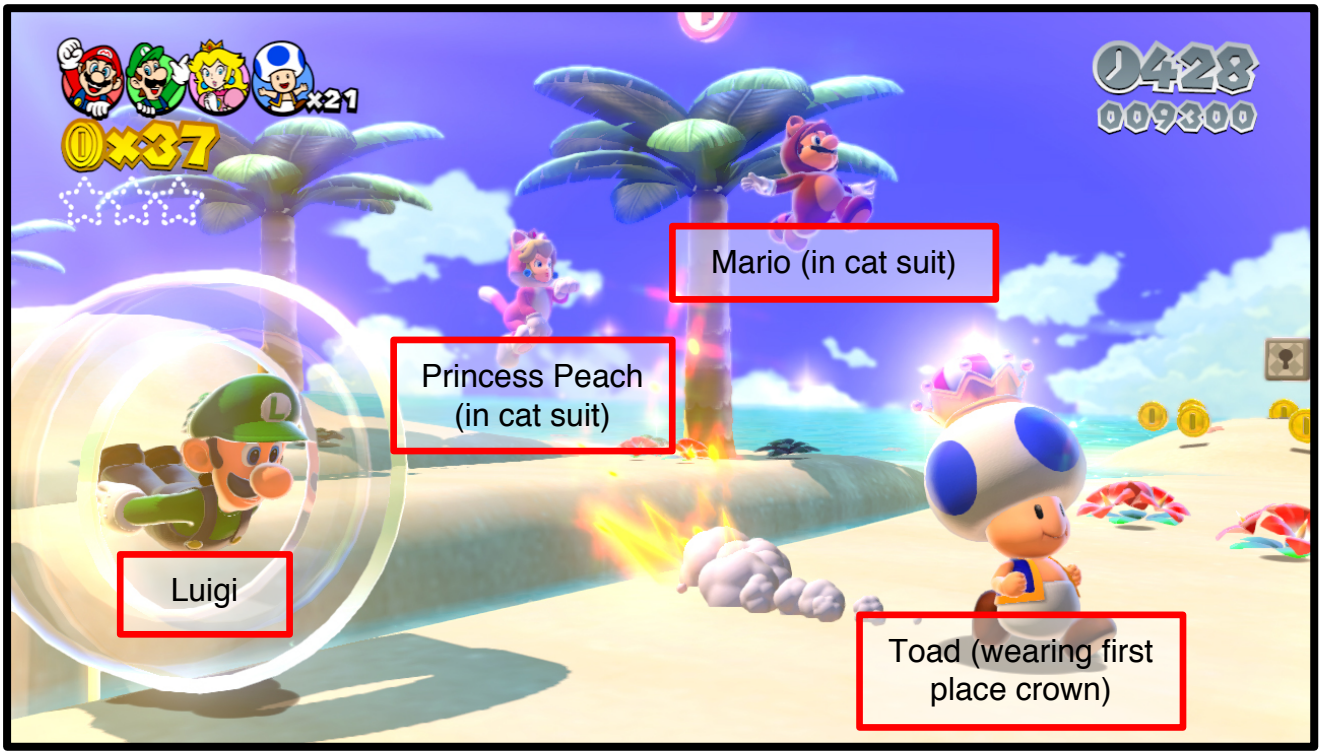


Figure 5.15. The four playable characters in Mario (Nintendo, 2013).

However, unlike the previous two games, the players are mostly free to run ahead and leave their peers behind. To a certain extent, the game even encourages this via a 'king of the hill' mechanic. This mechanic involves awarding the first person to reach the end of level flag with a crown for their avatar to wear in the subsequent level, denoting them as the current 'king' of the game. These game design decisions create a tension, requiring players to cooperate

in order to progress, but then also encouraging them to maintain a degree of competitive independence from their peers.

Mario is also a more complex game when compared with **Rayman** and **Kirby** due to the game requiring players to navigate levels on a three-dimensional plane. The students had to solve more complex puzzles, particularly because of the more sophisticated physics engine underpinning this game in comparison to two-dimensional platform games. This game also delights in playing with user expectations by defying long established genre conventions, such as which platforms are safe to stand on and which items should be collected.

5.6.4 Game 4: Star Fox Zero

This final game was requested by two of the students. ***Star Fox Zero*** (Nintendo, 2016) or **Star Fox**, is a cooperative action game and falls within the subgenre of 'on-rails shooter', as shown in Figure 5.16. This game has two co-pilots sharing a common *Arwing* aircraft. One player serves as the pilot steering the spacecraft, and the other player serves as the gunner, shooting at enemy targets.



Figure 5.16. Player roles in controlling an *Arwing* ship with two players in Star Fox. Adapted from Redemption (2016).

There are two key differences between **Star Fox** and other games used for this study. The first is the shared control of a common avatar, the *Arwing*, creating a level of co-dependence not available in the other games, as there is no allowance for individual action within the game. The second difference is the genre of the game and implications for the participants presented by the conventions of this genre. **Star Fox** is a 3D action game, which alternates between sections of the game being 'on rails', where the pilot's field of movement is restricted, and sections where the pilot has the freedom to fly anywhere. This genre is known for the speed of the action occurring on-screen and allows little time for processing and hesitation in communication between the pilot and the gunner.

5.7 Chapter conclusions

This chapter has reported on the modifications to three key areas of focus within the intervention. Responding to the data generated through each iterative cycle, the number of target skills was expanded, the methods of instruction were adjusted, and four different games were used. Analysing each of these modifications addressed the guiding research questions and provided important insights into the respective roles of the students, the teaching staff and the videogames.

Chapter 6 continues with the results of the analysis, focusing on the data generated from **Stage B** (cooperative gameplay) for each version of the intervention. This analysis provided insights into the frequency of use for each of the 15 targeted social skills and the ways the game design and the teaching impacted upon social interactions during this time. It was also a key source of data, informing the modifications to the intervention reported in this chapter.

Chapter 6: Results B – Analysis of interactions during cooperative play

6.1 Introduction and structure

The previous chapter examined the significant modifications to the intervention design. This chapter focuses on the analysis of the interactions during cooperative play (**Stage B**). Analysis of these interactions, alongside the interview data, informed modifications to the social skills being targeted in the intervention, methods of instruction and selection of the videogames. Video data generated during **Stage B** was coded and analysed in two distinct passes. Pass 1 identified three broad categories of interaction, then Pass 2 identified the specific nature of these interactions. This coding process can be summarised as:

1) Coding interactions between the students in the physical environment (Pass 1), identifying the performance of the targeted social skills (Pass 2).
2) Coding interactions between the students in the virtual environment (Pass 1), identifying instances of in-game assistance and communication (Pass 2).
3) Coding interactions between students and the teaching staff (Pass 1), identifying who initiated these interactions and references to the targeted skills in these interactions (Pass 2).

This chapter includes a closer examination of six key events that were of particular interest. It is impossible to report in detail on every event. These six events were selected due to their high frequency of targeted skill performance or showing a more sophisticated level of social interaction between the players than had previously been observed. Focusing on these events allows for a contextual analysis of how the students used social skills in particular scenarios, and the role of teaching staff and the game in supporting and nurturing these interactions.

6.2 Social skills observed in the physical space during cooperative gameplay

After coding individual instances of peer-to-peer interaction, the next logical step was to investigate the precise nature of the social skills that were being used within these interpersonal exchanges in the physical environment, as shown in Figure 6.1.

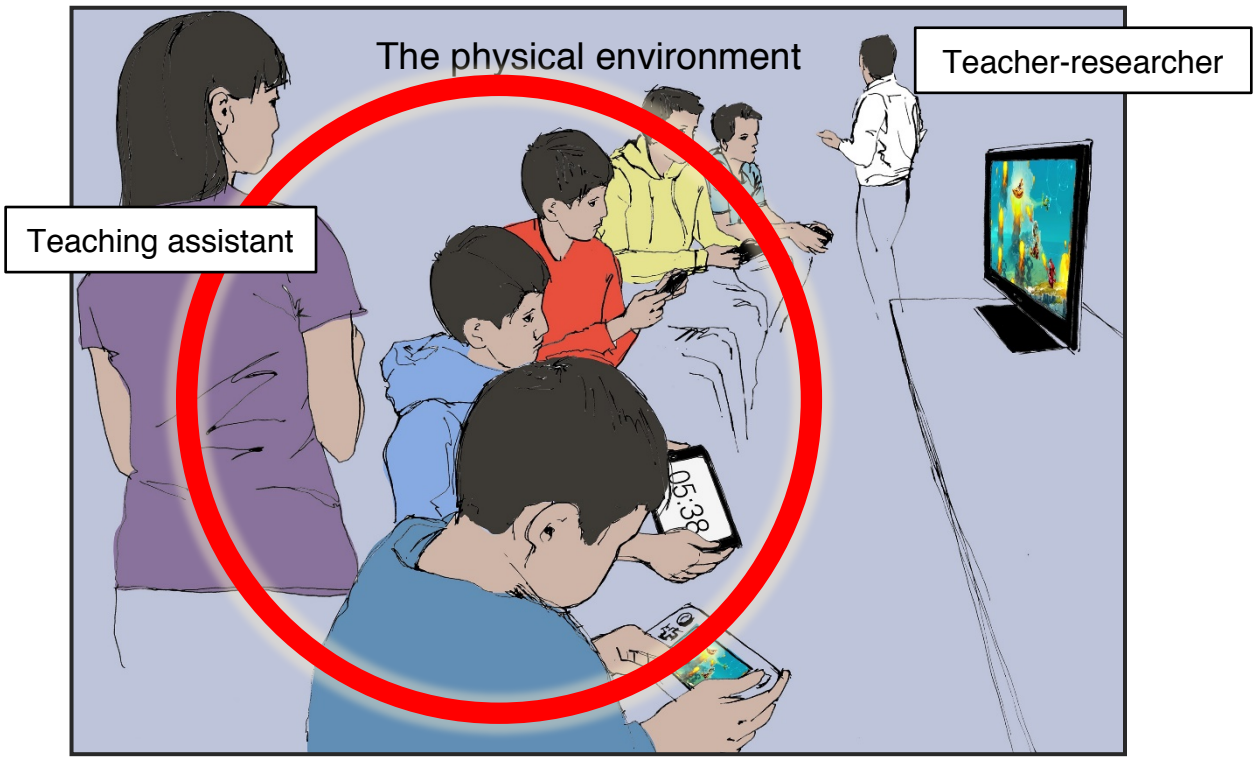


Figure 6.1. Observing social skills used in interactions between students in the physical environment.

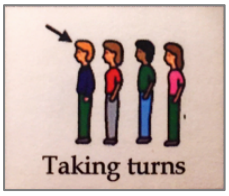
This section systematically unpacks the application of each of the 15 skills, which are grouped to align with the three sets developed through the design experiment process reported on in the previous chapter.

6.2.1 Performance of Skills 1 to 5

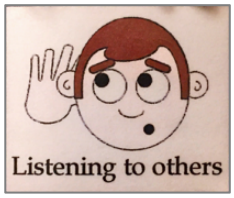
Skill 1:



Skill 2:



Skill 3:



Skill 4:



Skill 5:



Analysis of the variability of performance for each of the initial five targeted social skills presents some interesting results. Table 6.1 shows the number of times each skill was observed during play and the percentage of total play time that each skill was performed throughout the ten versions of the intervention.

Table 6.1. Instances of interactions between students using Skills 1 to 5 in the physical environment.

		Instance count (% of total time playing)									
		Rayman			Kirby				Mario		Star Fox
	Social skill	Version 0.1 Play time 24m 01s	Version 0.2 Play time 16m 54s	Version 0.3 Play time 27m 20s	Version 0.4 Play time 25m 41s	Version 0.5 Play time: 19m 48.08s	Version 0.6 Play time: 19m 04.76s	Version 0.7 Play time 30m 34.38s	Version 0.8 Play time 24m	Version 0.9 Play time 32m 15s	Version 1.0 Play time 31m 23s
Explicitly taught skills from V 0.1	1. Doing our jobs *(participation)*	**Full participation by all students**	**Full participation by all students**	**Full participation by all students**	**Full participation by all students**	**Full participation by all students**	**Full participation by all students**	**98.09%**	**Full participation by all students**	**Full participation by all students**	**Full participation by all students**
	2. Taking turns	19 (2.13%)	3 (0.28%)	2 (0.46%)	3 (0.90%)	**Not observed**	1 (0.27%)	13 (2.20%)	10 (2.73%)	4 (1.47%)	12 (1.69%)
	3. Listening to others	50 (6.13%)	68 (5.50%)	54 (4.76%)	89 (11.04%)	104 (8.85%)	87 (10.17%)	153 (7.43%)	137 (9.13%)	120 (7.75%)	114 (10.08%)
	4. Encouraging	7 (1.04%)	7 (1.32%)	6 (0.53%)	8 (1.07%)	21 (2.54%)	20 (3.05%)	32 (3.28%)	21 (14.01%)	15 (1.5%)	24 (2.33%)
	5. Quiet voices	43 (14.46%)	65 (16.08%)	113 (20.74%)	136 (36.89%)	49 (14.71%)	111 (19.85%)	187 (27.62%)	155 (27.48%)	184 (25.87%)	129 (25.80

6.2.1.1 Contextual analysis of Table 6.1: Skills 1 to 5

Interesting patterns emerged from the results shown in Table 6.1. The performance of Skills 1 to 5 was observed in all ten lessons of cooperative play, although the frequency of use and, more importantly, the sophistication of performance varied greatly.

Skill 1:

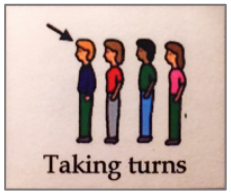


Indicative behaviours:

- Playing the game while attempting to accomplish the team goal.

The skill 'doing our jobs' had been explained prior to this activity as 'joining in an activity with your friends'. Given that the students requested to be part of this research project and had an active role in designing the intervention, it is not surprising that students almost universally engaged in playing the game. Despite some tensions within the group in Version 0.7, resulting in one student temporarily not playing the game, the student resumed working with his team members following a teacher-initiated time-out. This tension was caused by the student not understanding the role other players expected him to perform. Throughout the ten interventions, students actively participated in playing the game and working with their peers to accomplish the game-directed team goals.

Skill 2:



Indicative behaviours:

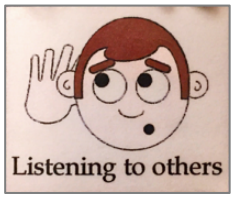
- Voluntarily verbally or physically offering to relinquish control to another player.
- Verbally communicating that the other player can make a decision.

Variations between the different versions of the intervention for 'taking turns' are seemingly a result of ecological constraints and game design. For example, there were substantially more instances of this skill being used in Version 0.1, the first lesson of play of **Rayman**, than

in the subsequent versions because of differences in the number of players. Version 0.1 had four players sharing two controllers. In the following two lessons there were only two players, so there was no one sitting around anxiously waiting for their turn. This relationship between more players and shorter turn times was also observed in Versions 0.7, 0.8 and 1.0, with these lessons all having at least one excess player waiting for a turn.

Game design had a strong influence on the performance of this skill. **Star Fox** was limited to two simultaneous players, so players were eager to have shorter play times to reduce their time between turns, which the students admitted was driven by self-interest. This significantly increased the performance of the skills. Game design and the use of video review also had a subtler influence upon the length of turns when players recognised unique capabilities for different avatars. Players in Version 0.7 were eager to control *Kirby* once they recognised this avatar's special abilities and positioning within the game as the central protagonist in the narrative. Collectively, students remained proficient throughout the intervention in using external tools, such as the timer, to ensure equal play time. Those who saw themselves as 'expert gamers', however, expected to spend the majority of their play time as the avatars they perceived as the central protagonists.

Skill 3:



Indicative behaviours:

- Verbally or physically acknowledging that the student heard their peer.
- Changing actions in game to comply with peer.

Listening is a difficult skill to measure when all participants are primarily watching a screen. Due to the culturally and contextually subjective nature of listening, directly observable indicative behaviours were identified that were appropriate for this activity with these students. Analysing the performance of the skill across the ten versions, there was a general

increase in instances of listening over the ten weeks. Version 0.7 provides an excellent example of the importance of using video review as teaching tool. In **Stage A** (skill instruction) of this lesson, video review had been used extensively to plan a strategy to reattempt a difficult section of the game played the previous week. As part of preparing a strategy for coordinating actions within the game, the importance of verbally acknowledging that the players had heard each other was highlighted by the teaching staff.

It was shown that this was important for the person receiving instructions or asking a question so that they knew that their volume was loud enough to be heard and to check whether the intended audience understood. This lesson subsequently saw the highest count of verbal acknowledgements. While the following three versions recorded lower frequencies of performance, there was still a positive trend across the ten lessons. This suggests that the group had begun to understand the importance of indicating to the other players that they were listening to the group discourse in trying to achieve a common goal.

Skill 4:



Indicative behaviours:

- Making a positive comment about the performance of a player.
- Verbally reassuring a player when they make a mistake.

Out of the initial five skills, the teaching staff thought that the students were most familiar with the skill of ‘encouraging’ prior to the beginning of this project. This is interesting because the data in Table 6.1 suggests that although the students might have been aware of the meaning of this skill in some sense, only two students used it within Version 0.1, and only one student in Versions 0.2 and 0.3. The frequency of use for this skill only increased from Version 0.5 onwards. The most obvious explanation for this shift was the focus on this skill in **Stage A** (skill instruction) of Version 0.5. During this lesson the value of the skill had been explained

in terms of encouragement as a tool for students to use to keep their peers focused on achieving the joint team goal. Promoting a relationship between the positive regulation of the socio-emotional state of their peers and the performance of the team seemed to resonate. The average use of this skill in Version 0.5 to Version 1.0 was more than three times that of the first four lessons (21.17 compared with 7.0 average instances). This suggests that students developed an understanding of the importance of the performance of this skill in maintaining their peers' levels of motivation, especially in situations of collective failure.

Skill 5:



Indicative behaviours:

- Student is using a volume that allows other students to be heard.

Like 'listening to others', the use of 'quiet voices' is a difficult skill to both teach and assess, as the appropriate application of the skill naturally changes depending on context. It is also contingent upon the emotional investment the student has in the verbal interaction, their recognition of their acoustic environment and their ability to plan their responses to certain prompts ahead of time. Playing **Kirby** resulted in the largest range of data, varying from the second lowest frequency to the highest. The first lesson of introducing this game, Version 0.4, involved the players learning together to control *Kirby* and his assistants. The slower pace of **Kirby** combined with one player having the ability to scroll the screen allowed for a large degree of player control over the rate of action.

Kirby is also known as being an easier series of games with a very gentle difficultly curve (Sliva, 2015). This may have contributed to less spontaneous outbursts of communication as threats were always well signposted ahead of time in the early stages of the game. Within this first lesson, over a third of the total play time involved students using a 'quiet voice'.

Results from Version 0.7 indicate the students began to understand the importance of 'quiet voices' in order for them to plan their team strategy collectively. This followed extensive use of video review to discuss the reasons why using a 'quiet voice' is important in achieving the team goal which appeared to be a successful approach as the percentage of play time in which students used a 'quiet voice' increased significantly from the previous two lessons.

6.2.2 Performance of Skills 6 to 10

Skill 6:



Skill 7:



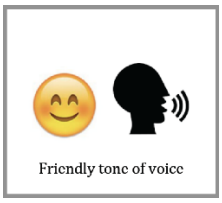
Skill 8:



Skill 9:



Skill 10:



As discussed in the previous chapter, five additional focus skills were included in this intervention from Version 0.2 onwards. An overview of the performance of these skills is presented in Table 6.2, followed by an examination of the contexts in which Skills 6 to 10 were used.

Table 6.2. Instances of interactions between students using Skills 6 to 10 in the physical environment.

		Instance count (% of total time playing)									
	Social skill	Version 0.1 Play time 24m 01s	Version 0.2 Play time 16m 54s	Version 0.3 Play time 27m 20s	Version 0.4 Play time 25m 41s	Version 0.5 Play time: 19m 48.08s	Version 0.6 Play time: 19m 04.76s	Version 0.7 Play time 30m 34.38s	Version 0.8 Play time 24m	Version 0.9 Play time 32m 15s	Version 1.0 Play time 31m 23s
Explicitly taught skills from V 0.2	Asking peers for help	Not observed	2 (0.49%)	Not observed	Not observed	1 (0.14%)	2 (0.51%)	9 (1.03%)	3 (0.33%)	12 (1.45%)	2 (0.14%)
	Offering peers help	Not observed	2 (0.26%)	Not observed	1 (0.22%)	2 (0.54%)	4 (6.98%)	7 (1.10%)	9 (1.71%)	9 (1.91%)	10 (1.42%)
	Using our voice to give instructions	44 (12.86%)	43 (7.63%)	118 (14.69%)	95 (14.49%)	71 (12.79%)	71 (13.64%)	118 (15.14%)	97 (14.01%)	122 (13.10%)	91 (12.58%)
	Asking for ideas	5 (1.1%)	6 (1.68%)	3 (0.26%)	3 (0.41%)	3 (0.51%)	Not observed	3 (0.35%)	Not observed	Not observed	Not observed
	Friendly tone of voice	25 (5.88%)	10 (2.01%)	20 (2.49%)	18 (6.98%)	31 (9.19%)	28 (4.52%)	31 (4.67%)	38 (6.99%)	23 (3.20%)	14 (1.49%)

6.2.2.1 Contextual analysis of Table 6.2: Skills 6 to 10

To varying degrees, Skills 6 to 10 were all observed in the majority of the ten lessons of cooperative play. Like Skills 1 to 5, the prevalence of use and the sophistication of performance varied greatly depending on a complex combination of factors. Qualitative analysis complements the data presented in Table 6.2 by considering the contexts in which these skills were performed or not performed.

Skill 6:



Indicative behaviours:

- Verbally communicating to another player or the group that they need help with the mechanics of the game.
- Picking up the help card.

Skill 7:



Indicative behaviours:

- Asking another player or the group if they need assistance with the mechanics of the game.
- Physically communicating to another player that they can help them.

'Asking for help' and 'offering help' are addressed together, as although they were not observed in the same interaction often, they were used by the students in very similar situations. It became apparent that although students knew how to ask for help in other contexts, they either struggled to recognise the need for assistance or did not know how to ask for it in this context, as this skill was not observed in three of the first four lessons. In Version 0.2 it was Link, the oldest and most outwardly anxious student, who called upon Falcon, his friend and someone Link identified as having expertise, to show him what to do. With two students self-identifying as gamers, it might be assumed that from the outset of the intervention these students would be offering help. This was not the case. It was only after explicit modelling of the steps for requesting help in Version 0.5 and video review focusing

on the performance of this skill prior to play in Version 0.7 that students appeared to learn how to identify the contexts in which they should use this skill.

Following a similar pattern, it was not until Version 0.6 that there was a noticeable increase in the number of observed instances of students 'offering help'. This increase can be attributed partially to assigning this skill as an individual goal for two of the students. Interestingly, while Pit had a wealth of gaming knowledge to draw upon and share with his peers, Banjo proved more effective at being able to break down multifaceted procedures into step-by-step instructions. After Version 0.6, players became more aware of the performance of their peers and actively looked for opportunities to help, particularly in the final three versions, when games with more complex mechanics of play were introduced.

Skill 8:



Indicative behaviours:

- Verbally communicating instructions to another player or the group.

One skill that was most frequently used by the students in all ten of the cooperative play lessons was 'using our voice to give instructions'. The lessons that had the highest frequency of instructions being given were those where the two gamers felt most confident in their abilities and assigned themselves unofficial leadership positions within the team. This is particularly true of Falcon in Version 0.7 and Pit in Version 0.9, with the recording of two of the highest frequencies of instructions being given.

A high frequency of instances of verbal communication does not in any way guarantee that the instructions are effective in achieving their purpose, but at the very least they do indicate an attempt at communication. This is best exemplified by the comparison between the frequencies of instructions being given in Version 0.2 and Version 0.3, with two different

pairings attempting to complete the same puzzle in **Rayman**. It appears that the pair in Version 0.3 were more engaged in communicating with each other, which might imply a greater degree of coordination between the players. However, this was not the case, as the two players in Version 0.2 quickly established an expert-novice relationship and completed the puzzle in significantly less time. This example highlights that the frequency of instructions did not equate to effective communication between the players, with the quality of instruction becoming a focus for instruction beginning in Version 0.4. Once the language and sentence syntax for giving instructions was explicitly modelled by the teaching staff, there was a noticeable improvement in the quality of the instructions being given by most of the students over the final six versions.

Skill 9:



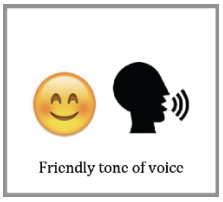
Indicative behaviours:

- Verbally requesting from an individual or the group a solution to a novel puzzle or challenge within the game.

One skill that was underused throughout the ten lessons was 'asking your friends for ideas'. This was despite efforts by the teaching staff to encourage the students to ask each other for solutions to some of the puzzles they faced within the game. This might have been a result of some of the puzzles being either too easy or optional to completing the main goal. If the puzzle was within an individual's ZAD (Vygotsky, 1978), then that student would simply complete it themselves or tell the other students what they had to do. If the puzzle was optional, then the students would attempt it for a short while, but then redirect their focus back to completing the primary goal of the level. Despite the relative ease of the puzzles found in **Rayman**, as this game was new to all of the students these first three lessons recorded the most observations of students asking their peers for possible solutions.

It is notable that the frequency of performance actually decreased over the ten lessons, with no instances observed in Version 0.8, 0.9 or 1.0. This could be because some students were familiar with the final two games and already knew some possible solutions. Familiarity resulted in these students attempting to solve puzzles as quickly as possible by themselves or providing short and sharp directions to the other players if multiple avatars were required for the solution. This was exemplified by Pit sharing his well-honed knowledge of **Mario** to solve some more sophisticated physics-based challenges in Version 0.8 and 0.9. These results suggest this was not a skill that the students developed as part of this intervention.

Skill 10:



Indicative behaviours:

- Using a lower pitch and a slower pace of voice when speaking, while smiling when appropriate.

When analysing the students' performance of 'using a friendly tone of voice', two interesting observations emerged. The first became apparent when comparing contexts of use with 'using a quiet voice', the skill closest in nature and purpose. Both skills relate to emotional self-regulation in order to maintain a collective emotional state conducive to constructive communication, so it might be suggested that they would share patterns of performance across the ten lessons. However, this was not the case. The version of the intervention with the most time allocated to pre-play planning of roles within the group, Version 0.7, represented the highest frequency of 'using a quiet voice', but this was the not case for 'using a friendly tone of voice'. The version of the intervention where players were learning to play **Mario**, arguably the most complex game, was the version that recorded the highest frequency of performance for this skill.

The second interesting observation relating to the players' use of a friendly tone is an apparent pattern between the more skilled players simultaneously playing together, and the

greater percentage of time that the players used a friendly voice. While it might be suggested that this is a result of an increased number of social interactions, this is not reflected in the results of the analysis. The two versions with the highest frequencies of 'using your voice to give instructions' had below average frequencies of 'using a friendly tone of voice'. This could be because players were interacting with different peers more frequently and not playing with the same person for a prolonged time. This resulted in less established history on which to identify patterns of poor play and purposeful non-compliance with a specific peer's instructions. Although the students demonstrated their understanding of the purpose of this skill through discussions in **Stage A** (skill instruction), the data generated during cooperative play does not indicate that any student could consistently perform this skill. This is further explored in *Chapter 7*, as it might not be appropriate to develop this skill in the context of using stress-inducing videogames.

6.2.3 Performance of Skills 11 to 15

Table 6.3 presents an overview of the performance of the final five skills that were never explicitly taught during the intervention:

- Skill 1: sharing task information
- Skill 2: requesting task information
- Skill 3: providing performance feedback
- Skill 4: requesting performance feedback
- Skill 5: giving non-verbal instructions

This is followed by an analysis of the contexts in which each of these five skills were used and incidental progression of learning over the ten versions.

Table 6.3. Instances of interactions between students using Skills 11 to 15 in the physical environment.

		Instance count (% of total time playing)									
	Social skill	Version 0.1 Play time 24m 01s	Version 0.2 Play time 16m 54s	Version 0.3 Play time 27m 20s	Version 0.4 Play time 25m 41s	Version 0.5 Play time: 19m 48.08s	Version 0.6 Play time: 19m 04.76s	Version 0.7 Play time 30m 34.38s	Version 0.8 Play time 24m	Version 0.9 Play time 32m 15s	Version 1.0 Play time 31m 23s
Additional skills observed during coding	Sharing task information	25 (6.30%)	38 (9.13%)	76 (9.64%)	95 (14.49%)	72 (14.32%)	76 (13.48%)	168 (20.36%)	147 (19.09%)	174 (21.17%)	102 (13.82%)
	Requesting task information	9 (1.67%)	18 (4.02%)	17 (1.945)	44 (5.65%)	17 (3.48%)	19 (2.85%)	46 (3.92%)	44 (4.97%)	25 (2.60%)	26 (2.44%)
	Providing performance feedback	17 (4.12%)	11 (2.34%)	21 (2.55%)	43 (8.21%)	49 (8.06%)	56 (8.85%)	102 (11.96%)	103 (14.23%)	95 (9.29%)	84 (9.38%)
	Requesting performance feedback	2 (0.50%)	Not observed	Not observed	4 (0.60%)	1 (0.21%)	1 (0.16%)	1 (0.09%)	Not observed	Not observed	Not observed
	Giving non-verbal instructions	4 (1.09%)	2 (0.48%)	13 (2.28%)	13 (4.62%)	8 (2.42%)	7 (8.27%)	7 (2.87%)	11 (1.93%)	3 (0.27%)	11 (2.63%)

6.2.3.1 Contextual analysis of Table 6.3: Skills 11 to 15

Skills 11 to 15 were important skills that came to light in the process of coding the video data. The skills 'sharing' and 'requesting task information', and 'providing' and 'requesting performance feedback' are discussed as pairs. The frequency of the final additional skill, 'giving non-verbal instructions', became apparent only after multiple viewings of the video footage, but it is important in discussing the provision and reception of different forms of communication.

Skill 11:

Sharing task information *(No visual)*

Indicative behaviours:

- Verbally informing another player about the rules or mechanics of the game, or the team goal.

Skill 12:

Requesting task information *(No visual)*

Indicative behaviours:

- A question directed from one player to another player or the group about the rules or mechanics of the game, or the team goal.

The highest recorded frequency of 'sharing task information' was observed in Version 0.9, in which there was a very different dynamic amongst the players. While all players in Version 0.7 were observed sharing task information, Version 0.9 primarily involved one student sharing his intimate knowledge of his favourite game with his less experienced peers. Three of the students had never played this game before and were not familiar with the mechanics of play. The design of the game had a big impact upon their ability to share information successfully on the goals of the game and the mechanics of play. When playing **Mario**, Pit tried to communicate how to control the avatars and how to navigate the levels. The

challenge here was that these kept changing, and the complexity of the game mechanics were clearly beyond some players' ZPD (Vygotsky, 1978). While **Mario** is noted for its creativity in challenging players' expectations (Plunkett, 2013), this diversity in mechanics had the unintended consequence of forcing players to relearn how to play the game from level to level.

There are also interesting patterns in the performance of 'requesting task information'. Like the other Skills 11 to 15, this was never explicitly taught to the students. While it could be assumed that as players became more familiar with a game there would be fewer requests for information relating to how to play the game, this was only the case in Version 0.9 when the students were playing **Mario** for the second time. At first this might seem confounding given that this is the game with the least goal consistency between levels, but it could be explained by opportunity and the ecology. One player was using personal expertise in this game to pre-emptively provide information about what the group should be doing, so 'requesting task information' might have been necessary.

Reviewing the other versions, use of this skill seems bounded by the social relationships between the players and their comfort in asking the expert gamers what they should be doing. This highlights the importance of using explicit instruction to influence the social dynamics within the group and to make it socially acceptable for players to admit to not knowing something.

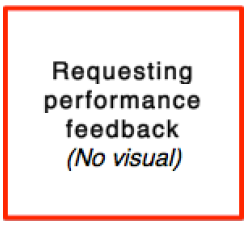
Skill 13:



Indicative behaviours:

- One player verbally communicating to another player or the group their perceptions of an individual or the team's level of performance, either within the game or in using the social skills.

Skill 14:



Indicative behaviours:

- One player verbally asking another player or the group for feedback on performance.

Students regularly provided feedback to their peers throughout the ten lessons, but rarely requested feedback on their own performance. From Version 0.2 to Version 0.8 there was a positive trend in both frequency of feedback being provided by the students, and the duration of each instance of feedback. This can be explained partially through the modelling provided in **Stage A** (skill instruction). While no explicit instruction was provided on how to structure effective feedback, analysis of the footage reveals that some students transported the language and syntax modelled by the teaching staff for 'using your voice to give instructions' to how they verbalised feedback. This was particularly evident after Version 0.4, when students began to directly connect individuals' actions to achieving the team goal. What was *not* modelled explicitly, and was absent from most observed instances of peer feedback, was the importance of communicating the steps required for a player to change their actions in order not to repeat the mistake. Likewise, requesting performance feedback was never modelled, so the students might not have had the language necessary to request an assessment of their performance within the team.

Game design also appears to have an impact on the performance of these skills, highlighted by the decrease in feedback being provided in the final two versions using games with more complex mechanics of play. **Mario** allows players to be somewhat independent of their peers and less affected by another player's poor performance, but **Star Fox** tethers the fates of the two players together. This might indicate that the positioning of the students within the group, particularly in terms of when there is a universally accepted expert-novice relationship, can shift the focus from providing performance feedback to providing task information. In such situations, students recognise that novice players require more information to be successful, so this is prioritised. In terms of explaining the lack of requests for performance feedback, all four games had clear systems for providing individual-level feedback in a form that was understood by all five students, perhaps making this skill redundant in this context.

Skill 15:

Giving non-verbal instructions *(No visual)*

Indicative behaviours:

- Pointing at the screen or to the controller with a hand, head or foot gesture.

The use of physical prompts or gestures was largely dependent upon the preferences of individual students for verbal or non-verbal modes of communication. Consequently, use depended largely on who was participating in each version of the intervention. Pit often used gestures to clarify the meaning of an instruction, such as simultaneously physically modelling and verbally communicating where to find the button on the controller. This was different from Falcon's approach. He often used non-verbal communication as a substitute for verbal instructions and could become frustrated when the recipient did not respond to his gestures. If the student did not comply with the instruction, Falcon would sometimes

point in a more a vigorous manner, moving closer to the screen in the process. It was only when these more exaggerated movements failed to illicit acknowledgement from his target audience that he would verbalise his instructions. When he was feeling anxious or agitated, Falcon appeared to revert to relying primarily on non-verbal communication, despite constant reminders from the teaching staff to “use your words.” While augmenting verbal instructions with supporting gestures was not encouraged, the broader objectives of this intervention resulted in verbal communication being prioritised.

6.3 Social interactions in the virtual environment

Analysis of the interactions occurring between the players’ avatars in the game environment provided insights into another site of social interaction during the cooperative play, as shown in Figure 6.2.



Figure 6.2. Focusing on interactions in the virtual environment.

These game-based interactions were vitally important to the objectives of this research study as they served as the antecedent for the performance of many of the targeted social skills in the physical environment. Consequently, these interactions were central to addressing two of the guiding questions relating to creating the conditions for collaboration:

Guiding questions:
d) How do the rules and mechanics of different games impact upon social interactions? e) How can game design create the conditions for inclusion?

In order to analyse the video data to address these questions, indicative behaviours were required that demonstrated a conscious effort by the players to positively interact with their peers in the virtual world. Three categories of virtual interaction were identified:

- 'Direct assistance' involved one player's avatar having a direct interaction with another avatar in the game world to assist that player or the team to achieve their goals. An example of this is a player's avatar picking up another avatar to evade an enemy projectile. This was the most prevalent form of in-game interaction between players.
- 'Indirect assistance' involved one player taking an action to specifically assist the other players. Whether or not an action was an intentional act of assistance was confirmed through analysis of the dialogue between students in the physical environment. Examples included using *Murfy* in **Rayman** to flick switches or using the Wii U Gamepad to draw a bridge for the other players to cross a perilous pit in **Kirby**.
- 'In-game communication' interactions involved players using their avatars or items to bring something in the game to the attention of other players, much like 'indirect communication'. This was particularly evident in **Rayman** where the player controlling *Murfy* could use him as a form of 'pointer', highlighting areas for the other players to

focus their attention. When considered with the use of non-verbal means of providing instructions in the physical space, a comprehensive picture emerged of which students preferred verbal or non-verbal modes of communications. These differences in communication styles have important implications for the inclusion of all learners.

Alongside the three categories of virtual interaction, it is also important to consider instances where the game design requires these interactions for players to progress, as part of the purpose of this study is creating the conditions conducive to collaboration. Comparing the prevalence of these virtual interactions with whether or not they are required by the game allows for the analysis of the effect of enforced virtual interactions upon how the players work together in the game environment.

Table 6.4 presents the three categories of virtual interaction and the number of instances where the games require these interactions. Comparing the performance frequencies for each category across the ten versions is an important starting point, but most significant in addressing the research questions are the game design contexts in which these interactions occurred.

Table 6.4. Instances of virtual interaction presented with game design affordances (instances of required coordination and summative feedback).

		Instance count (% of total time playing)									
		Rayman			**Kirby**				**Mario**		**Star Fox**
	Social skill	Version 0.1 Play Time 24m 01s	Version 0.2 Play Time 16m 54s	Version 0.3 Play Time 27m 20s	Version 0.4 Play Time 25m 41s	Version 0.5 Play Time 19m 48.08s	Version 0.6 Play Time 19m 04.76s	Version 0.7 Play Time 30m 34.38s	Version 0.8 Play Time 24m	Version 0.9 Play Time 32m 15s	Version 1.0 Play Time 31m 23s
Additional skills observed during coding	1. Direct assistance	2 (0.66%)	3 (0.26%)	14 (2.89%)	9 (4.34%)	39 (23.73%)	23 (8.73%)	44 (11.90%)	2 (10.94%)	4 (8.14%)	5 (29.46%)
	2. Indirect assistance	48 (16.12%)	46 (11.13%)	36 (4.82%)	64 (16.40%)	45 (10.83%)	54 (19.00%)	69 (15.19%)	1 (0.46%)	5 (6.80%)	**Not observed**
	3. In-game communication	7 (1.45%)	14 (3.64%)	5 (1.23%)	**Not observed**	**Not observed**	**Not observed**	**Not observed**	**Not observed**	**Not observed**	**Not observed**
Game design components	4. Game design requires player coordination	48 (26.31%)	2 (15.86%)	3 (14.16%)	**None required**	**None required**	**None required**	**None required**	1 (10.83%)	10 (15.27%)	5 (29.38%)

6.3.1 Analysing the influence of game design upon virtual interactions

These three categories of virtual interaction were largely dependent on design affordances provided by the game, so comparisons between versions are examinations of game design rather than student learning. This section examines the types of interactions between the players in the virtual environment afforded by the design of each of the four games.

6.3.1.1 Virtual interactions afforded through Rayman's design

In the three versions of the intervention involving **Rayman**, the positioning of the character *Murfy* as an omnipresent assistant resulted in a significant number of observed instances of 'indirect assistance'. Interactions between *Murfy* and non-playable characters and elements of the environment accounted for the vast majority of 'in-game communications'. These included *Murfy* flicking switches to open doors, tickling enemies, disarming traps and pulling out platforms for the other characters to stand on. Particularly in Version 0.1, many of these early levels required the players to coordinate their action between *Murfy* and the other avatars. While the game does not provide many opportunities for 'direct assistance', there were still several instances recorded in the first two versions, but these interactions were not required for the players to proceed (e.g. *Murfy* bringing magical vials that restored the health of other avatars). Version 0.3 presented a significant shift, with an increase in direct interaction and a proportional decrease in the number of indirect interactions. This appeared to be a result of a change in the way that the players approached the challenges.

6.3.1.2 Virtual interactions afforded through Kirby's design

An increased frequency of both 'direct assistance' and 'indirect assistance' was observed in all four versions using **Kirby** although there remained more indirect interactions than direct, with the ratio between the two forms much closer. A reason for this might be the mechanic of

the *Rainbow Paintbrush*. This mechanic afforded opportunities for the player controlling *Kirby* to make the game easier for the other players, as shown in the example in Figure 6.3.

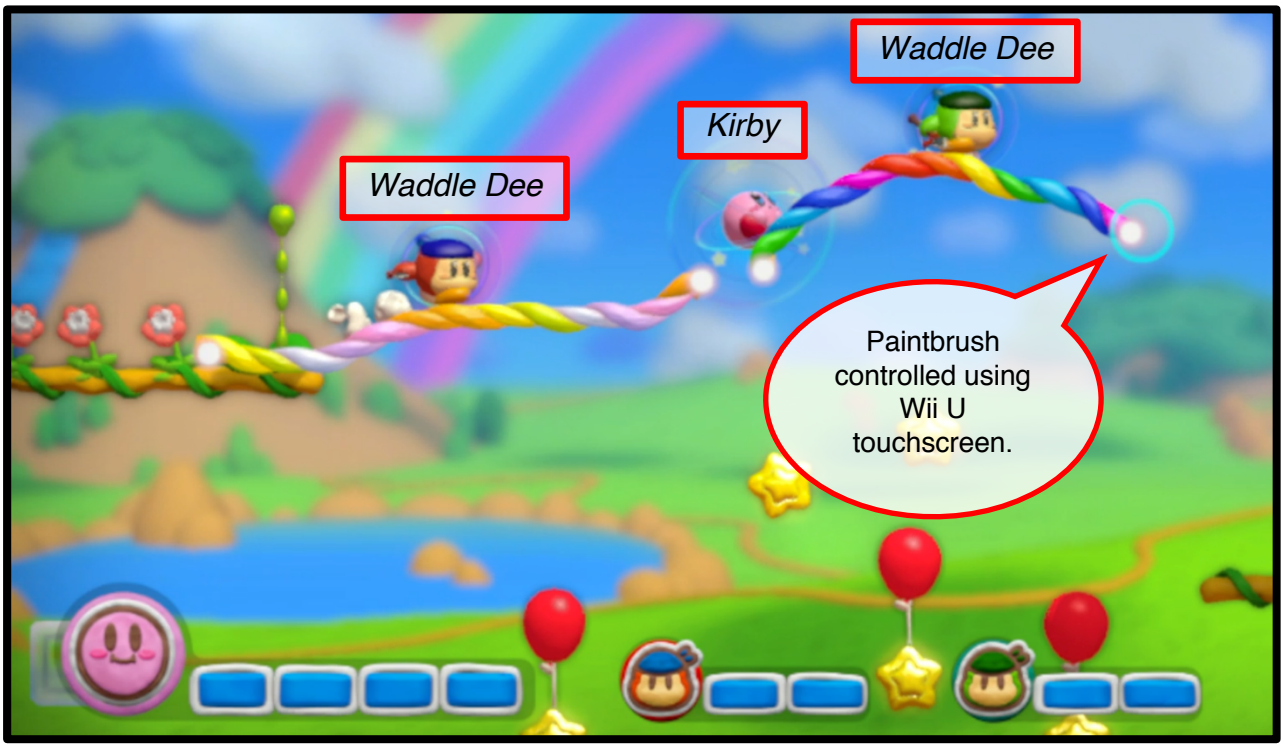


Figure 6.3. Example of a player using the *Rainbow Paintbrush* mechanic to draw a bridge for themselves and the other players.

As this game was designed as a single player adventure, there are no sections that required the assistance of the *Waddle Dees* in order to progress. The role of these secondary characters is to reduce the challenge of the game in certain areas. This included providing 'indirect assistance' by defending *Kirby* from enemies and acting as 'human shields' to intercept projectiles targeting the main protagonist. 'Direct assistance' in this game largely revolved around the ability of the *Waddle Dees* to pick up *Kirby* and carry him to safety. There were several instances where a less capable player was attempting to control *Kirby*, and the other players identified both these control challenges and a risk from a nearby enemy. In these cases, other players would pick up the main protagonist and move him out of the way.

6.3.1.3 Virtual interactions afforded through Mario and Star Fox's design

While the first two games promoted constraining players from leaving their peers, the majority of **Mario** provided freedom for players to speed ahead of the slower players. This reflected a larger focus on individual agency and less focus upon assistance within the game. Predictably, this resulted in far few instances of 'direct assistance' and 'indirect assistance'.

The one exception to this was the level *Plessie's Plunging Falls*, where all players share control of a common avatar and succeed or fail as a team. This section of the game is very similar in design to that of **Star Fox**. Both the *Plessie's Plunging Falls* level and **Star Fox** require 'direct assistance' from every player, demanding a high degree of coordination to navigate the levels. They also share an element of being 'on-rails', where the game is constantly moving them forward so the players are required to make decisions quickly as a team. This introduces an added layer of complexity to their social interactions.

While **Star Fox** assigns each of the two players a set role, either as pilot or gunner, *Plessie's Plunging Falls* allows every player to do everything. This resulted in the players having to negotiate amongst themselves as to their roles, such as who is going to decide when to jump. This level in **Mario** and the design of **Star Fox** differ in the ways that they present summative feedback to players. **Mario** retains the emphasis on individual performance within the team, while **Star Fox** only provides a collective score. It is interesting to note that **Mario** provides no indication as to how it calculates individual contributions to the team control of the avatar, but on both attempts at this level the students each were awarded differing scores.

While reviewing these in-game interactions in isolation tells part of the story, the connection between these in-game interactions and the interactions between the participants in the physical space presents a clearer relationship between game design and the application of

social skills. Six specific events are presented later in this chapter to explore this relationship, focusing upon the interplay between the design of the games and the actions of the study participants.

6.4 Interactions between the students and the teaching staff

This research project also sought to examine the role of the teaching staff within the intervention in supporting the development of the targeted social skills, as asked in guiding question c:

Guiding question:
c) What is the role of the teaching staff in supporting students' social skill development in this intervention?

While the previous chapter addressed the role of the teaching staff in facilitating the skill instruction (**Stage A**) and the group reflection (**Stage C**), this section analyses the role of the teaching staff during the cooperative play in **Stage B**, as depicted in Figure 6.4.

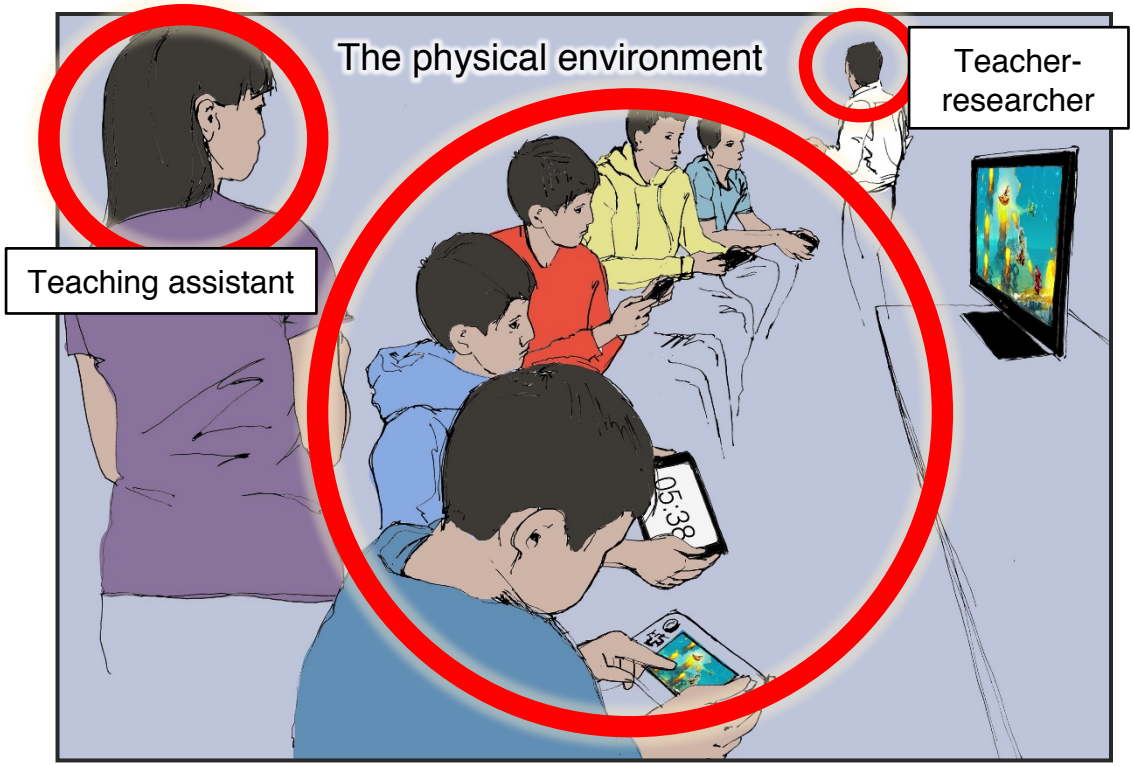


Figure 6.4. Focusing on interactions between the students and the teaching staff in the physical environment.

In order to analyse the nature of interactions between the students and the teaching staff during the cooperative play, four categories of interaction were identified and subsequently analysed:

- interactions initiated by the teaching staff;
- interactions initiated by the students;
- references to a target skill by the student directed to the teaching staff;
- references to a target skill by the teaching staff directed to the student.

Table 6.5 presents an overview of the data generated through the application of this coding scheme. This is followed by an examination of why these categories are important in understanding the role of the teaching staff within the broader design of the intervention.

Table 6.5. Instances of interactions between the students and teaching staff in the physical environment.

		Instance count (% of total time playing)									
		Rayman			**Kirby**				**Mario**		**Star Fox**
	Social skill	Version 0.1 Play time 24m 01s	Version 0.2 Play time 16m 54s	Version 0.3 Play time 27m 20s	Version 0.4 Play time 25m 41s	Version 0.5 Play time: 19m 48.08s	Version 0.6 Play time: 19m 04.76s	Version 0.7 Play time 30m 34.38s	Version 0.8 Play time 24m	Version 0.9 Play time 32m 15s	Version 1.0 Play time 31m 23s
Interactions between students and teaching staff in the physical environment	1. Teaching staff-initiated interactions	42 (24.17%)	12 (25.44%)	26 (20.14%)	26 (28.73%)	41 (42.16%)	31 (40.28%)	45 (39.47%)	45 (37.48%)	58 (44.28%)	103 (45.28%)
	2. Student-initiated interactions	1 (2.26%)	2 (2.29%)	3 (1.61%)	4 (3.54%)	2 (4.88%)	4 (6.46%)	11 (13.05%)	3 (0.72%)	6 (6.26%)	6 (14.29%)
	3. Teaching staff referring to specific skill	19 (2.61%)	12 (4.66%)	16 (2.65%)	21 (7.86%)	34 (6.89%)	28 (7.56%)	55 (7.41%)	38 (5.89%)	59 (6.22%)	59 (6.63%)
	4. Student referring to specific skill	**Not observed**	1 (0.13%)	1 (0.13%)	2 (0.22%)	4 (0.65%)	7 (3.73%)	16 (1.74%)	3 (0.30%)	3 (0.31%)	1 (0.15%)

When considering this data, the frequency of performance for each category of interaction is important in making comparisons between versions, but this is only a starting point for analysis. What is most significant is the nature of these instances, and how the interactions with the teaching staff impacted upon the students' performance of the targeted social skills.

6.4.1 Identifying the initiating party in a student-teaching staff interaction

A central consideration for the teaching staff was determining when, and when not, to intervene in student interactions during play. Beyond ethical reasons for immediate intervention, such as when a student was visibly distressed or was showing signs of frustration with their peers, calculated decisions had to be made by the teacher-researcher or the teaching assistant as to when to provide positive reinforcement, offer feedback or assist with the emotional regulation of the group.

In the earlier versions of the intervention, the teaching staff also fulfilled the role of ensuring that all players had the opportunity to perform all of the targeted skills. When there was an established expert-novice relationship between players, there were periods of time of minimal social interactions where the expert player exclusively made the decisions for the team. While this was an efficient way of progressing through the game, it did not provide other students with many opportunities to apply the target skills beyond 'listening to others' and 'friendly tone of voice'. In these situations, teaching staff intervened by calling a number of time-outs to ask other players to take on a more active role in leading the team. A pattern emerged in the first three versions of the intervention, with the more experienced gamers dominating the decision-making processes. As a consequence the teaching staff made the decision, beginning in Version 0.4, to intervene earlier to actively ensure a rotation of roles within the

team. An expert-novice relationship did however re-emerge in Versions 0.9 and 1.0 with the introduction of more complex games. These two versions recorded the highest duration of time of teaching staff interacting with students, with a notable emphasis on attempting to have all players included in determining the course of action.

In the later lessons, the students were also more willing to initiate interactions with the teaching staff to seek clarification or assistance with the complex game mechanics. This was most evident in Version 1.0, where 14.29% of the total play time was spent in student-initiated discussions of the mechanics of play. Of this considerable percentage of time, a large proportion was the teacher-researcher coaching Samus and Banjo on how to fly the ship using the Wii U Gamepad. Samus in particular recognised that this game was very different to the previous games he had played, and that he required game-specific knowledge that he did not possess. Interestingly, Samus also articulated his lack of understanding of the game mechanics in Version 0.8, but rather than relying on the teaching staff, Pit took it upon himself to advise Samus of the controls and the rules of play. These results suggest that when there is an imbalance of knowledge of a game within the group, teaching staff need to take on a more interventionist role to ensure that all players have the opportunity to contribute to the decision-making processes.

6.4.2 Referencing the targeted skills during student-teaching staff interactions

When interacting with students there was a deliberate attempt by the teacher-researcher and the teaching assistant to refer to the common language of the ten focus skills. Some students also began to use this language to describe the skills that they recognised as being required in certain situations. References to the focus skills by the teaching staff and the students are

shown in Table 6.5, above. When coding the footage, the duration of an instance of a staff member or student referring to a skill was recorded from the initial mention of the skill to the end of that staff member or student explaining the meaning or providing an example. This meant that if the teaching staff asked for clarification or further information, the instances were recorded as being significantly longer than if a student simply made a reference to a skill and then talked about something unrelated.

The frequency of references to the ten focus skills by the teaching staff increased over the ten lessons, but the percentage of total play time dedicated to these references largely remained the same from Version 0.4 to Version 1.0. This increase in frequency but decrease in time spent on each instance was partially deliberate. The staff felt that the students better understood the meaning of the skills after the first three lessons, so as the research progressed, less time was required in explaining what these skills could look like when applied in playing the game. Explanations of these skills alongside examples from previous gameplay lessons were being used in the video review in **Stage A**, so less time was required. One surprising result is that the percentage of time in which the skills were referenced remained the same when a new game was being introduced. It is reasonable to suggest that there should be an increase in the amount of time allocated to referencing skills in a new context. This was not the case. Of the games played over multiple lessons, only **Rayman** showed an increased frequency of teachers referencing the focus skills in the initial session of play. Versions 0.6 and 0.7 showed a significant number of student references to the focus skills, and were the lessons with the highest amount of time in **Stage A** (skill instruction) allocated to video review, with a focus on modelling this language. This highlights the importance of the explicit modelling of the desired behaviours preceding play, with the role of

the teaching staff being to positively reinforce the students' adoption of this language during play in **Stage B**.

6.5 Analysis of specific events of interest during gameplay

Fifteen significant events were identified during the cooperative play that highlighted:

- a high frequency of social skills performance from all of the participants;
- a more sophisticated use of the focus skills;
- a pertinent example of how the methods of instruction during play supported the students during the intervention; or
- an example of how instructional design or game design presented barriers to skill performance.

Six of these events are presented in this section to illustrate the interplay between the three categories of interaction:

- the student to student interactions in the physical space;
- the interactions occurring in the virtual environment; and
- interactions between the students and the teaching staff.

Within the analysis of each event, a coded timeline sequences these interactions allowing for an analysis of the antecedents and consequences of the skills being used. A key to these codes is reiterated in Figure 6.5. This shows which skills are being performed, and the conditions in which they are being used. In some cases, multiple attempts at the same section of a level are presented side by side, allowing for a juxtaposition of different approaches to a problem, the impact of differing combinations of players, or the impact of students engaging in a structured reflection following a team failure.

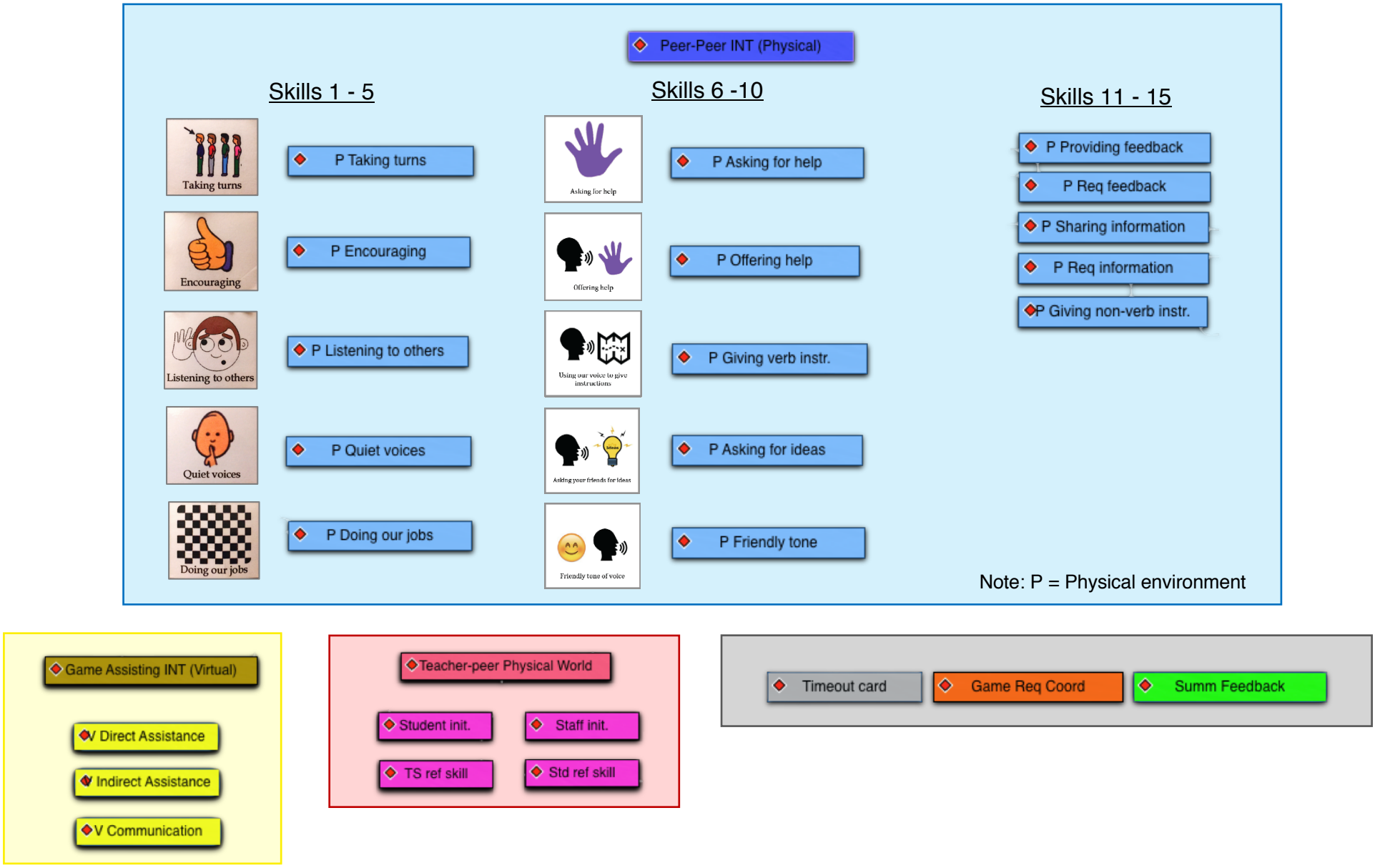


Figure 6.5. Reiterating the scheme developed to code the video data.

6.5.1 Event A: Co-discovery through learning to play a new game together

Version	Game played	Duration of event
0.1	Rayman Legends	12m 7s

One of the reasons for the selection of **Rayman** was that it built upon the familiar conventions of traditional 2D platform games with which all five of the students were familiar. Event A examines the degree to which the students interacted with each other in the process of co-discovering this new game, and the extent to which players shared their previous experiences of this genre with each other.

6.5.1.1 Description of the students learning to play

This event occurred at the very start of the first lesson of gameplay in Version 0.1, with the students each trying to come to grips with the mechanics of play and their role within the team. All of the students appeared to understand that the basic goal of the game was to move from the left of the level towards the right of the level, progressing towards a level exit or finish line. Familiarity with the team goal allowed the students to focus on the differences between **Rayman** and other platform games in how the avatars are controlled and interact with each other. The design of the level throughout Event A gently introduced the players to these differences, with on-screen prompts instructing players on how to control their respective characters. What the game did not do was explain *how* the unique capabilities of the different avatars could be used together to solve puzzles. One of the earliest puzzles required the player controlling Murphy to tickle a large enemy using the touch screen so another player's avatar could move past him, as shown in Figure 6.6.



Figure 6.6. The players learning the controls in the first level of Rayman.

6.5.1.2 Analysis of the social interactions

There were several social interactions of interest in Event A. The first was Samus trying to engage in friendly 'small talk' about the game, thanking Falcon for tickling a giant monster so that he could pass and then expressing that "This game is hard." Falcon remained silent and only spoke to give verbal instructions when Samus missed an item and was told to go back. The teaching assistant Tetra actually perceived this as a significant improvement in Falcon's willingness to interact with his peers:

Tetra:	I thought the game was great, considering that they hadn't played it before, and Falcon had played it, but found the game very hard. So it was good to see that working in the team, they actually, they could work it out together, and he did not get frustrated. And he [*Falcon*] was able to give instructions to the other students to let them know what they needed to do.

Link, waiting for his turn to play, was told that he was allowed to tell the players what he thought they should do. After this intervention (**A** in Figure 6.7), Link was far more vocal, recognised that Samus could not read the on-screen prompts and proceeded to read them for him. It was actually Link who provided verbal instructions on how the players should synchronise their actions so that they could progress past the large monster holding the shield.

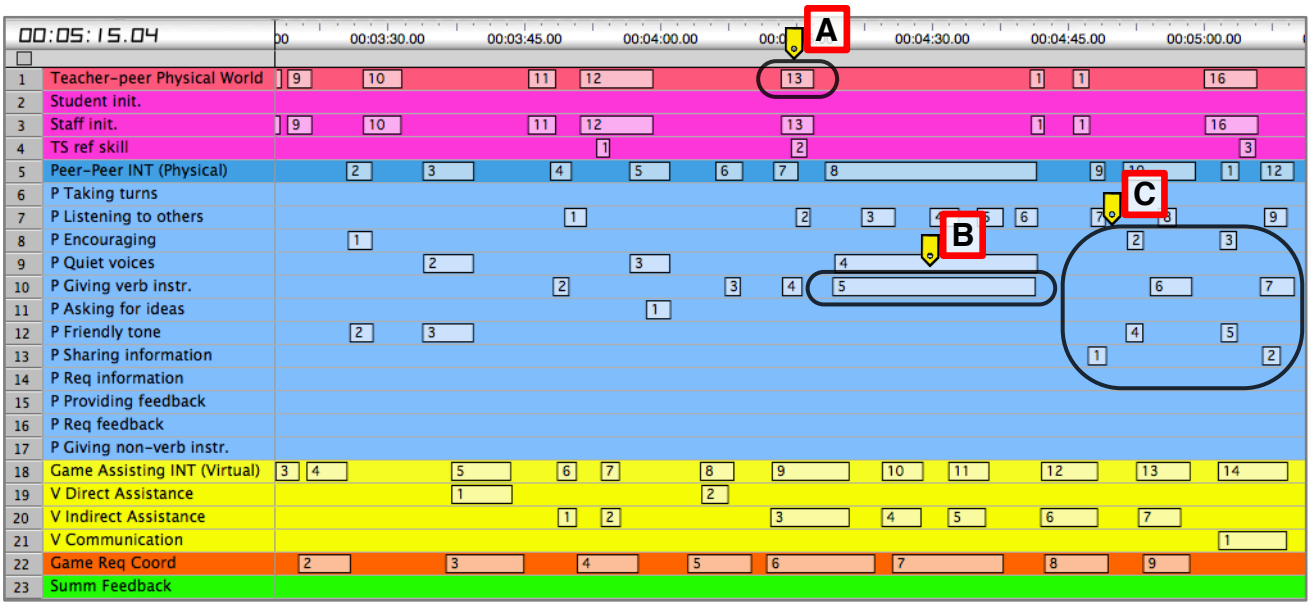


Figure 6.7. Sample coded data generated from Event A.

As the players became more comfortable with the game controls and move sets for their respective characters, they began to engage in providing and clarifying more sophisticated instructions about how to progress through the level, shown at **B** on the timeline in Figure 6.7. This section of the game promoted longer interactions by setting a high number of mini-challenges that required collaboration in order to proceed. Most of these initial challenges involved moving past static enemies and allowing the players to take their time in coordinating their actions. Failure at this point only set the player back to the previous screen, so there was very little risk for the players in trying something new. From **C** onwards the players became more confident and began to encourage each other and share information.

Interestingly, Falcon attempted to communicate at the end of this event using *Murfy* to highlight a door by waving the free floating avatar in front of where he wanted Samus to move. When Samus failed to understand the intention behind Falcon's motions, Falcon changed the form of his communication and verbally prompted Samus to travel through the door. These examples highlight the importance of individual students being provided with time, by both the game and their peers, to become comfortable with the controls and rules of play before focusing on longer-term team goals with their peers.

6.5.2 Event B: Real-time collaborative problem-solving

Version	Game played	Duration of event
0.2	Rayman Legends	5m 32s

While the complexity of the problem-solving in **Event A** was relatively simple, the challenges became increasingly complex as the players progressed in **Rayman**. **Event B** is an example of a more complex puzzle requiring precise coordination.

6.5.2.1 Description of the puzzle

This optional puzzle occurred towards the end of Version 0.1, with the players detouring to a room that held an optional prize. Link had to use *Murfy* to rotate a giant wheel, as shown in Figure 6.8. Inside this wheel was a maze through which one player had to navigate their avatar.

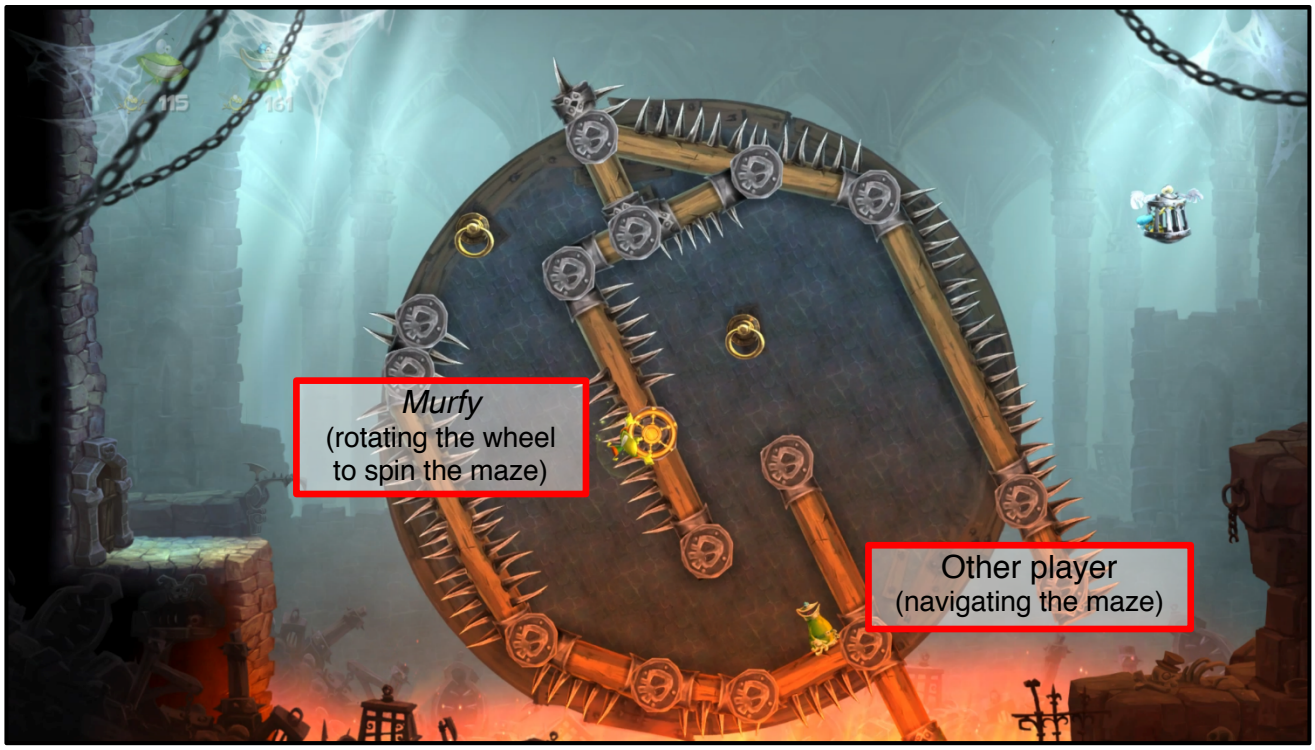


Figure 6.8. A puzzle requiring one player to navigate a maze while another player assists by rotating the environment.

This puzzle required both players to jointly plan and coordinate their actions. The design of the physics engine underpinning the platforming, particularly the game's interpretation of gravity, meant that it was not possible for one player to avoid the deadly spikes unless the other player changed the angle of the maze by rotating the wheel in consultation with their partner. One mistimed turn of the wheel meant that the navigating avatar would slide into the spikes requiring both players to restart this section of the game.

6.5.2.2 Analysis of the social interactions

This puzzle required constant player coordination in the virtual environment, which in turn required communication in the physical environment between the two players. By this stage of play, both Falcon and Link were very comfortable controlling their respective avatars. This was the first event in which the players died multiple times attempting the same puzzle. That said, the game was still quite forgiving, restarting them just outside of this room. When Link

first saw the wheel, he asked Falcon to provide feedback on whether he thought that they were skilled enough to complete this task. Falcon affirmed this and quickly took on the leadership role. On the first attempt beginning at **A** in Figure 6.9, Falcon gave Link a series of short but precise instructions on when to stop and start turning the wheel.

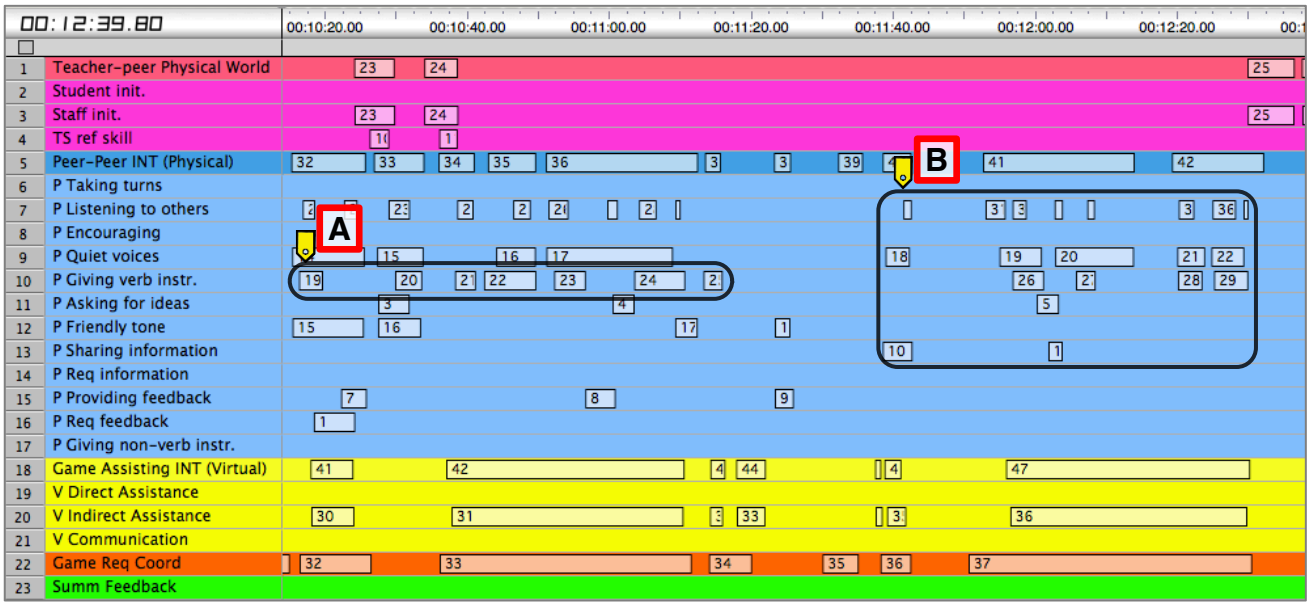


Figure 6.9. Sample coded data generated from Event B.

Link verbally acknowledged most of the instructions and immediately complied. It was only when Link accidentally tilted the wheel at the wrong time and dropped Falcon into some spikes that negative feedback was verbalised.

Falcon:	You made me die Link!

After restarting outside the room, Falcon quickly re-entered the puzzle room, pulling Link along with him. In their second attempt, it was Falcon who made the mistake, mistiming his initial jump into the left-hand side of the wheel and falling into the flaming pit below. Link briefly noted this but in a much subtler way than Falcon did earlier (shown at **B** in Figure 6.9). The two players attempted for a third and ultimately successful time, with Link asking for ideas as to which angle the wheel needed to be at in order to make it easy to avoid the

spikes. Falcon again provided very short but easily understood instructions and the players completed the maze. Link's recognition of when and how to provide feedback on performance was key in helping Falcon to regulate his frustration and for the team to achieve their goal.

This event illustrates the importance of teaching staff highlighting the connection between the effective use of the targeted skills, as modelled here by Link, and achieving the team goal. Central to this is developing a sense of shared responsibility between the players, ensuring that everyone understands their role and that team strategies are understood by all players.

6.5.3 Event C: Impact of stress upon skill performance

Version	Game played	Duration of event
0.3	Rayman Legends	5m 13s

Until this point in the game, **Rayman** had allowed players to control the speed at which they progressed through the game. There were no designed mechanics, such as time limits, to force the players to progress at a minimum pace. The level in Event C, entitled *Dungeon Dash*, however, introduced a mechanic requiring increasingly rapid decision-making. This created a sense of urgency amongst the players.

6.5.3.1 Description of the level design

As a wall of fire chased the players through the level, one player had to control a platforming avatar and move as quickly as possible through the level. Their path was blocked by a number of gates, traps and other impeding obstacles that *Murfy* could move out of the way. Some of these objects would only temporarily remain out of the path of the platforming avatar,

so timing was key. Figure 6.10 shows a failed attempt, where the player controlling *Murfy* had not lowered a platform in time for his partner, condemning them to a crispy death.



Figure 6.10. A player is trapped because his partner, controlling *Murfy*, has not lowered a platform to let him pass.

In order to succeed, the players had to coordinate their actions so that the path was clear at the right time, all while being pressured to accelerate their actions by the foreboding wall of fire.

6.5.3.2 Analysis of the social interactions

External pressure had a visible impact upon the interactions between the two players in this level. As soon as Falcon recognised the threat from the wall of fire, he changed the brevity of his instructions, as shown in Figure 6.11.

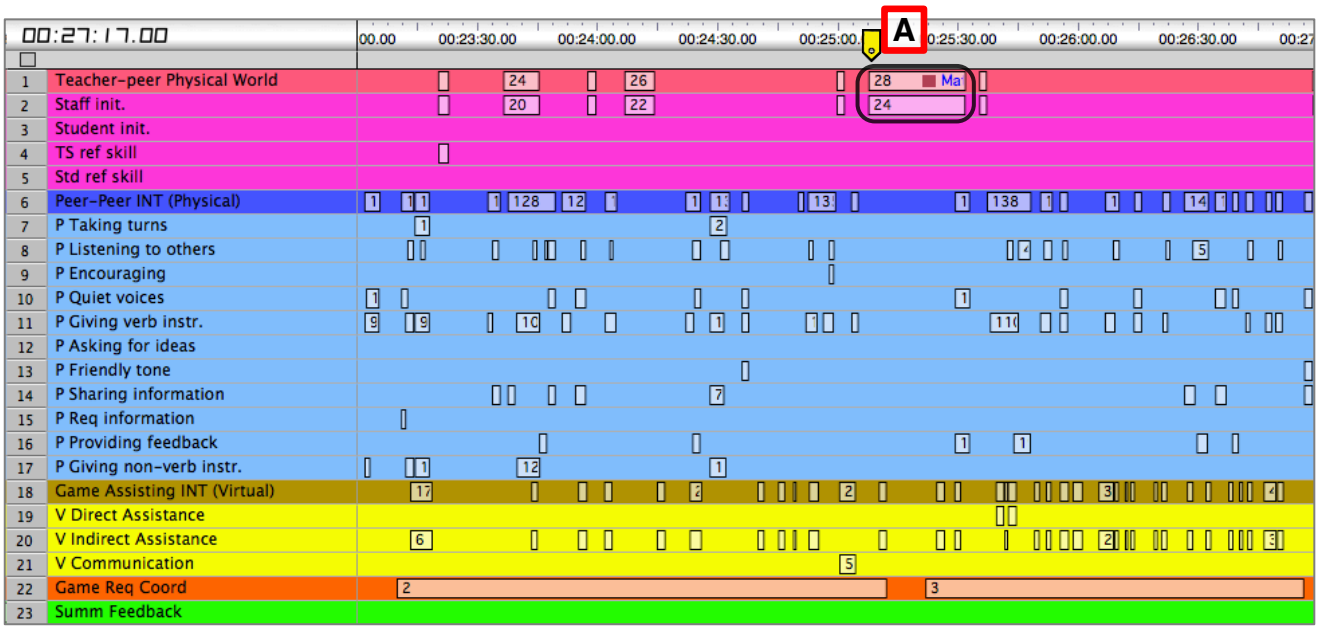


Figure 6.11. Sample coded data generated from Event C.

Using mainly incomplete sentences, he quickly grew frustrated with Pit's non-compliance. This in turn resulted in Pit becoming frustrated with Falcon's feedback on his performance, insisting that "I'm trying Falcon!". While Pit's feedback on his own performance suggests that he is trying to help, it was unclear whether he was not opening the gates due to insufficient processing time, the level of fine motor skills required to quickly use the stylus and touch screen, or a combination of the two. Importantly, Falcon then appeared to recognise that Pit did not understand what was required, and he changed the way he was giving instructions. At first, he used a combination of one- or two-word phrases such as "Open it!" in conjunction with non-verbal gestures towards the obstacle on the screen. This resulted in multiple failures.

At this point, the role of the teaching staff became central, as this scenario presented an ideal opportunity for guiding the players in strategies to regulate their emotions and to identify the language required for communicating clear instructions. The teacher-researcher intervened (shown at **A** in Figure 6.11), facilitating dialogue between the players so that they could

reconcile their individual roles within the team and consider what the other player would need to know. Although Falcon and Pit continued to perform the same types of skills following the intervention, the way they used these skills was much more effective. The players were more receptive to each other's feedback, adjusting their individual strategies and becoming more synchronised in their actions. This allowed them to complete this challenging level. It was important that the teaching staff actively supported players in the performance of the targeted skills during these challenging segments of play rather than avoiding stressful segments. This event highlights that with careful teacher guidance, stress inducing mechanics can provide learning opportunities for students to rehearse emotional regulation in parallel with skill performance.

6.5.4 Events D1 and D2: Informing future strategies through analysing failure

	Version	Game played	Duration of event
D1	0.6	Kirby and the Rainbow Paintbrush	7m 45s
D2	0.7	Kirby and the Rainbow Paintbrush	9m 3s

Events D1 and D2 present two of the most complex sets of interactions between the players, the game and the teaching staff. One convention of videogame design that largely transcends genre is the 'boss battle'. In such battles, the player or players are faced by an antagonist with substantially more life than 'normal' adversaries and take considerably longer than the average foe to defeat. These boss characters also often use defined patterns of attack and have a point of weakness within this pattern. The key to successfully completing these boss

battles is recognising that pattern, identifying a weakness and then systematically exploiting it.

6.5.4.1 Description of the boss battle

Whispy Woods was the first boss character encountered by the players in **Kirby**. As alluded to by his name, this boss character was a giant and ill-tempered tree that created gusts of wind causing the players to lose control of their characters. The only way to defeat *Whispy Woods* was by directly attacking his large trunk, shown in Figure 6.12.



Figure 6.12. As part of his attack pattern, *Whispy Woods* released a flock of birds to target *Kirby* and to serve as shields for himself.

This act is further complicated by the gradual introduction of other obstacles. Spiked balls grow from his branches, and *Whispy Woods* then blows these at the players' characters. Once the boss has taken a certain amount of damage, protective birds hatch from nests in his branches, giving the players many different threats to monitor and evade. The red birds

act as shields, preventing the players from getting too close to *Whispy Woods* and causing him damage. The blue birds lock onto *Kirby* and will home in until they crash into him, causing significant damage. This was significant because when *Kirby* died the whole team was required to restart the battle from the very beginning. This component of design prioritises the protection of *Kirby*, meaning that some players had to defend the primary protagonist while other players would go on the offensive and attack *Whispy Woods*, as shown in Figure 6.13.



Figure 6.13. The players adopted roles within the team, with two players defending *Kirby* while one player attacks *Whispy Woods*.

This created the need for players to develop roles within the team to effectively counteract these threats and to eventually defeat the boss. Two attempts at this boss battle are presented below, with the first attempt occurring in Version 0.6 and the second attempt in Version 0.7.

6.5.4.2 Analysis of the first attempt

The first attempt at defeating *Whispy Woods* in Event D1, as shown in Figure 6.14, involved a near constant stream of interaction between the five players.

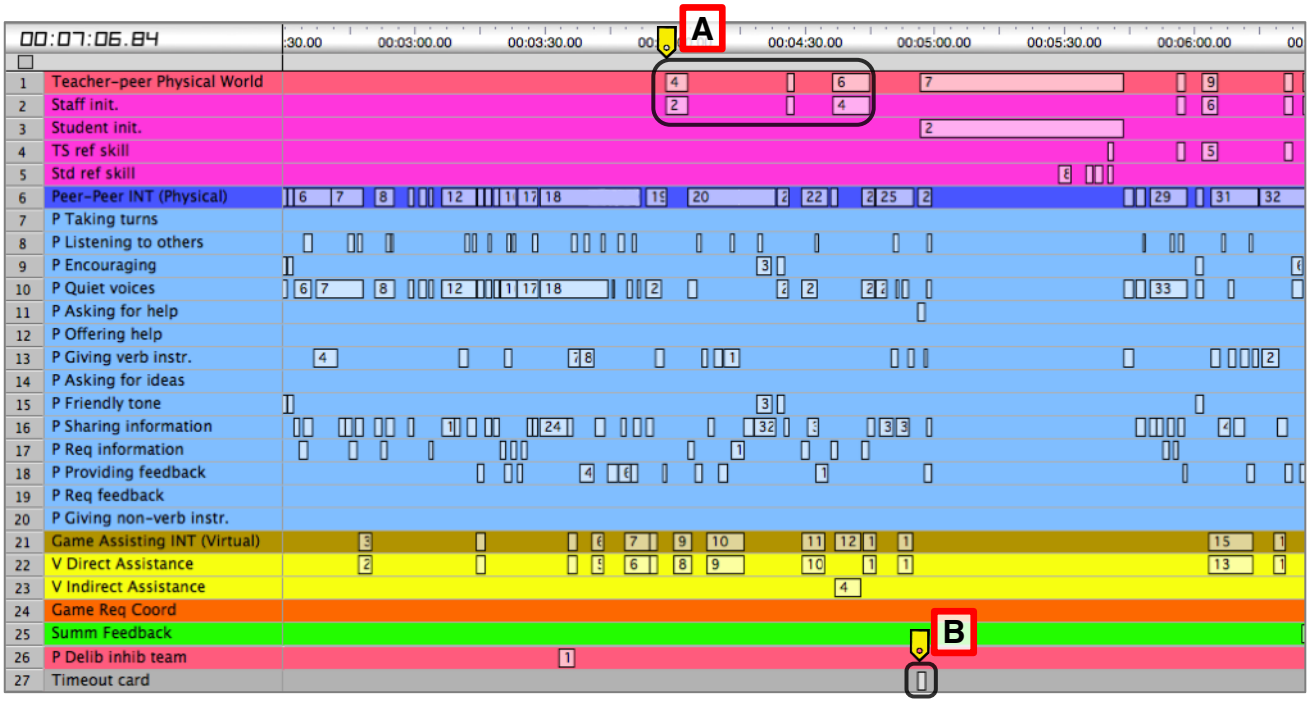


Figure 6.14. Sample coded data generated from Event D1.

A large number of these interactions consisted of the players sharing information about the status of the boss, sharing the role that they were taking on at that point of time, and requesting information about which strategy was required at a particular point of the boss's pattern of attack. Falcon took it upon himself to defend *Kirby*, while instructing Pit and Samus to attack *Whispy Woods*. The students largely organised themselves and until **A** (in Figure 6.14), there were minimal interventions from the teaching staff.

The players began this battle controlling the volume of their voices, but as the intensity of the boss's attack patterns increased and *Kirby* took substantial damage, this socio-emotional regulation decreased. At **B** (in Figure 6.14) Falcon called a time-out to ask for intervention from the teaching staff. During this time-out the players clarified both the team goal and the

strategies that they were using, with the teaching staff helping them to identify universally understood language. When prompted, the players could articulate some of the skills they had been using and why these skills were important in this battle. Although this intervention was a positive display of the students' understanding of the purpose of the targeted skills, this did not translate immediately to success in the game. Once play resumed, *Kirby* died, with the players forced to restart the battle.

6.5.4.3 Analysis of the second attempt

While the teaching remained largely passive in the initial attempt, there was a recognition by teaching staff of the need to strategically call regular time-outs in order to break this long battle into smaller stages of play. This was rehearsed during video review of the previous attempt during the **Stage A** (skill instruction) directly preceding this second attempt. These intermediate periods of pausing the action allowed for evaluation of the current strategies and planning for adjustments, as can be seen in Figure 6.15.

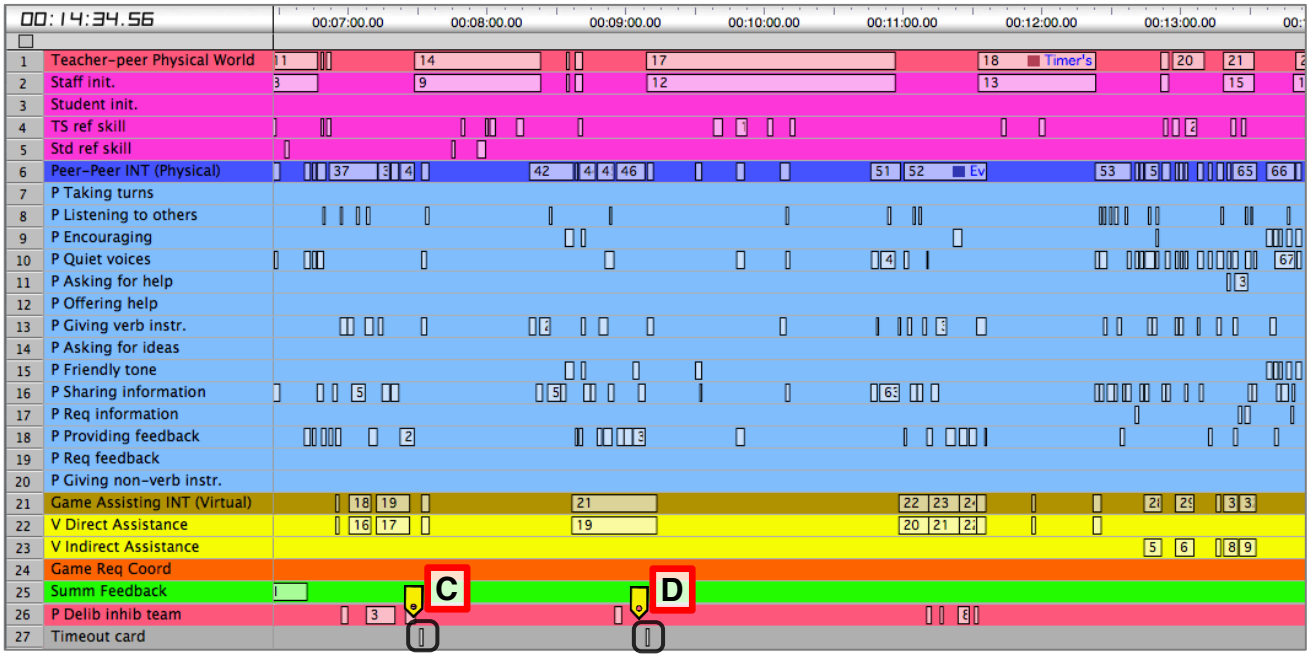


Figure 6.15. Sample coded data generated from Event D2.

These breaks in the action resulted in the players being able to plan their communication and feedback to each other calmly. The importance of these breaks was recognised by the players, as they called time-outs at **C** and **D** during play (see Figure 6.15). These events highlight the affordances offered by more complex boss battles in providing opportunities for group strategisation, as well as the importance of the teaching staff in positioning failure as a learning experience.

6.5.5 Event E: Learning to navigate a more complex game world

Version	Game played	Duration of event
0.8	Super Mario 3D World	5m 15s

This event encapsulated the entire first level of **Mario** that was introduced for the first time towards the conclusion of the design experiment in Version 0.8 of the intervention. This level represented a significant increase in difficulty for some players, with less experienced players finding the game controls and mechanics challenging to access.

6.5.5.1 Description of the event

Although building on many of the conventions used in 2D platform games, the addition of a third dimension in **Mario** necessitated more complicated controls and afforded more complex level design. These two factors combined to require that the players had a level of depth perception that **Rayman** and **Kirby** did not require. The physics engine contained within this game was far more sophisticated than that in the previous two games, and various sections of the game used this to create additional challenges and puzzles relying on an understanding of force and gravity. For these reasons, even though this was only the first

level, ‘Super Bell Hill’ was considerably more challenging for some of the players than anything encountered in the previous two games.

Furthermore, this game did not require players to wait for their peers, which allowed a far greater amount of freedom for individuals to play for themselves and not attend to other players. If a player dropped too far behind the rest of the group, they were placed in a 'bubble' and automatically brought to the front runners. This created a cycle where the less skillful players would lose control of their characters, reducing their opportunities to practice and improve their skills. This can be seen in Figure 6.16, where a player has fallen behind and is about to be placed in a bubble.

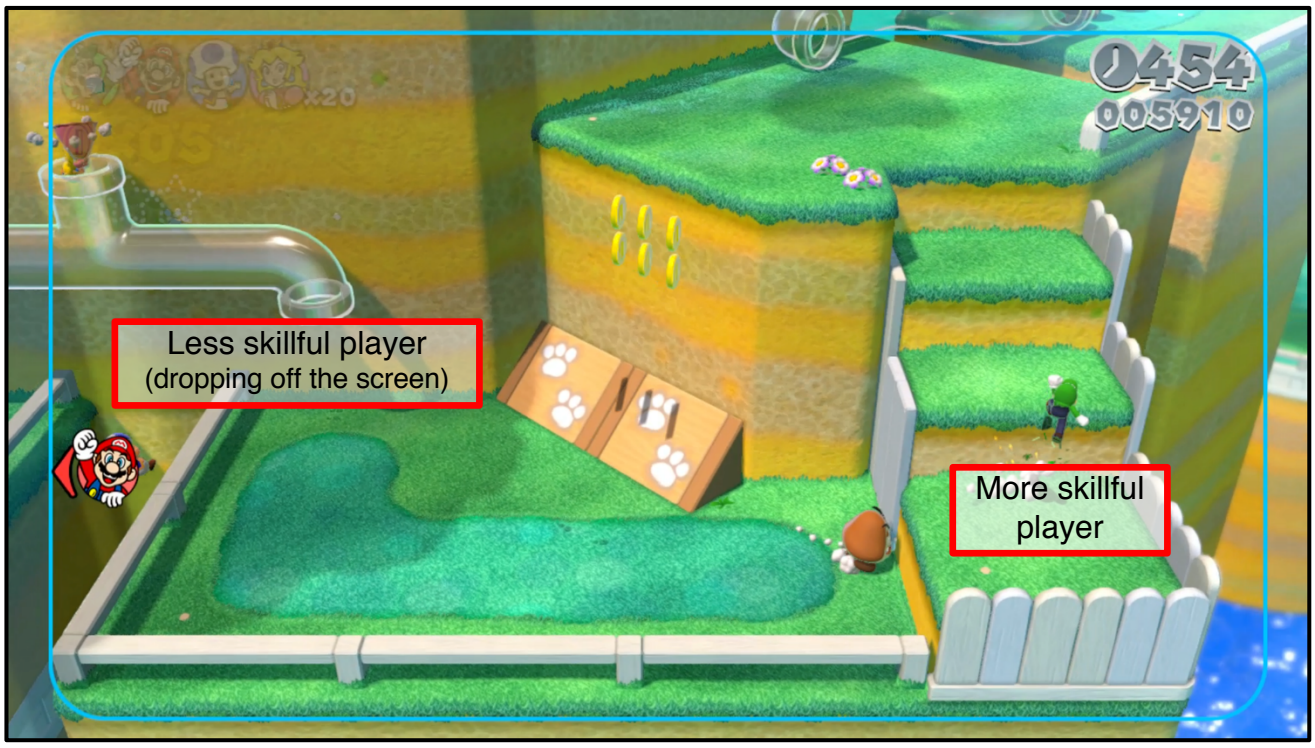


Figure 6.16. The two more skilled players often ran ahead of the less skilled players.

Pit was intimately familiar with this game, while the other students had never played it. This led to an interesting dynamic within the group that impacted upon the interactions between players. While the previous two games in this intervention focused on team performance by

providing feedback on the total number of items collected, **Mario** highlighted and rewarded individual performance. This is most evident in the summative feedback provided by the game at the conclusion of a level. As can be seen in Figure 6.17, a bar graph displays and visually compares the performance of all the team members, allowing the players to compare and contrast their relative performance. The highest performing player is rewarded with a crown, which their avatar wears in the following level.



Figure 6.17. Each level provided summative feedback on the individual scores of each player.

6.5.5.2 Analysis of social interactions

As can be seen in the timeline for this event shown in Figure 6.18, Event H required numerous interventions by staff due to the design of the game that allowed less skillful players to be left behind by their peers.

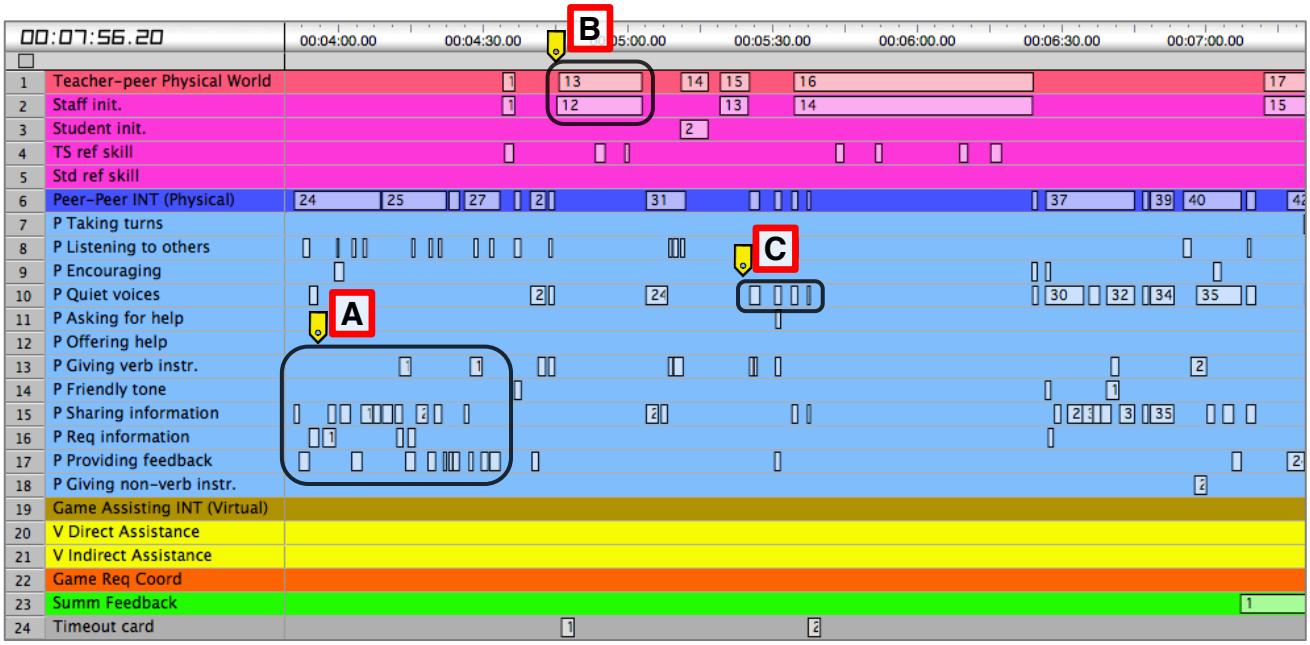


Figure 6.18. Sample coded data generated from Event E.

This level begins with all of the players standing together, but Falcon and Pit left little time for Samus and Banjo to figure out the controls. They quickly ran off, causing Samus and Banjo to 'bubble' and return to Pit and Falcon. For Samus and Banjo to leave the bubble, Falcon or Pit had to make contact with them to 'pop' them out and return control to those players. However, these two experienced gamers made no observable effort to do this. As they were almost immediately placed in the bubble, Banjo and Samus began asking Falcon and Pit for information about the controls. Falcon ignored them and instead focused on sharing possible locations of hidden items with Pit. Pit did attempt to explain the controls at **A**, but he did not release either of his teammates from their bubble imprisonment (see Figure 6.18). While **Rayman** and **Kirby** enforced the collective movement of the group, in **Mario** this was a task teaching staff had to fulfil to ensure that all players could productively contribute to the team goal.

At **B** the teaching assistant called a time-out and instructed the two experienced players to release the two novices from their bubbles, and to go slowly (see Figure 6.18). During this

break, the teacher-researcher made reference to the skill 'using your voice to give instructions' because although Banjo had asked to be released, Samus had remained silent. It is unclear whether Samus understood that he did not have control of his character for the majority of this first segment of play. This first intervention did little to change the pace of play by Falcon and Pit, despite Samus now asking for help at **C**, as shown in Figure 6.18. The teacher-researcher once again interrupted play with a time-out. Making multiple references to the 'listening to others' and 'offering help', he explained that the team shares a common set of lives, and that every time Samus or Banjo lose a life because the other two were pushing them to move too quickly, then everyone is disadvantaged. This made little difference. Although Pit continued to share information on the rules of play and directed Samus towards the 'run' button, he did not reduce the speed at which he was playing. As is shown in this event, intervention from the teaching staff during play is most effective when they are supported by a game design that promotes the participation of all players rather than one that rewards individual accomplishments.

6.5.6 Events F1 and F2: Enforced coordination through sharing an avatar

	Version	Game played	Duration of event
F1	1.0	Star Fox Zero	14m 3s
F2	1.0	Star Fox Zero	6m 12s

While the students had some experience of sharing control of a common avatar, most notably in the *Plessie's Plunging Falls* level in **Mario**, the entire multiplayer mode of **Star Fox** was designed around this mechanic. Events F1 and F2 analyse two attempts by the same players

at co-piloting their shared spaceship. This ultimately resulted in a sophisticated instance of perspective-taking by one of the students.

6.5.6.1 Description of the co-piloting mechanic

Each player had to understand their role, and also had to possess the skill to accurately fly or target enemies. If one player lacked understanding of their role, or the skills to carry it out as demanded by the level design, then the team would fail. Like the level *Dungeon Dash* in **Rayman**, forced progress through the level added to this tension by creating a sense of urgency. This demanded that decisions be made with very little time for processing or regulatory planning. The conventions of this genre of game required a different skillset to that of the platform games that had been used prior to this version of the intervention.

The three-dimensional field of play also created navigational challenges, as even in **Mario** the players were generally expected to move from left to right. While the game was clear in presenting the level objectives, the actual location of where the player had to be in the free moving 'all range mode' was not as clearly signposted as in previous games. In part this can be attributed to the more complex graphical detail found in this game, with less experienced players finding it difficult to discriminate between quickly moving inactive and active objects, such as a background decoration and an enemy, as shown in Figure 6.19.



Figure 6.19. The fast-paced opening level of Star Fox is filled with enemies, obstacles and visual distractions.

This game was far less forgiving of error compared with the other three games. The opportunity for Falcon to showcase his expertise in a complex game might be one reason why he requested using **Star Fox** in this intervention. The computer-controlled allies also modelled how an expert pilot should be flying. A more complex game design and an increased level of difficulty highlighted the skill gap between the skilled gamers and the novices.

6.5.6.2 Analysis of the social interactions in the first attempt

This was the first time that Samus had played **Star Fox**. When questioned later about his level of skill with this game, Falcon proudly declared himself an expert. Initially, Samus piloted the craft, while Falcon controlled the weapons systems. From the outset of play there were a number of instructions issued and peer feedback provided, primarily by Falcon, but no instances of information being shared. This suggests that Falcon might have assumed that

Samus would either have a similar level of skill to himself or would independently work out how to play. Figure 6.20 shows that the frequency of sharing information only increased following the initial time-out called by Falcon (A), with him recognising that he was becoming frustrated with his partner. By this tenth lesson, the students had become comfortable with the time-out mechanic and were using it as a form of emotional regulation. During this break, the teaching assistant suggested that Falcon play the pilot and Samus control the weapons systems. While this idea was enthusiastically embraced by the other students, Samus initially protested but then relented when reassured by his peers. This is significant because it highlights a tension in that Samus understood that the pilot role was beyond his skillset but he was also a proud gamer.

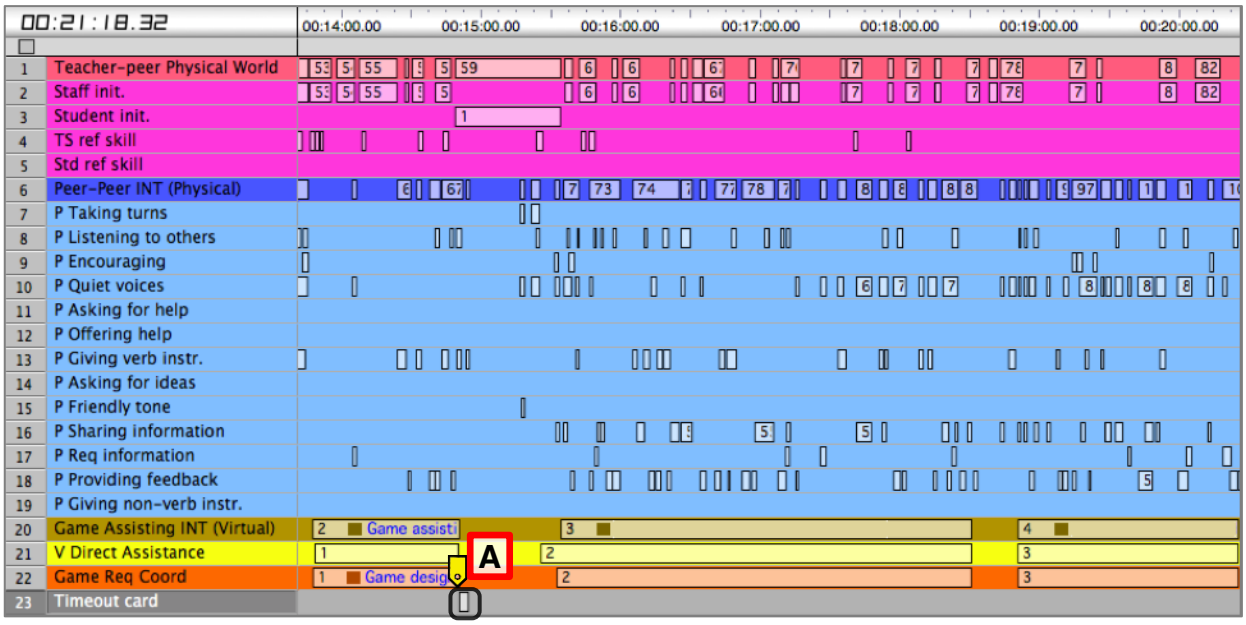


Figure 6.20. Sample coded data generated from Event F1.

During this student-initiated intervention, it was also pointed out to Falcon that he was the only one who had played this game before. When play resumed, the other students attempted to assist Samus. While the sharing of information and feedback was initially provided in controlled, quiet voices, the students soon lost patience with the frequent crashes and lack

of progress through the level. This frustration suggested that Falcon recognised both the importance of each players' roles, and that Samus was not particularly skilled at either. The challenge here was that unlike the other games, there was no built-in mechanics to compensate for a less skilled player working with a more proficient partner. Consequently, they could not progress past the first level. This was the first time this had occurred over the ten lessons and the students did not know how to respond in this situation.

6.5.6.3 Analysis of the social interactions in the second attempt

Event F2 represents the second attempt by Falcon and Samus to play together, this time facing off against a large boss character. As Falcon was adept at avoiding enemy fire and had memorised the attack patterns of the boss, he could both prolong the time the team could stay alive and simultaneously coach Samus as to how to defeat the boss. In between Event F1 and F2, Falcon had practised with the teaching assistant a series of instructions, detailing where Samus needed to aim. Despite this effort, the two players were undermined by the game design's use of an overly complicated control scheme. The weapons system required the use of the Wii U Gamepad and the gyroscope controls built into the hardware. To aim, a player had to look at the small screen and move the larger controller to aim the guns that he was controlling. Samus had developed the confidence and skills to ask his peers for help, and Banjo tried to model this for him, but he remained confused as the mechanics were so different from anything he had previously experienced. At **B** the most important event of this Version 1.0 occurred (see Figure 6.21). Falcon called a time-out and suggested that Samus should play the training mode.

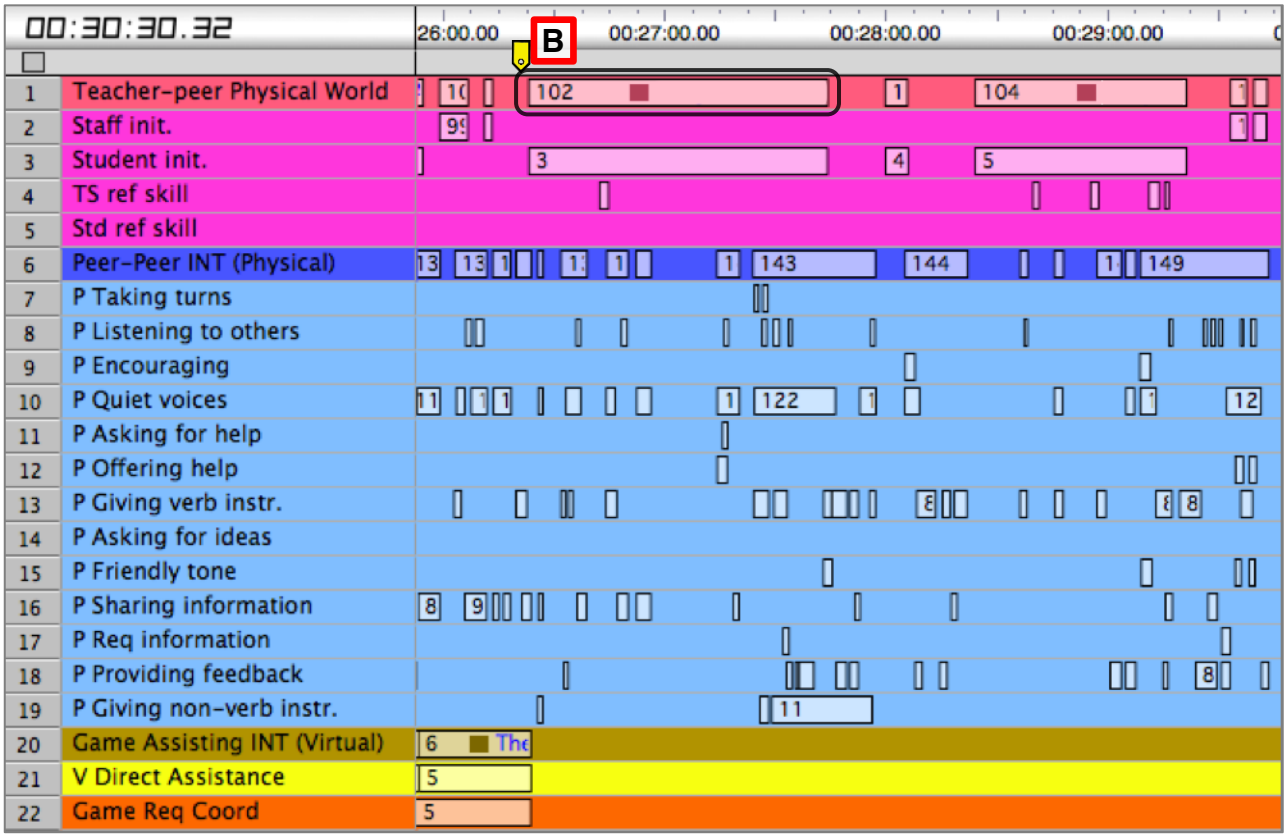


Figure 6.21. Sample coded data generated from Event F2.

This is significant because Falcon was knowingly encouraging Samus to play the tutorial mode that is exclusively single player, which would exclude him from having his turn. This event demonstrated that a player with social-communication challenges had:

1. recognised that team success may require their individual sacrifice;
2. recognised that they may not have the communication skills required to instruct their peers; and
3. reflected upon how they had learnt to play the game and had shared this instructional aid.

6.6 Chapter conclusions

This chapter has reported the analysis of the social interactions occurring during the cooperative play in **Stage B**. These interactions occurred across multiple levels. Performance

of the targeted social skills were observed in the physical space, while students also directly and indirectly assisted each other in the virtual environment using the affordances of the game design. Important to the findings of this study were the scope and nature of interactions between the teaching staff and the students, and how this supported the performance of the targeted skills.

Analysis of these interactions is important in understanding what was occurring at each level. The six key events presented in this chapter allowed for a deeper analysis of the interplay between these levels of interaction. These events are significant in addressing all five of the guiding research questions, and informed the design modifications reported in *Chapter 6*. They also illustrated the connection between the game design mechanics found in the four games used in this study and the effect these had on the interactions within the physical and virtual environments.

Chapter 7: Optimising skill development and the systems for intervention

7.1 Chapter introduction and structure

The findings from the research presented 15 focus social skills that were identified through the design research process. Effective instructional methods were identified for nurturing the students' understanding and performance of these skills, as well as resources educators could use to support these methods. Contrasting the findings of this study with the principles of effective instruction in the reviewed literature allows for recommendations to be made on how educators can best optimise the development of social skills through digital games-based intervention. This chapter examines how these recommendations can inform the design of an intervention that utilises the social interactions created during cooperative gameplay, addressing the guiding questions relating to optimising the systems of intervention, as shown in Table 7.1 and subsequently discussed below.

Table 7.1. The research questions addressed in Chapter 7.

Primary research question: How can children with social-emotional challenges develop targeted social skills through intervention using cooperative videogames?	
Objectives:	**Guiding questions:**
Optimising the systems of intervention: To design a set of guidelines for interventions using cooperative videogames.	a) What methods of instruction can be used to optimise the learning of targeted social skills? b) How can targeted social skills be practised and performed during cooperative gameplay? c) What is the role of teaching staff in supporting students' social skill development in this intervention?

Guiding questions **a**, **b** and **c** relate to two of the three focus components of the designed intervention, as shown in Figure 7.1. This chapter is concerned with optimising the methods of instruction to develop the 15 targeted social skills and how these can be implemented using the three-stage structure (**Stage A –** skill instruction, **Stage B –** cooperative play and **Stage C –** group reflection).

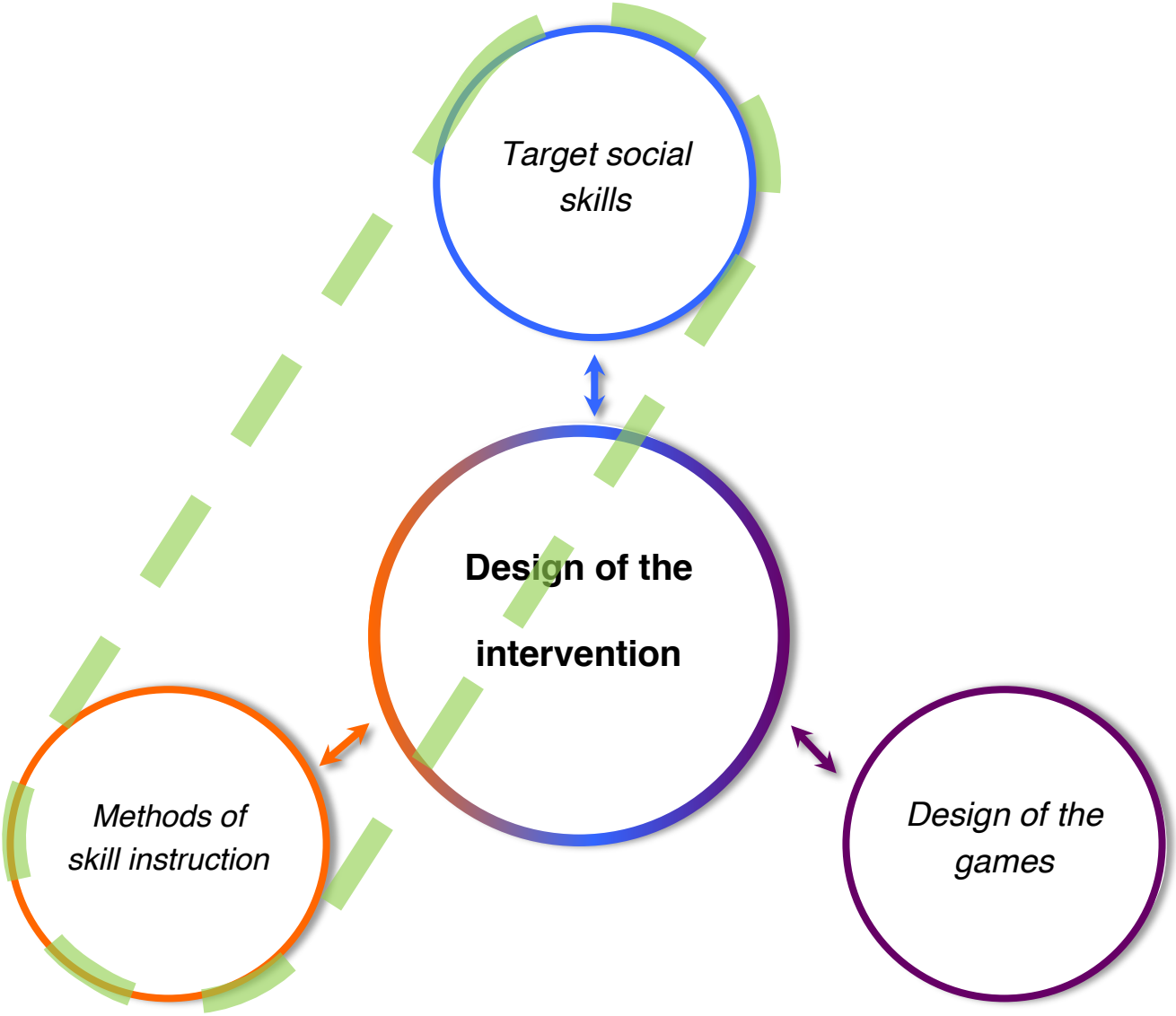


Figure 7.1. The emphasis on optimising the target social skills and the methods of skill instruction in *Chapter 7.*

Moving beyond individual skills, this chapter explores how students can combine these skills at increasing levels of sophistication and how educators can support students in doing this. The *Collaborative problem-solving empirical progressions* (Hesse et al., 2015) discussed in *Chapter 2* and included in Appendix A provide examples for educators of how students can use the focus skills together. Examples drawn from the progressions are useful for educators in ascertaining the levels of skill performance, as they provide detailed descriptions of what skills should look like when being performed at varying levels. The progressions are organised from the initial level of 'independent working' through to the most sophisticated level of 'cooperation and shared goals' (Hesse et al., 2015), shown in Figure 7.2.

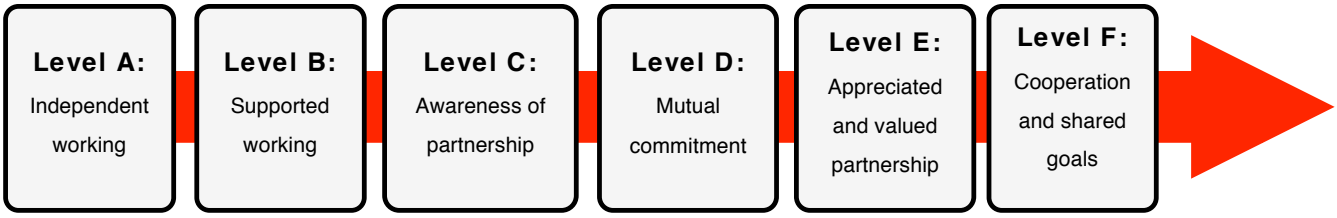


Figure 7.2: Six levels of collaborative social skill performance in the *Collaborative problem-solving empirical progressions.*

Educators can address Hattie and Timperley's (2007) question of 'Where to next?' for students by following the typical developmental path conceived by the *Collaborative problem-solving empirical progressions*. While it is important to recognise that some students with socio-emotional challenges might not always follow this typical pathway (Coles-Janess & Griffin, 2009) and do not address every focus skill, these progressions are useful for providing a well-defined vocabulary and a point of comparison for discussing levels of sophistication in consultation with other literature.

7.2 Scaffolding and nurturing the development of the targeted skills

Data generated through the design processes provided insights into the types and frequency of students' use of social skills when playing cooperative videogames. This section examines the ways that the focus skills were used by the students when supported by the teaching staff, comparing the findings of this study with the established social skills intervention literature. The 15 individual focus skills are grouped within six key themes identified during the analysis of the data and the literature. The introduction to each theme includes specific reasons why the skills were organised into these groups. While themes characterise key competencies represented in the Collaborative problem-solving empirical progressions (Hesse et al., 2015), as shown below these are not a perfect alignment. These Collaborative problem-solving empirical progressions are most useful are in illustrating how students can combine individual skills in increasingly sophisticated ways with support from educators.

Using this analysis of the performance and conditions for use for each of the targeted skills, a set of **recommendations** for educators to scaffold, nurture and support the development of these skills is presented.

7.2.1 Participating in group activity



Indicative behaviours:

- Playing the game while attempting to accomplish the team goal.

Participation is a prerequisite for the use of all other focus social skills, as every social interaction requires at least two people (All et al., 2016; Griffin et al., 2012). This is reflected in the *Collaborative problem-solving empirical progressions* (Hesse et al., 2015), which

position engaging with a peer as the foundational step on which performance of all the other skills depend. Examples of increasingly sophisticated levels of students participating in social interactions are shown in Table 7.2.

Table 7.2. Three levels of participation in the *Collaborative problem-solving empirical progressions*.

Level	Indicative behaviours
Level A indicators (Independent working)	🔍 The student commences the task independently focusing on the instructions provided. 🔍 Interaction with their partner is limited to the beginning of a task and only in those situations where the instructions are clear.
Level C indicators (Awareness of partnership)	🔍 The student demonstrates effort towards solving the problem. 🔍 The student discusses the task with their partner by responding to communication cues and requests.
Level D indicators (Mutual commitment)	🔍 The student perseveres to solve the task by repeating attempts and/or multiple strategies.

Including the terms ‘effort’ (Level C) and ‘perseveres’ (Level D) in these examples suggests that Hesse et al. (2015) differentiate levels of participation on the ability of a student to remain motivated and engaged when the team experiences challenge and failure. In this study, videogames represented a shared area of interest which provided sufficient motivation for students to sit with their peers and play the games. The results showed frequent instances of the group discussing tasks set by the games with each other and responding to communication cues and requests from their peers. In other tasks these students would regularly complete intended group tasks individually. Key events reported in *Chapter 6* include multiple examples of the students experiencing repeated failure, yet

importantly they persisted in playing with their peers and attempted to overcome each challenge.

This highlights that one of the most important affordances of cooperative videogames is that game design can guide players towards working with their peers to complete the team goals without students having to make a conscious choice. An example of this can be seen in the rules of **Rayman**, which dictate that both players must fulfil their roles within the team to complete the level, with no one player being able to complete the required tasks as an individual. Constraining player agency might seem to be in conflict with the principles espoused by Gee (2007b) and Squire (2005), but this study demonstrates a clear benefit of manufactured social interaction. While at first glance withholding the choice of whether to participate in working with peers in order to be successful in the game might seem undemocratic, the lack of agency in this regard resulted in near uniform participation. Educators have a vital role in selecting games strategically to ensure all players are active participants. *Chapter 8* further explores the role of game design in creating the conditions for collaboration.

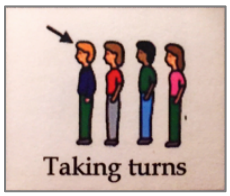
Where the students did have some degree of agency is in self-organising roles within the team. This freedom occurred in the metagame (Hayes & Duncan, 2012) in the physical environment, aligning with the types of social regulation described by Ducheneaut and Moore (2005). More than simply attempting to accomplish the team goal while sharing a virtual world with their peers, a sophisticated combined use of the targeted skills involved the students negotiating and forming a consensus around which 'jobs' or roles in the team each player would perform. This study showed that these discussions need to be facilitated by the teaching staff, ideally during a time-out breaks or during video reviews. For some learners, the language for describing their role within the team needed to be explicitly taught

during these discussions. As players regularly rotated through various roles, new vocabulary was often required. Cognitive load theory provides a lens for explaining the necessity of rehearsing this language. Sweller et al. (2011) emphasised that steps should be taken to ensure that learners can draw upon their long-term memory as much as possible to reduce the burden on their working memory. Specialised terminology for each role in a game, such as *Waddle Dee* in **Kirby**, needed to be modelled by the teacher and rehearsed prior to play in order to avoid the students overly relying on their working memories and becoming overloaded during these discussions of roles within the team.

Recommendations for supporting participation

1. As a prerequisite for the use of all social skills, educators should be strategic in selecting games that guide players towards working together to complete the team goals.
2. Educators should guide players to discuss their role and the roles of their peers within the team prior to gameplay or during time-out breaks.
3. Specialised terminology for each role needs to be practised and modelled by the teacher prior to every session of play.

7.2.2 Supporting students to consider others' perspectives on fairness



Indicative behaviours:

- Voluntarily verbally or physically offering to relinquish control to another player.

- Verbally communicating that other players can make a decision.

When students were working towards the team goal they soon recognised a need for systems to organise transitions between roles within the game. This led to a need for teaching staff to guide discussions around fairness and to implement strategies for supporting the students in considering the perspectives of their peers. Perspective-taking is a complex skill (Hesse et al., 2015) that some authors argue is very difficult for students with autism to develop (Baron-Cohen, 2017; Baron-Cohen et al., 1985). This argument derives from the contention that impaired theory of mind is an inherent trait of autism and contextually-specific rules for understanding what a person might be thinking need to be explicitly taught (Winner, 2007; Winner & Cooke, 2009). The complexity of students considering what their peers might be thinking is reflected in the *Collaborative problem-solving empirical progressions*, as shown in Table 7.3. Only when operating at Level E are students proactively seeking input from their peers.

Table 7.3. Two examples of perspective-taking in the *Collaborative problem-solving empirical progressions.*

Level	Indicative behaviours
Level C indicators (Awareness of partnership)	The student reports to their partner regarding their own activities on the task.

Level E indicators (Appreciated and valued partnership)	🔍 The student initiates and promotes interaction with their partner, often before entering their own answer.

When perspective-taking is taught through scripted rules, the data shows that students could express a plausible interpretation of their peers' emotional states or thought processes. The boundaries of effectiveness when using a scripted approach were evident in the ways that students used the skill 'taking turns'. Concepts underpinning 'taking turns' were familiar to all of the students, as they reported that they had been exposed to this language within formalised educational systems. As such, they already understood the contextual rules for recognising when another student might want to also play the game and could draw upon strategies they had used in other contexts. If the students did not understand the steps in recognising when someone else wanted a turn, it is highly likely that this would have required explicit instruction.

This study found that teachers can use the limitations of games as a means of practising 'taking turns', as long as the players remained motivated to play the game. Eseryel et al.'s (2014) model of motivation in multiplayer gaming suggests players are willing to find solutions to social challenges within their group when problems arise from limitations imposed by the game design. As an example. when there were more potential players than there were game controllers, students in this study independently recognised the need for a mechanism to distribute these resources.

Educators can use the functional limitations of games, such as the possible number of simultaneous players, to provide a context for having students consider fairness from multiple

peoples' perspectives. From the very first lesson, some of the students recognised the importance of an impartial means for allocating turns of playing the game, underpinned by their perceptions of fairness. The use of a visual timer provided one way for students to self-monitor and evaluate their play time but, importantly, this requires a developmental understanding of the concept of time. When interviewed about the underlying reasons why 'taking turns' is an important social skill, some students framed their responses in terms of ensuring a good outcome for every player, while others wanted to ensure that they had their 'fair' amount of time in the game role they desired. Educators can use conversations around sharing controllers or power-ups in the game to connect ego-centric perspectives of fairness to egalitarian perspectives. For students who find perspective-taking challenging, drawing these explicit links is a particularly important step in helping them understand how other people might be viewing their actions (Gallagher & Frith, 2003; Happé & Frith, 2006).

Beyond managing resources such as controllers in the physical environment, some games include mechanics that demand players take turns in the virtual environment. This could be a puzzle with an ordinal solution, where one avatar has to hit a switch before the other avatars can proceed, or it might be a platform that can only carry two avatars at a time. Both examples require an element of delayed gratification for some players, where a decision is made to temporarily take on passive roles within the team. In the reviewed lists of social skills observed in multiplayer gaming, none make explicit reference to players sacrificing their in-game agency in order to achieve a team goal (Ducheneaut & Moore, 2005; González-González & Blanco-Izquierdo, 2012; Zea et al., 2009), yet there were numerous examples of this occurring in this study. This might be because this study occurred in a co-located space. In the physical environment, the players had a tool, the timer, providing an impartial metric for ensuring fairness of turn length, while many virtual environments lack such affordances.

Further consideration is required to ascertain whether an online only iteration of this intervention would be feasible.

When players were forced to wait for a turn in the game, due to the mechanics described above, more skillful players often ensured that they went first and then guided their less skillful team members. This in itself is not problematic unless the game penalises players who are 'waiting' for an active role in the game, which is an important consideration in the selection of games. This guiding of less skilled players can actually represent a powerful opportunity for players to model in-game solutions and strategies, and then perform more sophisticated communication and perspective-taking skills in coaching those less skillful players. The use of video review provides a fertile space for students to assess their actions and be guided by the teaching staff in identifying opportunities for peer coaching.

Recommendations for supporting students to consider fairness and multiple perspectives

4. Students need to be explicitly taught the contextual rules for recognising when another student might want a turn.
5. The functional limitations of games, such as a limited number of players or power-ups, should be used as a context for discussions of fairness from multiple peoples' perspectives.
6. When players are required to take turns within the game, educators can support waiting expert players in coaching novice players and highlight the importance of all players in achieving the team goal.

7.2.3 Recognising when to give instructions and share information

Indicative behaviours:



- Verbally communicating instructions to another player or the group.

Giving non-verbal instructions *(No visual)*

- Pointing at the screen or to the controller with a hand, head or foot gesture.



- Asking another player or the group if they need assistance with the mechanics of the game.
- Physically communicating to another player that they can help them.

Sharing task information *(No visual)*

- Verbally informing another player about the rules or mechanics of the game, or the team goal.

These four skills are central in the process of providing instructions and sharing information with others so that coordination is possible. The findings of this research project demonstrated that students needed to be able to recognise when to use these skills in order to coordinate their actions with peers. The *Collaborative problem-solving empirical*

progressions (Hesse et al., 2015) provide indicators for recognising when students are communicating in more sophisticated ways as they become aware of their peers' level of understanding, as shown in Table 7.4. Students can be supported to use this awareness to tailor their language and provide instructions or share information in a way that can be understood by the intended audience.

Table 7.4. Three example indicators of students' awareness of their peers in the *Collaborative problem-solving empirical progressions* (Hesse et al., 2015).

Level	Indicative behaviours
Level B indicators (Supported working)	🔍 The student is aware of their own level of performance during the task.
Level D indicators (Mutual commitment)	🔍 The student comments on or shares information with their partner regarding their own performance while attempting the task. 🔍 The student is aware of their partner's performance on the task.
Level F indicators (Cooperation and shared goals)	🔍 The student is able to evaluate the strengths and/or weaknesses of their partner based on their performance during the task. 🔍 The student can tailor communication with their partner based on their awareness of their partner's understanding from the start of the task.

Although participants in this study were observed to be regularly monitoring the performance of their peers, when a player was not fulfilling their role in the team, students required support from the teaching staff in knowing how to communicate this constructively. An area of particular challenge was identifying what others needed to know and how to share this information in a way that could be understood by novices.

This research brings to attention a number of potential supports that can nurture the development of the skills students require to monitor the degree of understanding of their peers and to evaluate and respond to their contributions. The findings of this study and the literature surrounding the complex theory of mind concept suggest that these steps for communication need to be explicitly taught by teachers in the context in which they will be performed by the students (Crooke & Winner, 2017; Mišic et al., 2014). Many modern games offer some form of mechanical tutorial in their early levels. If a game does feature a tutorial level, educators can use these slower-paced sections to coach players in recognising the signs that a player might not know what to do, identifying what the challenge is for that particular player and the language required to share instructions or information on how to address that challenge. These early instructional levels also direct players as to how to combine the individual affordances of each player to solve a problem, modelling instructional language with supporting visual cues. The explicit, visual instruction provided in the tutorial levels of all four games used in this study aligned well with the recommendations for effective video modelling (Green et al., 2017; Mechling & Swindle, 2013; Reichow & Volkmar, 2010). Educators can use the language provided by the game to model communication between the players.

While instructions provided by the game were useful for educators and some students, other students had difficulty in interpreting them. This presented an opportunity for peer-mediated

instruction, with teaching staff assigning the mentor roles to specific expert players and then providing prompts, reminding them that they had this role. As these peers had a more sophisticated understanding of the focus skill, they fulfilled the 'knowledgeable other' role outlined by Vygotsky (1978). Even when playing unfamiliar games, this was an opportunity for the gamers to use their knowledge of genre conventions to practise communicating and checking for understanding with their peers. While at first mentors often simply read the on-screen directions for the other players, with support from educators, they could be guided towards checking for understanding and then modifying their method of communication. Many students with autism prefer visual instructions (Grandin, 2006), exemplified in this study by some students initially attempting to communicate through pointing or physical modelling. Through the teacher-led reflection provided by video review, two of the students who preferred non-verbal communication independently began to supplement their physical cues with verbal instructions. Referring to the *Collaborative problem-solving empirical progressions* (Hesse et al., 2015), changing methods of communication to be better understood represents a developmentally sophisticated level of performance of these skills.

Using the findings relating to optimal methods of instruction presented in *Chapter 5* and the analysis of 'sharing information' during key events in *Chapter 6*, the model presented in Figure 7.2 was developed. This model outlines the steps that educators need to teach explicitly so that students can work towards independently monitoring and evaluating whether the intended audience has understood them. Educators can model these steps during the video review of a section of a gameplay, such as when a player attempts to explain how to navigate over a crevasse. By explicitly verbalising their internal cognitive processes, educators can guide students through the processes required for evaluating responses to communication. Based on the analysis of attempts to communicate in this

study, this process can be structured as the *initial communication, monitoring responses* from the intended recipients, *evaluating success* in terms of achieving the *intended purpose*, and then *modifying communication* depending on this evaluation.

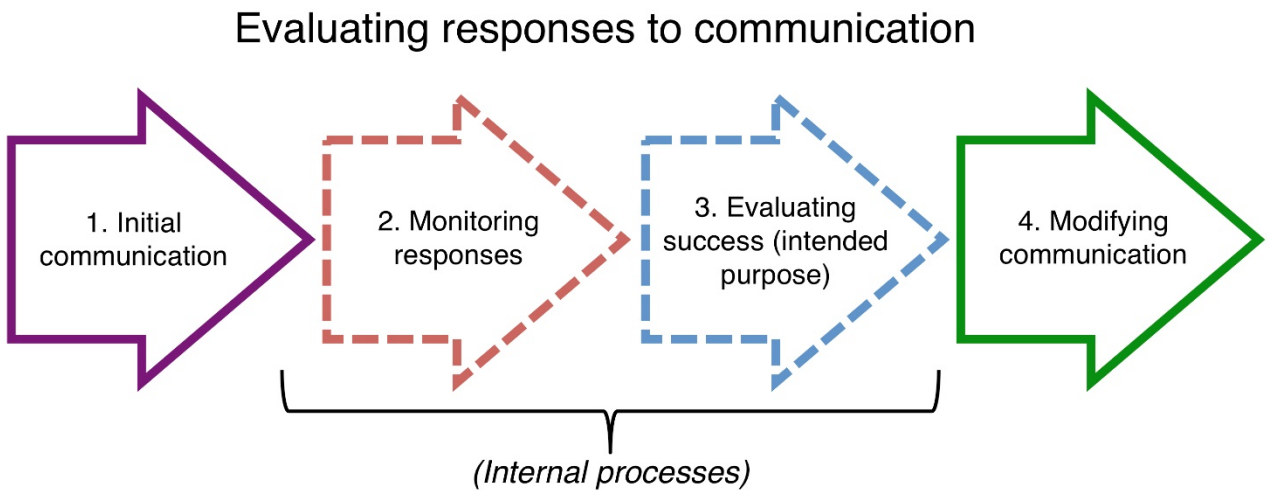


Figure 7.3. Process for evaluating responses to communication (checking for understanding).

Opportunities for performing these steps can also be shown through the use of video footage of past gameplay. When using games that create interdependence between players, educators can subsequently review gameplay footage with their students to highlight how offering help and sharing task information can be mutually beneficial in achieving the team goal. As long as they have the required language, the use of explicit examples drawn from recent play allows the students to practise verbalising their internal thought processes. Educators can support the development of this language through the use of prompts and by modelling the language when they describe their own internal processes during gameplay.

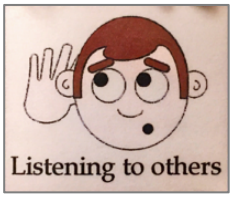
Recommendations for supporting students to recognise when to give instructions and share information

7. Educators should use slower-paced tutorial levels to coach players in recognising when and how to provide instructions and share information with peers.

8. Peer-mediated instruction can be introduced to position expert players as mentors, with educators providing close support to the mentor in checking for understanding and modifying their language.

9. Educators should model their internal cognitive processes aloud, guiding students through the steps for checking for understanding.

7.2.4 Creating an environment for constructive communication

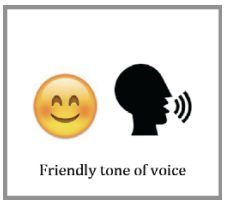


Indicative behaviours:

- Verbally or physically acknowledging that they heard their peer.
- Changing actions in the game to comply with their peer.



- Student is using a volume that allows other students to be heard.



- Using a lower pitch and slower pace of voice when speaking, while smiling when appropriate.

These three social skills are important for creating an environment of constructive communication. The *Collaborative problem-solving empirical progressions* (Hesse et al., 2015) place a high value on students considering the perspectives of other people within a group. This is seen as a hallmark of a more sophisticated level of communication, as shown in Table 7.5.

Table 7.5. Examples of communication between peers in the *Collaborative problem-solving empirical progressions.*

Level	Indicative behaviours
Level B indicators *(Supported working)*	The student is not overtly responsive to their partner, often taking a long time to respond, or not responding at all, and tends to ignore their partners contributions.
Level C indicators *(Awareness of partnership)*	The student discusses the task with their partner by responding to communication cues and requests.
Level D indicators *(Mutual commitment)*	The student modifies communication with their partner to improve common understanding and share resources and information.

In order to consider other perspectives, students must be able to listen actively and process what is being said to them. This presents a challenge for educators as 'listening to others' is amongst the most difficult skill to identify, yet it is a foundational skill in communication (Winner, 2007). It is hard to capture individual instances of listening, especially when players' eyes are directed towards the action occurring on the screen. This is further complicated by the preferences some students have for not making eye contact (APA, 2013; Baron-Cohen et al., 2001; Winner, 2007), either as a manifestation of the differences of autism (Winner, 2007), differences in cultural expectations (Jackson, 2002), or a combination of the two. Despite these challenges, the findings of this study reinforce the *Collaborative problem-solving empirical progressions* (Hesse et al., 2015), arguing that listening is essential in communication between team members. As such, educators need to know how to identify when students are listening and how to positively reinforce the performance of this skill.

One way of identifying individual instances of a student listening to another student was in the observation of verbal acknowledgments. These acknowledgments could be either direct, such as an answer to a question, or indirect, such as saying something that continued the conversation that another student had begun. Increasing the frequency of acknowledgments was an early priority in this intervention, as it allowed the other players and the teaching staff to recognise that attempts at verbal communication were being processed by the intended recipients. Educators should prompt students to provide a verbal acknowledgement if they have recognised that someone is attempting to communicate with them.

Another method for identification of listening is when a player changes their behaviour in the game as a result of a verbal instruction, comment or request from a peer. This requires a degree of interpretation, but when players are trained to look for such changes, they can

recognise that team members are listening to them. This final point needs to be explicitly highlighted to some students with socio-emotional differences; 'listening to others' is not just about the message receiver, but it also involves the sender knowing how to check that message has been received and interpreted in the intended manner.

The use of 'quiet voices' and a 'friendly tone of voice' are relatively easy to measure yet amongst the most difficult skills to teach. This is because the appropriate application of these skills changes depending on cultural context (Winner, 2007; Winner & Cooke, 2009). This study found that both volume and tone were contingent upon the emotional investment the student had in the verbal interaction, their recognition of acoustic environments and their ability to plan their responses to prompts ahead of time. One of the primary reasons for using videogames is to harness the students' excitement created by this medium to motivate participation in group problem-solving (Mysirlaki & Paraskeva, 2011). By its very nature, excitement naturally leads to heightened emotional states (Woolfolk & Margetts, 2016), which in turn makes controlling the volume of voice neither a priority nor a reasonable expectation for the students.

Much like 'quiet voices', teaching a generalised set of rules for using a 'friendly tone of voice' is problematic. Knowing when to use a particular tone is heavily context dependent and there are times when this is difficult for any child. By their very nature, many commercial videogames are designed to induce stressful situations. When students are told to use a 'low pitch' when providing instructions, the assumption is that this is possible in their heightened emotional states, and also that in these situations the person receiving the information cares whether this is occurring. While the use of a 'quiet voice' was functionally important in allowing other players to augment, clarify or correct instructions, in the predominant culture in which this research was conducted, tone provided more complex

messages about a person's emotional response to an event (Winner, 2007). Being able to self-regulate tone and volume of voice is a huge undertaking for anyone when playing games designed to elicit emotional states such as stress and excitement.

So, when are these skills important for students to use? This study found that these skills should be prioritised when the students are not playing or during lulls in action. Opportune times for teaching staff to highlight a 'friendly tone of voice' included during the provision of post-play feedback and planning during the scheduled time-out breaks. As outlined in the results of this study, regular emotional breaks during play were vitally important for the students. Breaks allowed time for the students to plan their communication in advance and to mentally rehearse how they would deliver their instructions. Providing a break in play was particularly important in the tense boss battle in **Kirby,** with the teaching staff able to help the students regulate their heightened emotional states. This resulted in the students lowering their volume and modulating their tone of voice.

Teaching recommendations for creating environments for constructive communication

10. Students should be prompted to provide a verbal acknowledgement if they have recognised that someone is attempting to communicate with them.
11. Educators should focus on modelling and encouraging a friendly tone during skill instruction, time-out breaks and the group reflection but prioritise 'quiet voices' during gameplay.
12. Regular time-out breaks allow educators to support students in regulating their emotional states and planning their verbal communication in advance.

7.2.5 Considering gamer culture and social context when drawing upon individual and collective expertise

Indicative behaviours:



- Verbally communicating to another player or the group that they need help with the mechanics of the game.
- Picking up the help card.

Requesting task information *(No visual)*

- A question directed from one player to another player or the group about the rules or mechanics of the game, or the team goal.



- Verbally requesting from an individual or the group a solution to a novel puzzle or challenge within the game.

Requesting performance feedback *(No visual)*

- One player verbally asking another player or the group for feedback on performance (for example, “How am I going?”).

A goal of this research project was to use an area of interest and relative strength for the participants, playing videogames, to help them develop the focus social skills. Building from this area of strength presented both opportunities and challenges. When team members

use the four skills shown above, they can draw upon their collective expertise, benefiting both individual players, and assisting the entire team in achieving common goals in games featuring designed interdependence. While students considering suggestions and information from their peers is mentioned in the *Collaborative problem-solving empirical progressions*, there is no mention of requesting further information or asking for assistance, as illustrated in the representative examples in Table 7.6.

Table 7.6. Examples of students considering information from their peers in the *Collaborative problem-solving empirical progressions.*

Level	Indicative behaviours
Level B indicators *(Supported working)*	The student is not overtly responsive to their partner, often taking a long time to respond, or not responding at all, and tends to ignore their partners contributions.
Level E indicators *(Appreciated and valued partnership)*	The student acknowledges and responds to contributions from their partner but does not make changes to their original plan.
Level F indicators *(Cooperation and shared goals)*	The student incorporates the contributions from their partner to suggest new solution paths or modify incorrect ones. The student uses solutions provided by their partner and works more collaboratively through the problem-solving process.

The results from this study suggest that the lack of mention of requesting further information or asking for assistance is an oversight of the progressions, as some students were able to recognise that they required further information or assistance in order to be successful in fulfilling their role. As this further information was often essential to students being able to complete the tasks set by the game, these four focus social skills should be accounted for in future iterations of the progressions. While the boundaries between these skills blur, they also exist as an imperfect hierarchy of vulnerability of which educators need to be mindful. This hierarchy is a product of the relationship between the contexts in which these skills are likely to be useful, and how the players want to be perceived by their peers. Novice players frequently asked for help. Much less frequently used was ‘asking for ideas’. While the results did not indicate clear reasons for this, teaching staff theorised that this could be caused by the social dynamics and cultural considerations within the group.

In relation to cultural considerations, some literature suggests that the differences inherent in autism might impact upon the recognition of knowledge in others (Winner, 2007, Baron-Cohen et al., 2001), but there are also additional cultural dimensions in all social interactions (Chen, 2012; Hayes & Duncan, 2012). Players who identify as gamers have a sense of pride in their self-perceived expertise (Chen, 2012; Gee, 2018). Rather than not recognising the abilities of others, this study found that there can be a reluctance to turn to others for any form of assistance. One useful example is that the skill ‘asking for help’ typically represents a call for a relatively short and immediate form of assistance focused on an obstacle within the game, or a specific mechanic of play, such as knowing which button is the ‘jump’ input. In this study, students who acknowledged being inexperienced gamers regularly asked for help, but this skill was much less frequently used by players who saw gaming as integral to their identity. These experienced gamers might have recognised that they required either

knowledge of the game mechanics or assistance within the virtual environment to overcome an obstacle but, to protect their social capital within the group, they perhaps chose not to share this need for help.

Likewise, ‘requesting task information’, typically representing a request for “Where next?” or “What does this do?” was used initially by all players when a universally unfamiliar game was introduced, but by the end of the initial lesson of play it was the self-identifying novices who were mostly requesting this information. This is where the importance of context becomes evident. When considering the situations in which players would feel like they require assistance from another, it can be seen that the less frequently used skill ‘asking your friends for ideas’ requires a higher degree of vulnerability than merely ‘asking for help’. Players only seem to identify the need for this particular skill once a team has attempted but failed to solve a problem, and when individual players each come to the realisation that they are ‘stuck’. This might lead to frustration, which in turn can result in a heightened collective emotional state within the team.

The use of video review in this context provides a powerful tool for addressing the challenges of culture and context. Footage of contexts in which the players appear stuck can be replayed to highlight the indicators that, individually, players might not have the solution to a problem. Ideally these contexts involve all players demonstrating through their in-game actions that they do not understand how to progress towards the collective goal. Examples of such indicators observed in this study included players repeating the same failed strategy multiple times or the lack of movement from the players’ in-game avatars. To develop students’ ability to recognise when they are ‘stuck’, teaching staff can model their own processes. This can be facilitated by the educator ‘thinking aloud’, as suggested by Winner (2007), modelling how they themselves identify as having insufficient knowledge, and then

using first person language to obtain this knowledge from other players. Changing social perceptions around what it means to ask for help is important, emphasising the primacy of the team goal in measuring success in the game. A game that values collective achievement rather than individual success is vitally important here.

Teaching recommendations for drawing upon individual and collective expertise

13. Educators need to make explicit connections between the collective knowledge of the team and group success.
14. Footage of contexts in which the players appear stuck should be replayed to highlight indicators that, individually, players might not have the solution to a problem.
15. Teaching staff should model their own processes by 'thinking aloud' about having insufficient knowledge to solve a problem, and then modelling the language used to obtain this knowledge from other players.

7.2.6 Providing encouragement and performance feedback



Indicative behaviours:

- Making a positive comment about the performance of a player
- Verbally reassuring a player when they make a mistake

Providing performance feedback *(No visual)*

Indicative behaviours:

- One player verbally communicating to another player or the group their perceptions of an individual or the team's level of performance, either within the game or in using the social skills.

At a superficial level, providing encouragement and performance feedback can be the most intuitive approach for learners with socio-emotional differences. Positive performance feedback, or the idea of acknowledging the successes of others, is usually taught across contexts from a young age (Winner, 2007), with the participants in this study having been coached into the socially expected phrasing and tone used to do this. More complex commentary on the strengths and weaknesses of others is considered a high-level collaborative skill in the *Collaborative problem-solving empirical progressions*, as shown in Table 7.7.

Table 7.7. Examples of providing feedback in the *Collaborative problem-solving empirical progressions.*

Level	Indicative behaviours
Level B indicators (Supported working)	🔍 The student is aware of their own level of performance during the task.
Level E indicators (Appreciated and valued partnership)	🔍 The student is able to **comment on their partner's performance** during the task.
Level F indicators (Cooperation and shared goals)	🔍 The student is able to evaluate the strengths and/or weaknesses of their partner based on the partner's performance during the task.

When reviewing the findings of this study, the use of the phrase 'comment on their partner's performance' in the more advanced Level E descriptor lacks the clarity required to differentiate between simplistic, general commentary and a more detailed analysis. "Falcon is good at steering the dinosaur" is less sophisticated than "Falcon knew how to control the dinosaur better than everyone else and could find the secret passages." This study found that all students who relied upon social scripts seemed to be reasonably proficient in

identifying the right time to action these scripts when the commentary was simplistic and positive. Reflecting on their own experiences of social scripting, both Grandin (2006) and Jackson (2002) noted that scripting was an important strategy for ensuring that they adhered to social expectations, even when they did not fully comprehend the reasons for acting in a certain way. The effectiveness and limitations of a scripted approach were evident in this study. A high number of instances were observed of students congratulating successful members of their team, particularly when the game provided visible cues that this player had done something worthy of praise, such as finding a hidden path or landing the final blow on a significant enemy. Educators should positively reinforce instances of students acknowledging the successes of others, as although the participants in this study found this skill easy to perform, this is a desirable social behaviour.

Beyond providing superficial positive feedback following prompts from the teaching staff, these skills seem to become much more challenging for some students as they did not understand the purpose and value of them. This reflects the challenges suggested in *Chapter 2* for students with autism, such as displaying cognitive empathy and knowing when to initiate communication. This study also found that the student with Down syndrome found it difficult to know when it was an appropriate time and in what form to give such feedback. For example, the teaching staff encouraged players to maintain a positive motivational state, with the students being told that this would in turn help to ensure that a player persists and attempts to increase their individual performance. When playing cooperative games with elements of interdependence, this benefits the entire team. In this study it was rare for the encourager to explicitly connect their positive performance feedback to the specific actions of their peers. Even after this had been modelled through video review, the speed at which most games progressed meant that players found few opportunities to provide this level of

detail. This is problematic because it then places the burden on the receiver to interpret this encouragement, exacerbating the challenges some learners with autism experience integrating verbal and non-verbal communication (APA, 2013; Winner, 2007). Whether the player receiving the praise understands the relationship between their play and this feedback is entirely dependent on their understanding of the goals of the game, and their cognitive capability and interest in analysing the context in which the words were stated. Educators need to model praising specific positive actions and encouraging students to do the same.

Encouragement and performance feedback need to be positioned as essential and complementary tools for effective teamwork and achieving success in the game. Players should learn to provide constructive feedback that identifies the problem and the next steps for the player to address this problem while minimising emotive language. While this must be taught and modelled explicitly, the results of this study also highlight the need for regular breaks so that students can provide timely encouragement and feedback without the pressure of having to continue playing the game. This is particularly true for providing performance feedback when a player is not fulfilling their role within the team. The teaching staff might need to take the initiative, call a time-out at the point of need and guide students through discussing the context in which the players find themselves and the appropriate language to use to ensure the constructive phrasing of the message.

Teaching recommendations for supporting participation

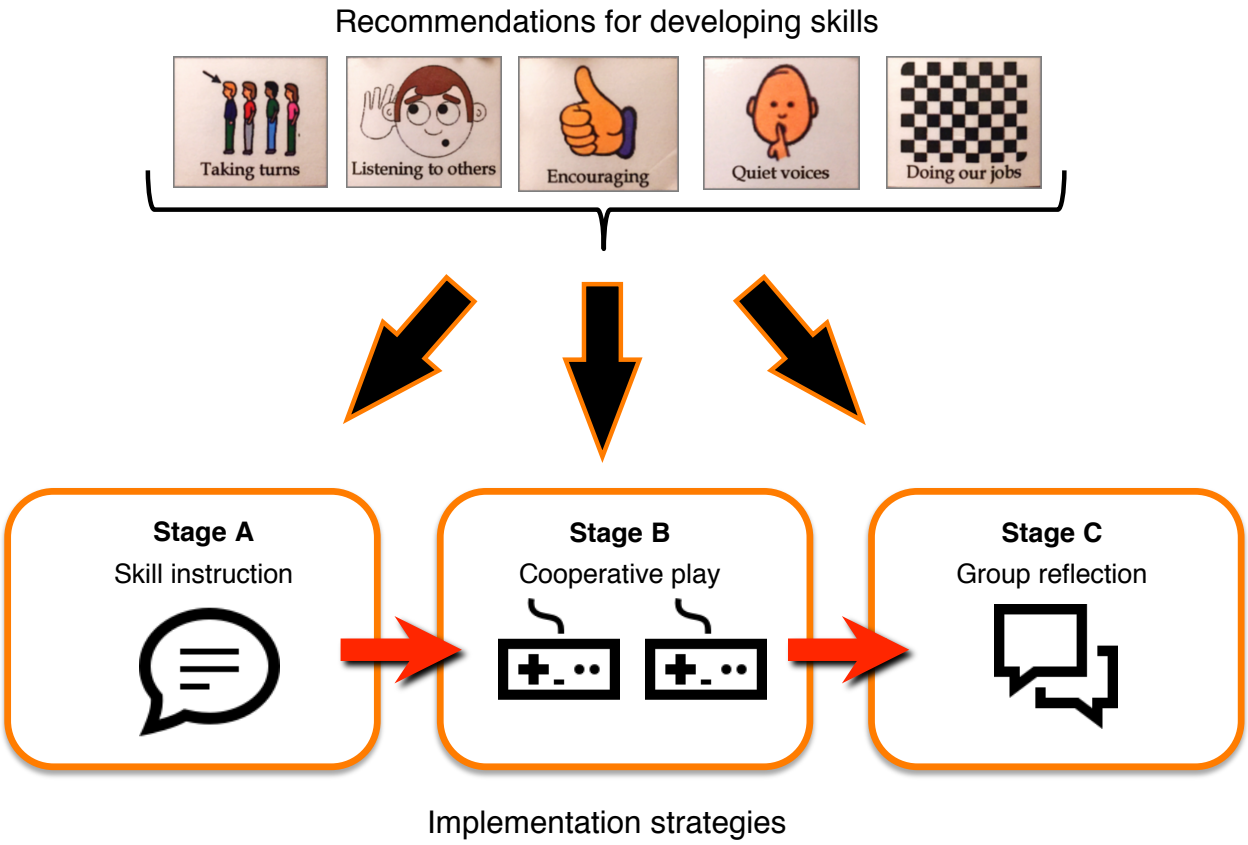
16. Educators should positively reinforce instances of students acknowledging the successes of others, encouraging them to link their positive performance feedback to the specific actions of their peers.
17. The language for providing constructive feedback needs to be taught and modelled explicitly, with regular breaks during play for rehearsing the required language to express and receive feedback.
18. Examples of more complex forms of feedback should be highlighted during video review, with this feedback being positioned as essential for effective teamwork and achieving success in the game.

The recommendations presented in this section provide educators with a set of strategies and supports that can be used with students to help them learn how to use the individual focus social skills together with increasing levels of sophistication. All 18 of these recommendations are presented together in Appendix M. The following section explores how these recommendations can be implemented within the three-stage structure designed as part of this intervention, optimising the systems for skill instruction (**Stage A**), cooperative play (**Stage B**), and group reflection (**Stage C**).

7.3 Implementation strategies using the three-staged structure

The previous section presented recommendations for teaching focus social skills and associated supports for students. This section outlines implementation strategies that

educators can use to optimise these recommendations within the three-stage structure (**Stage A**, **Stage B**, **Stage C**), as represented in Figure 7.4



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Figure 7.4: Implementation strategies guide educators on how to optimise the skill recommendations within the three-stage structure of the intervention.

Together, these recommendations and implementation strategies address the primary research question by identifying ways in which cooperative videogames could be used within a structured, teacher-led social skills intervention.

Providing students with a predictable structure is a key component of the National Autistic Society's (2016) SPELL framework for planning and implementation of an intervention. While this framework was intended specifically for students with autism, the underlying components can be found in this intervention, which is designed for a broader population. Table 7.8 provides examples of how each component, including structure, was addressed through the resulting intervention design that is a product of this study.

Table 7.8. Examples of components of the SPELL framework in the intervention designed through this research project. Adapted from the National Autistic Society (2016).

Component	Addressed in this intervention:
Structure: Structure makes the world a more predictable, accessible and safer place.	✓ Instruction throughout all three stages provided using visual information, such as the sticker chart and the use of video. ✓ Predictable and consistent **Stage A-Stage B-Stage C** format.
Positive approaches and expectations: Establish and reinforce self-confidence and self-esteem by building on natural strengths, interest and abilities.	✓ Highlighting skills performed using the sticker chart during **Stage B** (cooperative play). ✓ Use of video modelling to highlight and celebrate instances of positive skill performance. ✓ Using a shared interest of all five students to encourage participation.
Empathy: Making efforts to understand, respect and relate to the experience of the autistic person must underpin attempts to develop communication and reduce anxiety.	✓ Affording student voice through dedicated time in **Stage C** (group reflection) so that they could help to guide the intervention. ✓ The transition to video review so that they could select instances of play that they wanted to discuss with the group.
Low arousal: Approaches and the environment need to be calm and ordered in such a way so as to reduce anxiety and aid concentration.	✓ Providing familiar, dedicated spaces for each of the three stages, designed to reduce distractions. ✓ The use of time-out cards during **Stage B** (cooperative play) to allow for additional time to process information and rehearse verbalisation.
Links: Recognise the benefits of sharing information and working alongside the individual, their families and other professionals.	✓ Students interviewed at regular intervals to ensure that their perspectives are included in the analysis of the data from each version of the intervention.

The National Autistic Society (2016) argued that these components are vital in successful social skills interventions. This reflects the findings of this study. As shown in the following implementation strategies for the three stages, these SPELL components emerged through analysis of the data as important in the design of this intervention.

The **Stage A-Stage B-Stage C** structure could be used to structure interventions at any of the three tiers outlined by the RtI framework (Balu et al., 2015; Mitchell, 2014). Although this intervention was developed with a small group assessed as requiring more intensive social skills instruction than their peers (Tier 2), the principles here could be used as part of a whole-class series of lessons focusing on understanding the characteristics of effective collaboration (Tier 1). In a scenario where a student was not responding to the intensive group intervention, these principles could be used by specialist allied health therapists, such as psychologists or speech pathologists, as part of a personalised program (Tier 3). Adapting these recommendations for a Tier 1 whole-class or Tier 3 personalised program requires further research to identify areas of potential challenge in implementation. Despite this flexibility the implementation strategies presented in this section use examples from the context of a Tier 2 small group intervention, as this reflects the conditions in which this research was conducted.

7.3.1 Optimising the systems for skill instruction and video review of skill performance in Stage A

The findings of this study highlight the importance of educators explicitly teaching the meaning of the focus skills and the contexts in which the skills should be used. Video review and goal setting were important instructional tools in assisting students to understands the skills and their contexts for use.

7.3.1.1 Creating a shared understanding of the meaning of the skills

When developing understandings of the targeted skills, students need to have a shared recognition of what each skill looks like in a particular context. In line with both Elksnin and Elksnin's (1998) social skill instructional model and cognitive load theory (Sweller et al.,

2011), this requires more than just providing a definition of the skill. This research project has highlighted the importance of students sharing an understanding of how a skill should be performed, the contexts in which a skill is used, and the boundaries of when a skill is no longer appropriate for use. While Elksnin and Elksnin (1998) focused on the functional importance of all these components in order to perform a social skill, Sweller et al. (2011) highlighted the importance of building multiple connections to information stored in long-term memory. The length of time that information remains stored in schema in long-term memory is partly dictated by the number of connections to other pieces of information (Ang et al., 2007; DENSW, 2018; Preece et al., 2002). A more sophisticated performance of a skill that considers contextual variables can be illustrated through the students use of 'taking turns' when playing **Rayman**. Performing this skill in this context required a system for the orderly rotation of game controllers, setting the conditions under which the controllers would be exchanged and recognising when this system for ensuring fairness no longer performed its intended function. An illustrative example of the students recognising when a system was no longer serving its function was when the timer continued to run when a controller lost power and the user could no longer take part in the game. Such contextual awareness required students to recall not just abstract definitions, but the underlying purpose of each social skill.

7.3.1.2 Using video review as a tool for guided reflection

Opportunities for students to review their actions and their performance of the targeted social skills during play is invaluable in providing the prospect of self-reflection of their own performance, and critical discussion among peers on how individual performance impacts upon the team. Crucial to this process is the guidance of teaching staff in facilitating the language and tone of feedback, directing conversations towards students communicating

their decision-making processes leading up to the performance or non-performance of a skill. Self-reflection requires students to consider many variables in order to evaluate events, such as the rules and goals of the game, the actions of the other players and their own emotional state at the time of play. Therefore, careful guidance from the teaching staff is also critical for monitoring students' respective cognitive loads, supporting them to draw upon information consolidated in their long-term memories when processing new information identified in the video footage (Sweller et al., 2011).

In this study, there were instances of students remaining emotionally fixated on the actions of their peers. Using the terminology of DeLeeuw and Mayer (2008), these fixations can be deemed extraneous processing, as they did not support the objectives of the intervention. Successfully facilitating discussion of significant events requires strategic 'tagging' of key moments of skills performance or opportunities for performance within play. Unlike the findings in Qarabash et al.'s (2018) research, this study suggests that this tagging needs to be completed initially by the teaching staff until students learn the purpose of each target skill. Once students understand the underlying purposes of these skills, it is essential that they are involved in deciding which events should be collectively examined. Where the teaching staff feel an important event has been missed, they also need to be able to tag these events.

7.3.1.3 Setting team and individual goals for cooperative play

One particular affordance offered through the use of digital game worlds for collaborative interactions is that students familiar with the game genre conventions often already understand the team goal. The role of game design in providing this clarity around the goals of the game and conditions under which they can be achieved was discussed in the previous chapter, but the advantages of students' knowledge of genre are worth exploring here. Using

the lens of cognitive load theory, Ang et al. (2007) noted that familiarity with game mechanics can allow learners to utilise their working memory capacity to address the social interactions. When there is a collective knowledge of genre convention and all students are storing this information in their long-term memory, the emphasis in the pre-play discussions can be on the individual goals that sit within this common team goal. The teacher should focus on using instructional strategies to support the students to transfer these goals from working memory to long-term memory. It is through the contextualisation of these individual goals, via the lens of achieving the team goal, that the targeted social skills become meaningful. It provides a reason for the performance of the skills.

7.3.2 Optimising the systems promoting interactions during cooperative gameplay in Stage B

Cooperative gameplay served a twofold purpose in the design of this intervention. It provided the motivation for students to participate in a social activity, and well-designed games necessitated that users attempted to perform certain social skills in order to be successful in the game. Teaching staff can take advantage of these affordances to optimise the students' understanding and performance of targeted social skills at the point of need. Most importantly, this is done in a meaningful context for students with an interest in these games.

7.3.2.1 Monitoring interactions within simultaneous co-located gaming

A novel component of this study was simultaneously capturing instances of player interaction in the physical and virtual environments, and the analysis of the interplay between the them. Figure 7.5 maps these interactions between a shared physical co-located space, and a virtual environment such as in the game **Kirby** where players have control over individual avatars.

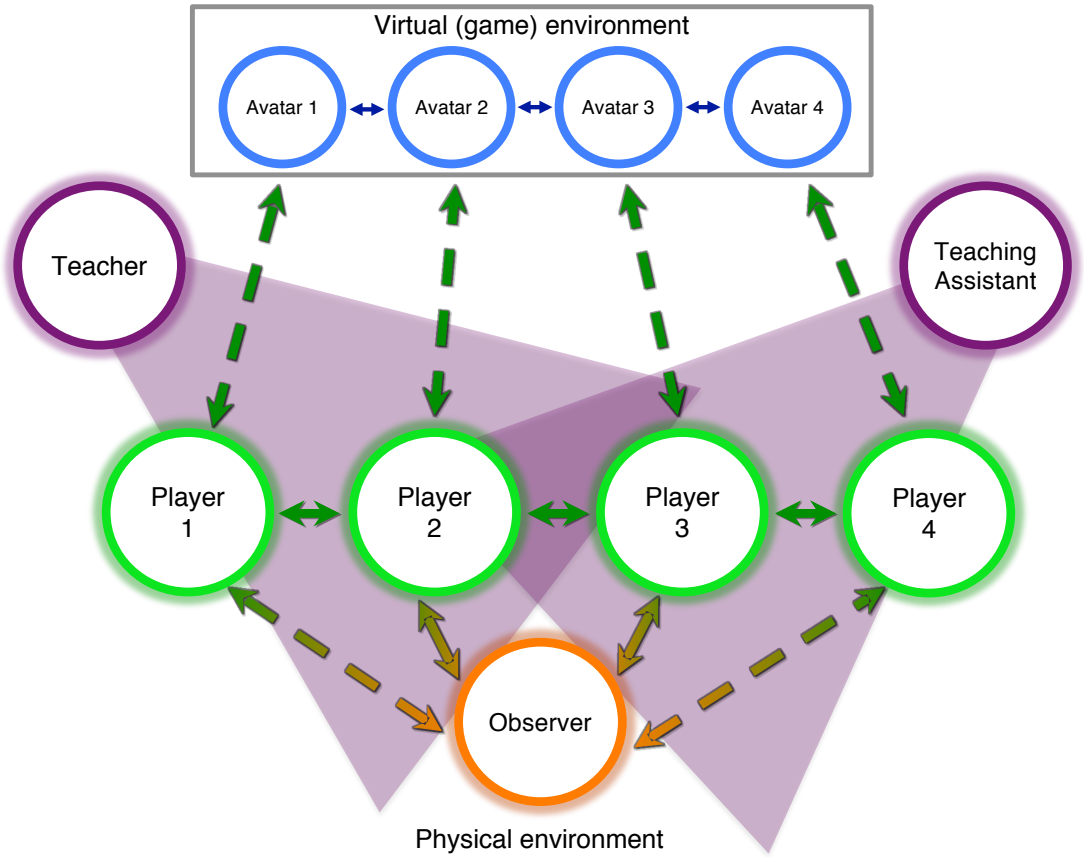


Figure 7.5. Social interactions between players in co-located gaming.

This representation depicts the lines of both direct control between the player and avatar, the interactions between the players in the shared space and in the virtual environment. Players in this study were not just monitoring their own performance but, as shown by the consistently high frequency of 'providing performance feedback', they were actively monitoring and evaluating their peers. When there were more players than controllers, there were roles within the team for the additional players to direct and support the active players This is consistent with Crawford's (2011) described roles for game observers. Educators need to be aware of where students are focusing their attention, both in the physical and virtual environments, in order to maximise the opportunities to teach the performance of skills at the point of need. Differences can exist in preferred modes of communication between neurotypical and

neurodiverse players, which is important to take this into consideration when analysing player interactions.

7.3.2.2 Rotating roles within the team

Depending on the design of the game, the avatars controlled by the players might have a designated role within the game. In some ways this is preferable, as it provides players with concrete individual goals to achieve in order to complete the team goal. In **Rayman** the player controlling *Murfy* is made aware by in-game signposting that their goal in the level *Dungeon Dash* is to open and close gates for other players to progress and for the team to complete the level. This is a form of interdependence described by González-González and Blanco-Izquierdo (2012), and Voulgari and Komis (2010). Players were completely dependent on each other through the subdivision of these roles, manufacturing a need for coordination between the avatars. Key to creating the conditions for such positive interdependence is each player understanding their roles and the roles of their peers.

In games such as **Kirby**, which have asymmetrical primary and secondary roles, it is important that these positions of responsibility are rotated within the playing group. It could be that not all students will be able to play at once, particularly if the game design or resource considerations limit the number of possible simultaneous players. This can be positive in promoting increased opportunities for interaction between the players. Figure 7.5 shows the influence of the observer, whose role changes depending on their relative knowledge of the game, level of confidence and their relative social capital within the group. This role needs to be explained explicitly, including guiding the mode of delivery for feedback and also the point at which observer feedback is most useful to the players. These two considerations are particularly complex, as what could be appropriate advice depends on a wide range of

variables, such as the emotional state of the players and the design of the game in allowing a pause in the action.

7.3.2.3 Monitoring of skill performance during gameplay

Many students find it difficult to monitor their own use of the targeted social skills, especially students with socio-emotional and self-regulatory challenges. The sticker chart provides a visual reminder of each student's respective target social skill, as well as a record of the skills that the teacher has observed them using during gameplay. At the time the teacher observes a skill being used, they should commend the student, label the specific skill used and connect the performance of the skill to achieving the team goal. While Lee et al. (2005) suggested that positive reinforcement external to the game should not be necessary if the game is well-designed, this study agrees with Ducheneaut and Moore (2005) in finding that players benefit from the use of 'tangible' real-world systems such as the sticker chart (see Appendix H). Using Elksnin and Elksnin's (1998) model for skill instruction, this should be done by explaining explicitly to the group how this skill has been used in the current context and how the performance of this skill has assisted the team in achieving the shared goal.

7.3.2.4 Structured teacher intervention in gameplay

While gameplay can provide an excellent arena for social interaction, the high degree of engagement in the game can also be prohibitive for students in monitoring their performance of the target skills during gameplay. It is therefore important to integrate regular, planned time-out breaks to discuss the skills being used through a guided review of the skills sticker chart. Review time can be embedded into existing systems used for allocating turns and rotating roles within the group. This guided review should focus the attention of each player

back to their individual skill goal, including reiterating why this is important in achieving the team goal, illustrated with examples from the most recent play lesson.

7.3.2.5 Promoting self and social regulation

One of the key considerations from both the literature around socio-emotional self-regulation and the results of this research project is the importance of breaks for the students. These planned time-out breaks provide an opportunity for students to reflect upon their own emotional states and those of their peers, but there also needs to be a mechanism for students to request a pause in the action. The use of the time-out card in this research project allowed additional time for students to process the events, their emotional states, and to plan their responses to potential triggers for distress or anxiety. An easily accessible time-out card provides a non-verbal symbolic cue to the teacher that the student has recognised they require this time. The ability to pause action at any time via the games console, without disadvantaging any player, is also vital in positioning a player using a time-out as helping rather than hindering the team in achieving their goals.

7.3.3 Optimising the systems for student reflection post-gameplay in Stage C

The final stage of each lesson involved students reflecting upon their performance of the targeted skills and sharing their perspectives on which skills they thought their peers had been using. This was useful for the teaching staff when identifying which skills were within each student's ZAD, which skills were within their ZPD and which skills were beyond what each student was ready to learn. Although the results of this indicated that there were challenges in eliciting verbal reflection, a number of iterative improvements to this stage of the intervention proved to be invaluable in identifying areas of priority for the students and

misconceptions about the nature and application of the skills. As outlined in *Chapter 5*, these improvements included:

- Improving students' understanding of what each skill means in the context of gameplay through the use of video modelling with curated footage of the students performing the skills.
- Allowing students to review the sticker chart from the session of play so that they could see the types of skills that the teaching staff had observed them performing (see Appendix H). The teaching staff also used this sticker chart to help them to plan their goal social skill for the next session.
- Introducing a revised visual reflection chart for supporting reflection on the skills that the group had collectively used and had not used (see Appendix I).

In addition to receiving feedback from the students on their performance of the targeted social skills, this intervention sought to position them as partners in co-designing the two focus areas of the intervention: the choice of games used to manufacture targeted social interactions; and the methods of instruction through which these skills were being taught. It was decided that the teaching staff needed to identify which social skills would be included in the intervention, as the results showed that the students could not articulate their own areas of challenge. The following sections discuss how these improved strategies and supports can be used by educators to promote student reflection on skill performance and voice in the design of the intervention.

7.3.3.1 Structuring and eliciting student reflection of skill performance

Structuring feedback so that the students understood exactly what they were expected to share in this component of the lesson was challenging. Simplified supports helped students

to organise skills they felt they used, and skills they needed to work on in the next lesson. Access to a sticker chart allows students to review what an observer had recorded, but there is a danger in them being uncritical in simply accepting this without any analysis or reflection. The use of augmented communication devices such as communication books and pictorial representations can assist in bridging this 'understanding gap'. However, these cannot compensate entirely for limited emotional recognition, particularly more subtle shades of difference such as labelling two similar but distinct feelings.

Students being unable to express these shades of emotion accurately was evident particularly when discussing responses to controversial events amongst the players. An example from this research was players not having the emotional vocabulary to describe frustration, with one player repeatedly substituting the word 'bored'. It was only when the player could access the video footage in the following lesson that they could visually show the event in question to the teaching staff, and the teaching assistant recognised confusion between the two terms. This highlights the value of both video review and using familiarity with the context or 'local knowledge'.

Each of the six key events analysed in *Chapter* 6 highlight examples of the teaching staff drawing upon their wealth of experience to inform what they believe the students need to know in order to progress towards their goals. However, the nature of cooperative play meant that they only had very limited time to focus upon this. Thomas (1998) discussed the power of video as a research tool in capturing a 'time and place' for infinite review, which aptly highlights the affordances provided by the use of video footage as a pedagogical tool in this study. Hattie (2009) discussed the advantages of delayed feedback as allowing students time to regulate and reflect emotionally, and the results of the current study show that this is also true for teaching staff. Additional time allowed for professional reflection and review of the

footage in order to assess what the student could do and how to support them in progressing towards their next developmental goal.

7.3.3.2 Eliciting student feedback to guide the intervention design

By the very nature of their disabilities or challenges, students with socio-emotional difficulties might require supporting scaffolds to enable them to express themselves and their opinions in a way that can be understood and acted upon by those seeking their input. This is problematic, as inevitably any scaffold will be imbued with the biases and assumptions of its creator. A neurotypical adult who has no exposure to gamer culture can find it close to impossible to include supports for what is important to the players; this is especially true for a student who is unable to communicate what exactly it is that does interest them. This is the dilemma in eliciting student input when designing an intervention for students with communication challenges. This is also why involving teaching staff with a history of working with these students is so important, as they offer unique insights derived from years of ongoing cycles of assessment and feedback.

7.4 Summary of the recommendations for the intervention design

The design experiment afforded the opportunity to iteratively refine the intervention through modifications to the targeted social skills, the methods of instructions and the games being used to facilitate collaboration between the participants. This chapter has contrasted the findings of the current study with the established literature to produce a series of **recommendations** for developing the focus skills, as summarised in Figure 7.6.

Optimising the systems of intervention: Recommendations for educators

Stage A: Skill instruction

Defining the targeted social skills

- Providing familiar game-based and non-game examples using supporting visuals
- Target social skills icons
- Key vocabulary and visual examples

Developing skill performance

- Using video models of students' performance to target specific skills
- Edited video footage
- Using video review to identify examples of performance and non-performance of social skills
- Unedited video footage

Reviewing game-derived team goals

- Supporting visuals of the game-specific vocabulary

Setting individual goals

- Using the Collaborative-Problem Solving Empirical Progressions to set an individual goal within each student's ZPD
- Sticker chart
- Target social skills icons

Stage B: Cooperative play

Encouraging participation

- Rotating roles within the team
- Selecting videogames that adhere to the 39 game design recommendations outlined in *Chapter 8*

Developing social skill performance

- Using the sticker chart to record individual goals instances of skill performance
- Target social skills icons
- Sticker chart
- Monitoring of and intervening at the point of need to support skill performance
- Prearranging regular time outs for reflection
- Recording footage for video modelling and video review
- High-resolution video recording device

Facilitating self and social regulation

- Providing student with close access to help and time out cards
- Help cards
- Time out cards

Stage C: Group reflection

Facilitating group reflection

- Structuring the reflection process
- Reflection chart version 2

Using student feedback to guide the intervention

- Eliciting student feedback to guide the intervention
- Student access to all resources used in the intervention to support conversation including the game boxes, controllers, etc.

Icon key:

- Strategy
- Tool/support

Target Social Skills

- Using the individual recommendations for the focus social skills to address specific areas of challenge for students



Collaborative Problem-Solving Empirical Progressions (Social dimensions)

- Using the typical developmental pathway for social skills required for collaborative problem-solving to identify what each student is ready to learn and where to next (Hattie & Timperley, 2007)

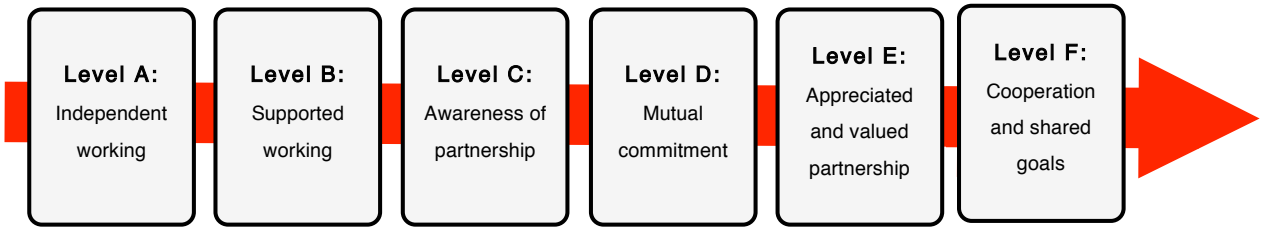


Figure 7.6. Recommendations for educators for optimising the systems of intervention.

In this chapter the 15 individual skills were organised into six thematic groups:

- Participating in group activity.
- Supporting students to consider others' perspectives on fairness.
- Recognising when to give instructions and share information.
- Creating an environment for constructive communication.
- Considering gamer culture and social context when drawing upon individual and collective expertise.
- Providing encouragement and performance feedback.

Alongside the recommendations for developing the targeted social skills, examples have been provided using descriptions of performance found within the *Collaborative problem-solving empirical progressions* (Hesse et al., 2015). These illustrated how these skills can be combined at different levels of sophistication. While the descriptions found within the progressions did not always align with the findings of this research project, this assessment instrument provides educators with a developmental pathway that has been validated in other contexts and can be augmented with the additional focus skills identified in this study.

Although the reviewed literature showed that there are many perspectives on what is important in an intervention, one priority that was shared by a number of authors was the need for a predictable, consistent intervention structure when working with children with social-emotional disabilities (Beaumont et al., 2015; Bond et al., 2016; Camargo et al., 2014). Students need to know what is expected of them, which can be established through the building of routines. Findings from this study showed that the consistent structure of skill instruction (**Stage A**), cooperative play (**Stage B**) and group reflection (**Stage C**) addressed this need. The **implementation strategies** allow educators to optimise the effectiveness of

the **recommendations** by using them within the three-stage structure that was tested through the design research processes.

Further testing is required to ascertain the effectiveness of the recommendations and implementation strategies in other contexts, but these initial findings indicate significant potential for optimising the impact of educators within a digital games-based intervention. Alongside a summary of the implementation strategies, Figure 7.6 summarises the tools and supports that can be used to enhance these strategies. An example of a support would be the sticker chart used to help students monitor their use of particular focus skills, as shown in Appendix H. Also included are the recommendations for the focus skills and *Collaborative problem-solving empirical progressions*. These would form the basis of an intervention that is tested at scale through broader clinical trials, as described by Phase 6 of the *Compleat model*. This next step is addressed in *Chapter 9*, the concluding chapter of this thesis. First, however, *Chapter 8* presents recommendations for creating the conditions for collaboration.

Chapter 8: Game design recommendations for creating the conditions for collaboration

8.1 Chapter introduction and structure

Central to this research project is the conceptualisation of cooperative videogames as tools for creating the conditions in which players are encouraged to collaborate and develop social skills. Emerging from the analysis of the research project results, a number of game design recommendations have been constructed that promote player interaction and social skill performance. Understanding these recommendations is beneficial to identifying existing games that are more likely to be appropriate in such an intervention. These recommendations also provide insights for the future design of serious games for the purpose of developing social skills. Table 8.1 reiterates the primary research question and shows the guiding questions addressed in this chapter.

Table 8.1. Primary research question and guiding questions addressed in this chapter.

Primary research question:
How can children with social-emotional challenges develop targeted social skills through intervention using cooperative videogames?
Guiding questions:
d) How do the rules and mechanics of different games impact upon social interactions? e) How can game design create the conditions for inclusion?

This chapter begins by examining the ways games can shape a sense of both individual and collective identity, and how these impact upon the roles within a team. The discussion then moves to exploring more broadly how this sense of player identity intertwines and conflicts with the participant's notions of leadership and gamer culture. Exploring how the design of the game rules can impact upon player interaction is addressed in relation to manufactured

interdependence between the players. Alongside the rules of play, the relationship between level design and the performance of a range of social skills is examined. These recommendations are derived from the results of this study and reflect the overarching ethical imperative: promoting the social inclusion of all learners in their communities.

To illustrate these recommendations, the four games used in this research project are referenced (as reiterated in Figure 8.1).

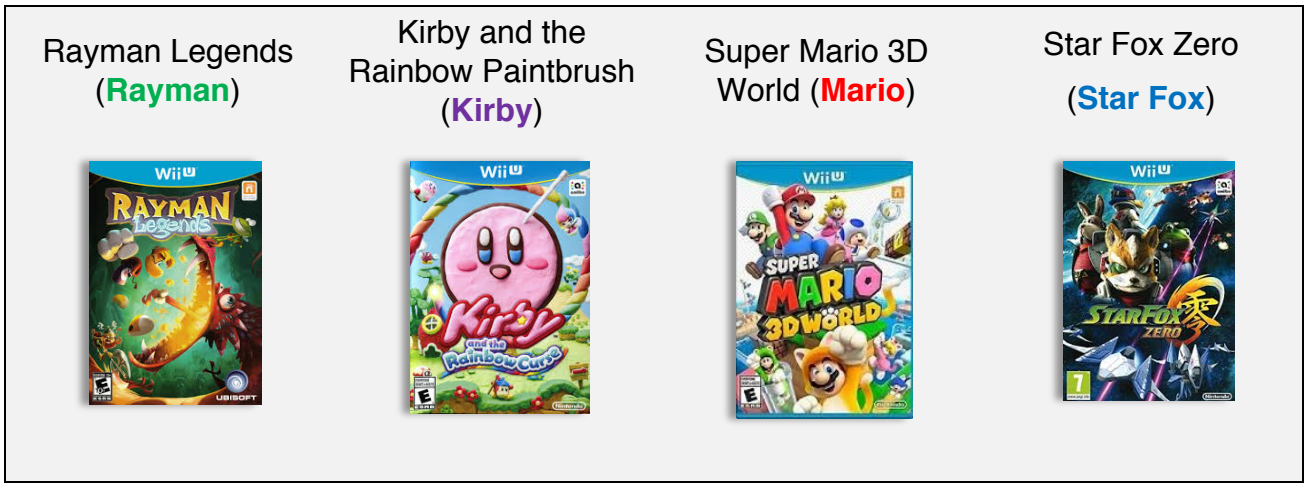


Figure 8.1: The four games used in this research project.

Thirty-nine recommendations have been thematically grouped using the following four themes:

1. Player identity within the team.
2. Rules of play to manufacture interaction.
3. Level design that is conducive to social skills performance.
4. Game design as an enabler or a barrier to inclusion of all players.

These themes were identified during the analysis of the key events highlighted in the previous chapter. While all four themes were also found in the reviewed literature, little attention was given to how these design considerations impacted upon player interaction and social skill

performance. As these four themes are central to addressing key research questions for this study, they provide the structure for this chapter.

8.2 Player identity within the team

One of the most interesting game design considerations is the way that aesthetic components interact with the game rules, the mechanics of play and the narrative to produce a sense of player identity. This is no more evident than when examining the design and 'feel' of the playable avatars used in a game, and what this means for individual identity within a group. The degree to which avatars serve as utilitarian tools or in-game projections of the player in the physical world is central to understanding this relationship. How non-playable characters are used to manipulate and shape the relationships between players is also important in considering how the game positions each player as a team member.

8.2.1 Avatars shaping individual identity within the group

While not true of every game, the games used in this study used playable avatars as representative of the player in the virtual world. Familiar character designs are useful in allowing players to identify themselves and their allies in the virtual environment. This study found that, initially, participants adopted Newman's (2002) 'instrumental view' of their avatars, with players needing to recognise their avatars as the tools through which they interacted with the game world and their peers. Players knowing which avatars they are controlling is an essential first step in virtual world collaboration, but educators need to be mindful of the role of familiarity in creating expectations about these avatars. Some avatars were immediately familiar to the participants, which made the task of self and peer identification

much easier and caused a wave of excitement and anticipation for the players. Other avatars were new to most of the participants.

Familiarity with the avatars presented both benefits and challenges that educators need to keep in mind. For some players, prior knowledge of avatars such as *Mario* or *Kirby* came with a set of expectations for these characters, reflecting Brown's (2014) notion of the 'liquid self' where players adopt the norms and values of their game-based representation. Cognitive load theory provides a valuable explanation for why familiarity derived from these expectations was particularly beneficial for learners with cognitive challenges. This theory contends that limited capacity of working memory can be circumvented through drawing connections with concepts stored in long-term memory, which optimises the cognitive load upon the learner (DENSW, 2018; Sweller et al., 2011). Design consistency helped learners to identify their character on screen and reduced the cognitive load in understanding the capabilities and controlling mechanics for using their respective avatar. This was particularly evident when the players were playing **Mario** for the first time. Two participants knew that the character Princess Peach had the ability to temporarily float while jumping, despite reporting they had never played **Mario** before. This knowledge had been gleaned through playing a previous game in this series, with these design characteristics being carried over into this newer game.

As avatars serve as tools of agency, players need to differentiate their peers from other characters and objects in the virtual world. While **Mario** provided a distinct virtual appearance for every player's avatar, **Kirby** provided different colour variations of the same model for players in the secondary roles. Using visually similar models can be problematic, as players might forget which of their physical world allies is controlling which avatar in the virtual world. This was never an issue in **Mario**, and actually increased verbal communication as players

could confirm with their peers who was using which character. Also important is the ability to recognise friend from foe, with the use of different colour palettes and distinctive designs providing useful visual cues for players who might have trouble recalling the cast of characters within a game universe.

When given the choice to select an avatar, the primary aesthetic concern for the students was that their avatar reflected how they wanted to be perceived by others in the group. When players are given the choice to select their characters, they should be provided with some degree of freedom to select how they are represented in the virtual world. When playing **Mario**, the male participants all stated that they did not want to play as the sole female protagonist, Princess Peach, yet the game required one of the players to play as this character. The literature offers a number of explanations derived from social conditioning as to why male players might be discouraged from selecting a female character. Players in this study might have been hesitant to select female characters because other students would recognise and judge the male player for being aesthetically represented in the game as a feminine character (Kowert et al., 2015). This reflects Castronova's (2005) perspective of avatars representing an instantaneous projection of identity from the avatar onto the player. Alternatively, Newman (2002), and to a lesser extent Brown (2008), suggested that the selection of an avatar is primarily lusory in nature; that is, the avatar is a tool and an initial strategic choice in order to best accomplish the goal. Both of these notions serve to highlight the need for character design to be thoughtful so as to not perpetuate negative stereotypes.

Game design recommendations for supporting collaboration

1. Familiar character designs are useful in allowing players to identify themselves and their allies in the virtual environment.
2. There needs to be a distinct visual difference between player avatars and enemies.
3. When players select their avatars, they should be offered choices for how they are represented aesthetically in the game.

8.2.2 The role of non-playable characters in forging a collective identity

Videogames often include a cast of non-playable characters that serve a number of roles and with whom players can interact. Non-playable characters in the games used in this study adhered to one of three roles, with each role having a different impact upon social interaction. The first role was providing advice on the mechanics of the game, including introducing the rules of play and explaining the value of new capabilities to players. Referring to Gee's (2013) situated learning matrix, these characters are tools designed to establish the goals and norms of the game, which in turn shapes the collective identity. Using these characters to provide advice, particularly through spoken dialogue, is useful in modelling the language that players can use in providing instruction to their peers.

The second role was to help advance the narrative or to build a sense of a 'lived in' world in which the players could explore. Narratives can help to provide meaning and emotional investment in the goals, functioning as a means through which to keep players engaged in the cooperative play. The third role was to directly assist the players by becoming an active participant in the gameplay, using artificial intelligence (AI) to play alongside the other

players. This was the only role that proved to be problematic, disincentivising cooperative play due to the way some participants compared their peers to the AI allies. As detailed in *Chapter 6*, skillful players compared the flying prowess of their computer-controlled allies in **Star Fox** to their less skilled human co-pilots, which created unrealistic expectations of how the novice pilot should be approaching the levels. Findings from this study aligned with Crawford (2005) and Castronova's (2005) critique of some 'magic circle' between real and play worlds, with the events in the virtual world constantly being seen through the lens of the established ecology of the physical world. Therefore, for an intervention centring on social interactions in the physical world, the focus of gameplay needs to remain largely on the agency of the human players. In order to promote an environment most conducive to collaboration between these players, non-playable characters should provide players with advice and build the narrative, but should leave the actual gameplay to the humans.

Most games are designed to follow a difficulty curve, with the beginning sections providing a safe space for learning the mechanics and rules of play. Players then experience increasing levels of challenges working towards the conclusion. This increasing difficulty curve can be observed in most games that challenge the player through the use of AI-controlled enemies. Some games achieve an increase in difficulty by simply providing the same enemies in greater numbers, while other games introduce more complex enemies that require multiple steps or the combination of player capabilities to defeat. In terms of increasing the need for player interaction, this study found that enemies requiring multiple steps from multiple players offered valuable experiences as they required coordination between the players. This in turn manufactured opportunities for the teaching of more sophisticated uses of the targeted social skills.

The idea of requiring a coordinated approach to defeating enemies is epitomised in the way games often use end of level 'bosses' as the penultimate test of player skill. Recalling the battles with *Whispy Woods* in **Kirby** and *Bowser* in **Mario**, these larger enemies are designed to be more complex, creating lengthier events involving players having to combine their individual capabilities. These battles illustrate Gee's (2007a) principle of cross functional teams, creating a sense of positive interdependence between the players (González-González & Blanco-Izquierdo, 2012; Zea et al., 2009). This provides fertile ground for teaching social skills at the point of need during these interactions. In order to necessitate the performance of these targeted social skills, boss battles should require a high degree of group planning, problem-solving and coordination. Rather than introducing new concepts or character moves, the focus should be on the simultaneous application of previously rehearsed player capabilities. This study found that boss battles adhering to these principles provided some of the most sophisticated examples of players performing the target social skills.

Game design recommendations for supporting collaboration

4. Non-playable computer-controlled allies should provide players with advice and build the narrative but should have limited impact on the actual gameplay.

5. Some enemies should require multiple steps from multiple players to be defeated.

6. Boss battles should require group planning, problem-solving and coordination through the simultaneous application of previously rehearsed skills.

8.2.3 Game feedback on individual and team performance

Players received feedback in the virtual world from the game, and in the physical world from both teaching staff and peers. This section examines the feedback systems employed by the game. Findings from this research project reinforce the importance of feedback in increasing the frequency and sophistication of performing the targeted social skills. While it can be argued that the feedback systems in commercial games are focused upon improving skill in the game, and not the performance of social skills, feedback systems have an important part to play. This study confirmed the findings of Kickmeier-Rust et al. (2008), and Tsai et al. (2015), that immediate feedback is essential for ensuring that players are continuously monitoring and evaluating their individual contributions to the team. Feedback on individual performance within the game can help in providing metrics through which the players can evaluate their own play and that of their peers. While Yang (2017), and Kickmeier-Rust et al. (2008), viewed well-designed games as being capable of serving as the primary source of all intervention feedback, the findings from this research project align more with Tsai et al.'s (2015) position that game-based feedback should focus on player performance in working towards the goals of the game. When used in conjunction with complementary social skills feedback systems in the physical environment, this task-level information can be used to improve individual performance in fulfilling each player's role in the collective team. As such, games designed to promote social interaction should focus on providing individual level feedback important for fulfilling individual game roles within the team, with feedback on the performance of social skills being provided by the teaching staff.

Individual feedback on performance for each role is important, but the game should privilege feedback on *team* performance. Feedback presented via the end of level screens has an important role in accomplishing this. The games used in this study each had a unique way of

presenting end of level summaries of individual and collective performance. Presentation had a significant impact upon whether the group interpreted this information individually or collectively. For example, the end of level screen in **Rayman** emphasises the total number of objects collected by the whole team, with the players' avatars shown celebrating together each time they reach a new high score. While this game does show individual contributions, the team score is shown in a larger bright red font in the middle of the screen. Trophies are awarded based upon the team reaching certain benchmarks. **Mario** uses an approach that emphasises the scores of individual players, presenting the scores as a comparative bar chart. The player who has the highest score is awarded a crown, which their avatar wears for the next level, providing a vivid illustration of the 'comparative feedback' described by Burgers et al. (2015). Examples of these screens are shown in Figure 8.2. Many of the factors that contribute to a higher score are largely incidental to the collective team goal of completing the level, and hence provide very little value in assessing the performance of individual roles.



Figure 8.2. The end of level screens in Rayman (left) emphasise the collective score, while Mario (right) celebrates individual performance.

Considering this limited value proposition in conjunction with the social friction such comparative measures can cause, **Rayman** offers a much more constructive approach to the presentation of feedback for social skills interventions.

In addition to considering what is emphasised in game feedback, there is also a need to consider how information is conveyed to the players. As this information is a key consideration for all players improving their role performance, it is important that it can be accessed by everyone. Feedback can include a numerical score, but should also include supporting visual, audio and haptic cues so that a wide range of players can interpret this information. Delaying the quantification of performance until a period of non-play aligns with Hattie and Timperley's (2007) call for consideration of the timing of feedback. Providing more detailed feedback when the player is not being asked to do anything else reduces the cognitive load of the intended recipients, allowing these players sufficient time for processing and to evaluate their play in light of this information.

Game design recommendations for supporting collaboration

7. Players should receive individual-level feedback, which is important to them in fulfilling their individual roles within the team during gameplay.
8. Feedback related to progress towards the collective goal should emphasise team-level feedback over individual-level feedback.
9. Feedback should be accessible to all players using multiple modes of representation and allow for sufficient processing time.

8.3 Rules of play to manufacture interaction

Beyond building player identity, games can also use targeted mechanics or rules of play to manufacture social interactions between players. When considering how games create limitations through the lens of multiplayer gaming, it becomes apparent that the design of games can create a sense of co-dependency through limiting the effectiveness of individual players. Within the four games used in this research project, there exist varying degrees of individual limitation and co-dependence. This can be achieved through the introduction of some form of constraint upon individual players, creating a degree of interdependence between individuals. In-built constraint as a design feature can foster leadership within the group through the positioning of certain players as essential in completing a task required to achieve the common goal. Finally, the effect of players sharing a single avatar requires careful consideration as there are implications for individual agency and team dynamics when players with diverging levels of skill are working together.

8.3.1 Interdependent progress through designed constraint

Co-located gaming often uses one of two techniques to ensure that all players can view themselves in the virtual environment: a subdivided portion of the screen for each player, known as 'split screen'; or a 'shared screen' that keeps all of the players locked to a common space. As player interaction was a primary consideration in the selection of games in this study, all four games used a shared screen. Interestingly, there are diverging rules surrounding the conditions under which the shared perspective 'scrolls' to a new scene in the level. **Kirby** locks the camera to its titular protagonist, with the responsible player controlling what all of the players can see and the direction that the team travels through the level. As opposed to the positive interdependence described by González-González and Blanco-

Izquierdo (2012), and Zea et al. (2009), this is more of an asymmetrical interdependence with the privileging of one player. If a player who is not playing as the primary character moves too far out of frame, they are teleported back to *Kirby*. **Rayman** and **Mario** are more democratic, with the camera following the majority of players. As described in the results of this study, the lone player is placed in a 'bubble' and returned to the other players. An issue identified in **Mario** was that this lone player was often isolated from the group due to falling behind the more skillful players, not because of a conscious choice. **Rayman** offered a clever solution, with the screen dynamically zooming out to allow players to travel at their own speed and allow for some agency, but at a certain point it required all players to be together before the screen would further scroll. This constrains the more skillful players from leaving the majority of their less skillful peers behind, but also reduces the individual agency and capacity for navigational risk-taking, which Gee (2007a; 2013) argued are important principles of DGBL. While a rarity due to the linear nature of most levels in these games, players might also wish to choose different paths. This can provide a valuable opportunity for teaching the skills required for negotiating and reasoning. Screen scrolling should require all avatars to be in close proximity to ensure more skillful players remain with less skillful players, and to provide opportunities for democratic decision-making.

Designed constraint also has a role in ensuring regular participation from all players regardless of skill. Overcoming obstacles or puzzles in order to progress provides a means through which the game can achieve regular participation if they involve all participants. Central to this is the strategic distribution of required capabilities amongst the players, as this manufactures a need for everyone to have a role. This can be seen in the relationship between the characters *Rayman* and *Murfy* in the level *Dungeon Dash* in **Rayman**, a vivid illustration of González-González and Blanco-Izquierdo's (2012) description of positive

interdependence. In order to progress, *Rayman* must safely reach the end of the level, but this is not possible without *Murfy* lowering and raising an intricate set of bridges, gates and platforms. In order to complete the level, both players must be involved by using their distinct but complementary capabilities. While the addition of more player-controlled avatars does dilute the role of *Rayman* in this level, *Murfy* remains centrally important. As group participation is a prerequisite for developing other social skills, active engagement in the group activity is vitally important. It is essential that the amount of time that a player is passive within the game world is minimised through the use of puzzles or obstacles requiring the involvement of all players.

Game design recommendations for supporting collaboration

10. Screen scrolling should require all avatars to be in close proximity to ensure more skillful players remain with less skillful players, and to provide opportunities for democratic decision-making.
11. Active participation should be manufactured through the use of puzzles or obstacles requiring the involvement of all players.
12. Specific capabilities should be distributed amongst the avatars so that they need to be combined with the capabilities of other avatars.

8.3.2 Limiting the use of shared avatars

Sharing a common avatar forces the most intimate forms of coordination yet can cause high levels of frustration. The near constant requirement for verbal communication presented a significant barrier for the students participating in this study due to their need for more

auditory processing time. Just as the younger students reported finding real-time text chat challenging in Garzotto's (2007) study of online communication, students in this study had difficulty in processing the verbal instructions of their peers quickly. The *Plessie's Plunging Falls* level in **Mario** and the cooperative play mode in **Star Fox** both used this avatar-sharing mechanic, as shown in Figure 8.3.



Figure 8.3. Shared avatars in Mario (left) and Star Fox (right).

While all players have access to the same functions in *Plessie's Plunging Falls*, in **Star Fox** the capabilities of the *Arwing* fighter are shared between two players. This study shows that regardless of whether all players have access to the same capabilities or not, a significant challenge exists when players share the same resources. These shared resources include power up items, scoring items and, most notably, a health bar. Should the shared avatar crash or be destroyed, every player has to restart the mission. Such design decisions stand in contrast to the individual agency that a number of authors believe underpin videogames as effective spaces for learning (Bidarra et al., 2013; Gee, 2007b; Squire, 2005). Instead, these examples of design create complete co-dependency, with the action or inaction of one player possibly causing the death of all players. The way in which shared avatars were

implemented in these two games represents high stakes cooperative gaming, providing very little accommodation for less skillful players.

The shared control of a single representation of the player is further compounded in these two example games by the forced travel through the level at a high speed. Even when one or more players recognise the need to coordinate their actions, shared avatars usually require all participants to be fulfilling their roles successfully. Forced movement, while providing constant excitement, reduces the amount of processing time available to the students and can be beyond many players' ZPD, especially for players with cognitive processing delays. When this occurs, the game is no longer 'pleasantly frustrating' (Gee, 2013). Trying to learn a more complex set of controls and game mechanics while monitoring and interacting with peers of differing skill levels often led to frustration in this study. Such scenarios led to conflict as the more skillful players felt they were unable to provide the instructions necessary to less skillful players. Instead of blaming the game design, they became frustrated with their peers. When using shared avatars, the game should provide differentiated roles for different skill levels. An example of this would be if the pilot role in **Star Fox** had an option for a simplified control scheme that would allow a proficient player to work with an expert controlling the weapons systems.

Game design recommendations for supporting collaboration

13. Ideally games with shared avatars should allow players to progress through the level at their own pace without forced movement.

14. Games using shared avatars should provide differentiated roles for different skill levels.

8.3.3 Game mechanics promoting leadership and apprenticeship

An interesting finding of this research was that certain game mechanics could encourage players to take on leadership roles within the group, particularly in regard to players learning how to play the game and the most effective strategies for overcoming challenging segments of a level. Through the lens of socio-cultural perspectives on the processes that underpin learning, the results show that students can fulfil the role Vygotsky (1978) described as the 'knowledgeable other'. Drawing upon the wealth of knowledge of gaming conventions and genre-specific strategies held by the experienced gamers in the group, clear opportunities presented themselves for peer mentoring and coaching, as suggested by Bond et al. (2016), and Wang and Spillane (2009). Peer mentoring required that expert gamers were familiar with the rules and strategies of the games being played, but the metagame became part of this study as these students went home to research the games that were unfamiliar to them. Gee (2018), and Hayes and Duncan (2012), highlighted the inherently social nature of knowledge generation in gaming affinity spaces, with expertise being generated by players refining their understandings through these interactions.

Game design has a role in nurturing apprentice-expert relationships through the sharing of expertise, as the mechanics define key roles for the players that should build upon these conventions and strategies. For example, most of the playable characters in **Rayman** utilise the same basic control scheme as other 2D platform games, and they perform as expert players would expect. While this predictability is important in supporting expert players to instruct novice players in how to play the game, gaming in general would become boring if every game was simply derivative of what has been previously released. Games need to provide new and unexpected capabilities for characters that allow for some form of individual discovery for novice players.

Games such as **Kirby** feature a primary protagonist controlled by a single player, with the other players serving in support roles. This places the weight of responsibility and agency upon the person in this primary role, positioning the person using this character as the de facto leader of the group. Findings from this study show that if the person in the primary role is considered by the playing group to be an expert, this is detrimental to the use of some targeted social skills. However, if the player placed in the primary role is viewed as requiring assistance, this can provide fertile opportunities for the more experienced players in secondary roles to coach and support this player. This, in turn, supports their team members achieving the common goal. This means that if a game does adopt a designed imbalance in agency between playable characters, then the design of the game needs to ensure that players switch between these primary and secondary roles within the team. This ensures that every player has the opportunity to experience this agency and to provide peer coaching through the sharing of experiences.

When a game uses player characters with largely similar or identical capabilities and roles within the team play, game mechanics must ensure that less skillful players still have a required and regular role in achieving the team goal. This can be achieved through a number of designed mechanics, such as requiring a certain number of players to move an obstacle or a number of players standing together on a switch to open a door. When less knowledgeable players are required to do something in the virtual world, this provides an opportunity for experienced players to offer instructions and clarify understanding.

Game design recommendations for supporting collaboration

15. The game should support peer coaching by adopting established genre conventions, allowing experienced players to utilise their knowledge to coach novice players.

16. Players should have opportunities to switch between primary and secondary roles in the team.

17. The play mechanics should allow less skillful players to have a required and regular role in achieving the team goal.

8.3.4 Failure as learning rather than punishment

Failure in videogames can play an important part in players developing their knowledge and skills of the game (Gee, 2013). However, this study shows this to be true only when the players reflect actively upon what went wrong and how they could approach a problem or event differently in the next attempt. This aligns with Eseryel et al.'s (2014) discussion of 'gaining' and 'losing' self-efficacy through the way failure is presented. As the multiplayer games used in this study require effective coordination, reflecting upon failure has significant implications for the use of the targeted social skills. In order for this reflection to be possible, players need to seriously evaluate the effectiveness of their own actions, and those of their peers (Hess & Gunter, 2013; Suárez et al., 2013). Findings from this study show that in order for this to be possible, players need to be in an emotional state that is conducive to such honest self and peer analysis. While the teaching staff and learners have important roles in the regulation of individual and collective emotional states, game design also has a role. Part

of this is ensuring that players feel that failure is fair. While common goals are important, players should have independent, individual health bars to ensure that more skilled players are not penalised by less skilled players. When games require active participation to progress but also reward individual skill, a playing environment is set that allows for emotionally devised peer coaching. It is through this peer coaching that the most sophisticated uses of the targeted social skills were observed in this research project.

Building upon this idea of 'fair failure', when individual players are unsuccessful, they need to be able to reflect on the reasons why and reattempt the challenge in a timely manner. The results showed that this is a delicate balancing act, as being reinstated in the game too quickly often denied players the opportunity to adequately reflect upon their performance and reduce the sense of risk and challenge. This study found that self-reflection can be aided by a short period of time in which they are observers of the action, allowing them to view how other players approach challenges. Alternatively, if players were held out of the game for too long, there was a risk of disengagement, as highlighted by Garzotto (2007) in relation to gamers who experience losing streaks. In order to ensure that games remain ‘pleasantly frustrating’ (Gee, 2007b; 2013), getting this difficulty curve right is essential. As there might be a variation of skill levels within the team, some players will experience failure much more frequently than other players, further complicating the design of adequate challenges. When a player dies and their peers are still alive, the player should be able to respawn relatively quickly so that they do not feel disengaged from the game. There should be an element of player interactivity in this waiting time, such as allowing the 'ghost' of the player's avatar to assist the other players in some minor way. This can guide waiting players' attention towards the actions of the other players and keep them invested in the game until they fully re-join.

In terms of determining the relative consequences of collective failure, once again there needs to be a balance between motivating players in trying to be successful and ensuring that players are not discouraged by disproportionately harsh punishments. When every member of a team fails a challenge, such as dying in a boss battle, there needs to be a negative consequence so that players value team success. Games played in this study used a variety of means in terms of collectively punishing the team for being unsuccessful. There need to be multiple checkpoints within a level, so that when all of the players are killed, they can return to an area close to where they died. The results show that the use of a shared bank of 'lives' can be detrimental in promoting positive social interactions between the players. The limited nature of this resource resulted in more skillful players quickly becoming frustrated when the team received the dreaded 'Game Over' screen as a result of the disproportionate number of deaths from less skillful players.

Game design recommendations for supporting collaboration

18. Players should have independent, individual health bars to ensure that more skilled players are not penalised by less skilled players.

19. When a player dies while their peers are still alive, the player should be able to respawn relatively quickly, and there should be an element of player interactivity in this waiting time.

20. There need to be multiple checkpoints within a level, so that when all of the players are killed, they can return to an area close to where they died.

8.4 Level design that is conducive to social skills performance

In addition to the designed capabilities of the avatars and the rules of the game world, level design has a significant impact upon the way in which players interact within the virtual and physical environments. This includes: 1) discussing the impact of different forms of signposting within levels on the ways that group decisions are made; 2) the notion of level interactivity as a means of promoting interactions between players; 3) considering the use of level design mechanics that add elements of stress into relationships between the players; and 4) the ways in which level mechanics can sustain player motivation and investment in achieving the team goal.

8.4.1 Level signposting to support player progress

Signposting the ways in which levels support and guide the players towards achieving their team goal was influential in how the players in this study understood that team goal. Sharing a common understanding of the team goal is vitally important in coordinating actions between the team members (González-González & Blanco-Izquierdo, 2012; Voulgari & Komis, 2010; Zea et al., 2009). This study found that for participants with cognitive challenges, clarity is of the upmost importance. This is especially true when discussing clarity of directional movement. While in other contexts games that require exploration and freedom of navigation in large open worlds might be beneficial, games being used to manufacture interactions should maintain some form of linearity to focus the attention of players. The use of the shared-screen mechanic also results in limiting independent exploration. Levels should largely follow a linear path so that all players have a general understanding of the direction in which they need to move, with the emphasis being on how the players can work together to progress towards the shared destination.

Videogames for use in social skills interventions can have elements of directional agency and exploration, but they should be short, optional sections of the level that fulfilled the needs of some expert gamers to showcase their skill and knowledge of the game world. These hidden paths can lead to special items or bonuses, but as these sections can be confusing to some players, it should always be possible to return to the more linear sections of the level. They should not distract from the primary team goal.

Signposting is also important in highlighting to players which areas of a level are safe and which areas should be avoided. Aesthetic cues, such as glowing red lava accompanied by the sounds of fire burning, are examples of visual and auditory warnings to the players to stay away from these hazards within the level. Obvious cues are important when a hazard will result in instant failure, ensuring that every player understands the risk. Other environmental hazards, such as the swinging axes in the background of a level in **Rayman**, provide more subtle visual cues to signal that these objects will injure the player's avatar, but will not cause instant death. In this example, the blades of the axes have an animated glint of light reflecting from them. While this sounds like an obscure warning, this cue is used throughout the game to signify when environmental objects will have some positive or negative impact upon the player.

Game design recommendations for supporting collaboration

21. Levels should follow a largely linear path so that all players have a general understanding of the direction in which they need to move.

22. Hidden paths leading to special items or bonuses can be included, but players should always be able to return to the more linear sections of the level.

23. High stakes hazards, such as bottomless pits, should have a clear visual cue that these will cause instant failure and should be avoided.

8.4.2 Environmental interactivity fostering player interaction

One means by which designers engage players through level design is environmental interactivity. This refers to non-sentient elements of a level which the player can manipulate in some way through an action. In the games used in this study, interactivity can be categorised into two broad categories, as illustrated in Figures 8.4 and 8.5. Optional interaction affords players the choice to manipulate the environment to gain some sort of benefit, while mandatory interaction requires player manipulation of the environment in order to progress.



Figure 8.4. An example of optional interaction, where a bonus coin requires coordination between the two avatars in Rayman.

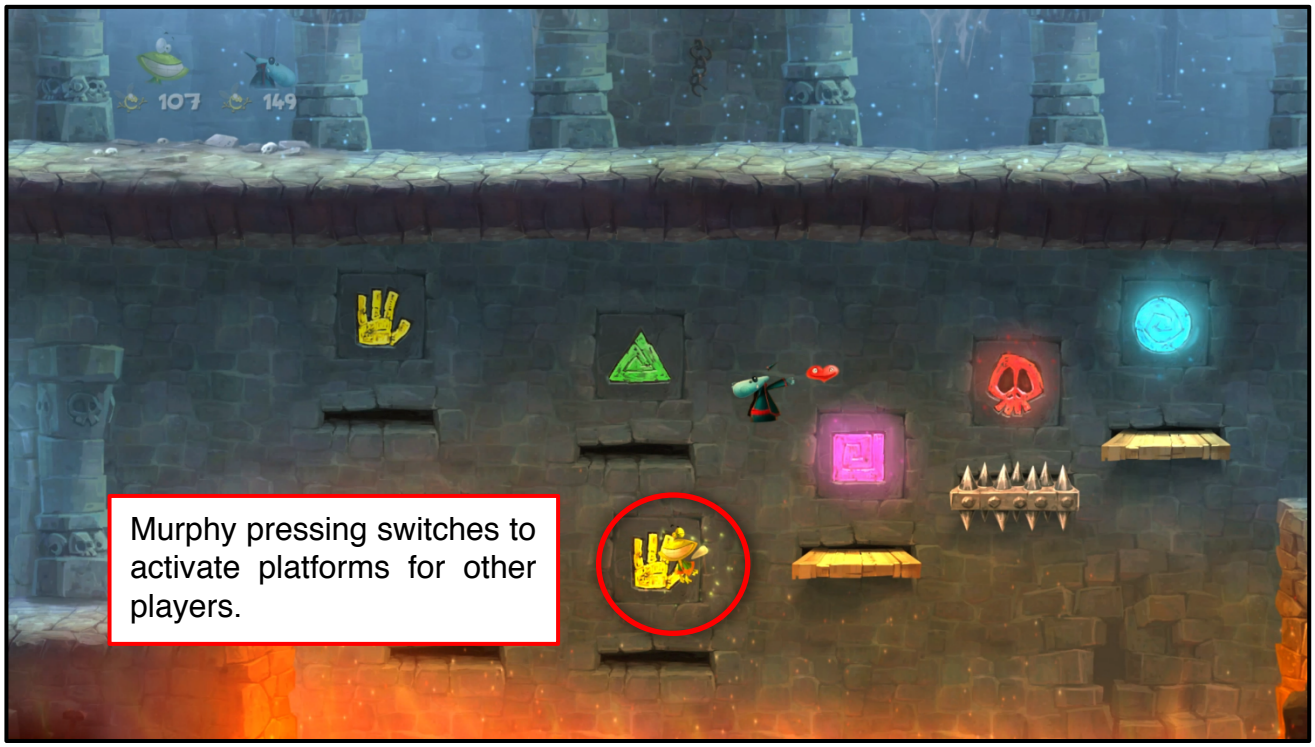


Figure 8.5. An example of mandatory interaction. Players need to interact with the environment by pressing the switches to activate platforms in order to cross a fiery pit.

Optional interactivity can be a clever design mechanic, providing a means for more skillful or knowledgeable players to reduce the difficulty barrier for their peers through indirect forms of assistance. For example, in **Rayman** there were sections of levels that included switches that provided a temporary bridge. While not required to complete the level, this bridge allowed the players to traverse this section of the level, avoiding more challenging enemies directly below them. The use of such optional interactive devices provides a means for proficient players who might not necessarily have the language to assist their peers to still find a way to support and nurture these players. In this study, some of the highest frequencies of interaction between the players were recorded in the sections of **Rayman** that included these devices, particularly with players providing evaluative feedback on collective performance (Burgers et al., 2015). These sections proved to be particularly effective in motivating those expert players who were otherwise hesitant to communicate verbally, as these sections required a clear understanding by all players of their respective roles. The expert gamers not only clarified the role of the less experienced players in these scenarios, but also their own role within the team. In the example of the switch activating a bridge, the activator explained what would happen, but also why this was important for making progress in the level. He had recognised that the other player might not understand the benefits of such a strategy. Reflecting the findings of Burgers et al. (2015), the expert player contextualising the importance of his peers' role appeared to motivate the novice player to persist when initially failing at this task. Such opportunities can be built upon by the teaching staff in order to highlight the importance of providing clear explanations and checking for understanding.

Frequent use of optional interactivity is ideal for providing players some agency as to the degree with which they utilise these affordances. However, 'optionality' can also present challenges when working with players with socio-emotional differences. In this study, some

students were not inherently concerned about the welfare or success of their peers, so for an intervention focusing upon social skills performance, they required some impetus to interact with their peers. Level design that used mandatory interactivity is one means of encouraging these players to consider the role of their teammates. Obstacles can also be placed in a level that require multiple players to interact in a coordinated fashion in order to proceed, such as the coordinated detonation of bomb blocks to destroy an impeding boulder. In this study, players could always choose not to participate in the game, but in every instance of players encountering such obstacles, they attempted to work with their teammates. This is a significant illustration of the power of game design in provoking social interaction where there might otherwise be none.

In order for players to utilise the mechanics of the interactive components of the level, they first need to understand how they work so that they can plan to use them in their play. Findings from this study suggest that when such components are first introduced, minimal pressure should be placed on the players to use them correctly. There needs to be room for player error, with broad accommodations for timing and control issues during this rehearsal period of play. The level should not require any degree of player coordination until individual players are familiar with how these interactive components function. Once this familiarity is present, then coordination can begin, with player focus shifting to planning, implementation and evaluation within the team. Increasing the penalty for failure at this early stage would only serve to heighten the emotional state of the players. In this study, such scenarios resulted in the feedback being disproportionately focused upon allocating personal blame rather than working more constructively on addressing the causes of the error.

Game design recommendations for supporting collaboration

24. Levels should include optional interactive objects that can assist the progress of another player, such as switches that provide a temporary bridge.

25. New interactive objects and obstacles should first be introduced with minimal pressure on the players, allowing them to coordinate their actions correctly until they are familiar with how they work.

26. Obstacles can also be placed in a level that mandates multiple player, coordinated interaction with the obstacle in order to proceed, such as the synchronised detonation of bomb blocks to destroy an impeding boulder.

8.4.3 Inducing 'stressful situations'

One of the most powerful affordances of well-designed videogames is the ability of games to motivate through adherence to the 'Goldilocks principle', providing the appropriate level of challenge by not being too easy or too hard. This is more difficult when games involve multiple players with varying levels of skill. Gee (2013) and Squire (2005) argued that good videogames have the capacity to incrementally adjust the level of difficulty to a point where players are feeling adequately challenged and thus remain engaged in the gameplay. They should also be accessible so that players still have a reasonable chance of making progress. In this model, game design encourages players to learn and adjust their strategies to accommodate this increasing level of challenge. One way in which the games used in this study increased the level of challenge was by having players use well-rehearsed skills in scenarios designed to create a sense of stress. Stressful situations can be induced by mechanics such as the giant wall of fire chasing the players in the *Dungeon Dash* level in

Rayman. In this level, players use skills they have been practising over the previous levels, but now they have to execute these skills in a timely fashion. Visual and audio cues build the sense of tension, from the more obvious effect of the large-scale wall of fire, to the change in colour tones around the players' avatars as the wall gets closer to them. Findings from this study highlight that games should only use mechanics of play that are familiar to all of the players and they should have sufficient ‘safe’ time to practice using those mechanics.

The line between excitement and frustration is difficult to maintain in these stressful situations, particularly in instances where players experience repeated failure. When players in this study were placed in stressful situations without recognising that this was a temporary situation, there were observable increases in players becoming verbally aggressive towards each other. This in turn limits the willingness of the players to collectively plan their approach to completing the challenge. In order to help students regulate their emotional state, the game needs to communicate to the players the length of gameplay in these sections and their relative progress towards removing these stressful conditions. This can be accomplished by providing either some form of in-game map, a count-down timer or even a visible finish line which the players are trying to reach.

To further ensure that these situations encourage a collective approach to planning and problem-solving, these designed situations should require input from all players but there should be ways for more skillful players to offer in-game assistance to their peers. This can involve these skillful players being able to use objects or items to temporarily reduce the pressure on the team, removing the immediate risk to less skillful players. When these mechanics are combined with sections of a level that require all players to complete an action in order to progress, optional in-game assistance can help in shaping a peer-mentoring

relationship between the players. Through this relationship, students will have the opportunity to rehearse and perform a range of targeted social skills.

Game design recommendations for supporting collaboration

27. In stressful situations, players should only have to use mechanics with which they are familiar, with sufficient 'safe' time allowed for practice.

28. The game should communicate to players when stressful situations will end.

29. Designed stressful situations should require input from all players and should allow players to offer in-game assistance to each other to reduce the immediacy of failure.

8.4.4 Sustaining player motivation through the introduction of new mechanics

As an overarching goal of this research was to videogames as tools for encouraging active participation, it is essential that the designs of these games motivate players. One means this study identified for motivating players was through the introduction of new mechanics at regular intervals, helping to maintain a sense of constant discovery. Each introduction of a new mechanic was also important in providing additional opportunities for interactions between the players. Level design has an important role in ensuring that these interactions around the introduction of a new mechanic can occur in a way that is conducive to the use of the targeted social skills by the players. Key to this is the principle that levels should offer safe spaces for players to explore new gameplay mechanics (Anthropy & Clark, 2014; Shute et al., 2011). This affords the players the opportunity to explore these new capabilities

collectively without the risk of failure, and all of the associated tension and anxiety that accompany such a risk.

Once players have been given the opportunity to work out how a new move or game object operates, levels should then introduce situations in which the players are required to use these mechanics through experimentation. When levels had players apply their previously rehearsed knowledge of an avatar's special move or a power-up in novel situations, this study observed many examples of the group discussing the possibilities and limitations of a new capability. One example was in the discussion of the *Cat Suit* power-up in **Mario**, which allowed the avatars to climb vertical walls within the level, as shown in Figure 8.6. This was most effective when all players had a foundational knowledge of the capability, so these new situations for application should first require the use of a move or object in isolation.



Figure 8.6: Players exploring the wall climb mechanic provided by the *Cat Suit* power-up in Mario.

As players develop a deeper understanding of the new affordances offered by this new move or power-up, new mechanics can be used and integrated with previously introduced mechanics. For example, in **Mario**, players soon learnt to use the *Cat Suit*'s wall climb with their standard jump capability to bounce from wall to wall. At this point, another new mechanic can be introduced, forming a cyclical process that maintains the sense of constant discovery and helps to avoid the players becoming bored through excessive repetition. This cycle is not dissimilar to the pedagogical concept of 'spaced practice' (DENSW, 2018; Hattie, 2009), with players being provided multiple exposures to a game mechanic. The four stages in the cycle are presented in Figure 8.7, bearing some resemblance to the cycles of expertise described by Gee (2013).

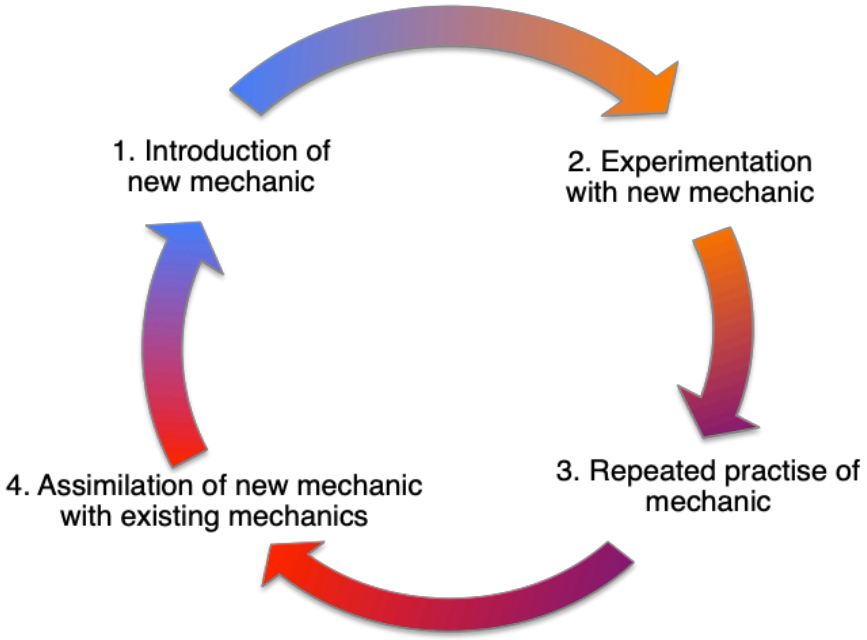


Figure 8.7. Sustaining motivation through the introduction of new mechanics of play.

This cycle can be used in deciding the points at which new mechanics should be introduced during the initial planning of the scope and sequence of a game. New mechanics are important in maintaining interest in the game and for facilitating discussion as players jointly explore these new capabilities.

Game design recommendations for supporting collaboration

30. New mechanics should be introduced regularly in order to maintain the sense of discovery, experimentation, assimilation and mastery.

31. Levels should begin with safe spaces for players to explore new gameplay mechanics so that they can practice these without the risk of failure.

32. Situations should be introduced in which the players are required to use new mechanics in isolation and then in combination with previously introduced mechanics.

8.5 Game design as an enabler for including all players

As this research project was conducted in a specialist setting with students having a diverse range of learning needs, care needed to be given to ensure that the games were accessible to all players. Despite the attention afforded the individual needs of the participants, the findings still identified a number of challenges that created barriers for some players. These findings inform important recommendations for inclusive game design, particularly in identifying specific enablers and barriers to participation. These include the challenges presented by three-dimensional virtual environments, the way that games controllers should be configured for use within the games, and the affordances of in-game tools for alternative means of communication.

8.5.1 The challenge of the third dimension

Essential to students being able to participate in cooperative gameplay is their ability to believe they have a high level of agency within the virtual environment. In games that represent the player using avatars, this agency is generated through control over these

avatars. The results from this study show that game designers need to prioritise accessibility over complexity, especially when it comes to the axis of movement within these virtual worlds. Controlling characters within a two-dimensional field of play presented no issues, but significant issues with control were observed in games that required avatars to navigate through three-dimensional environments, particularly for the student with Down syndrome. Whether these issues were a result of the increased visual processing demands placed upon the players or the more complicated control schemes required by three-dimensional games is unclear. The literature reviewed in *Chapter 2* suggests that either reason is possible (Gass et al., 2013; Kasari et al., 2001).

It is clear that not all players could access some required sections of the game, and thus were much less likely to perform the targeted social skills beyond asking for help. This created an equity gap, with players who could navigate these environments becoming frustrated with the inability of other players to fulfil their role. For the purposes of inclusive game design, videogames used in this context might contain elements of three-dimensional gameplay, but players should be restricted primarily to moving on a two-dimensional axis.

The use of the qualifying term ‘restricted primarily’ acknowledges that some non-compulsory three-dimensional components might be desirable so that expert players can showcase an area of strength to their peers (Crawford, 2011; Shaw, 2012). Many commercially available games do use three-dimensional gameplay, and this creates a level of expectation for some gamers (Chen, 2012; Shaw, 2012). A compromise between the needs of highly skilled and less skilled players is allowing for limited, optional sections of the game to utilise three-dimensional fields of play. This might include bonus levels or limited sections of a level, but these should be low risk in nature and optional to completing the primary goals.

Game design recommendations for supporting collaboration

33. Games can contain elements of three-dimensional gameplay, but players should be restricted to moving on a two-dimensional axis.

34. Bonus levels and limited sections of a level can use three-dimensional movement, but these should be low risk in nature and optional to completing the primary goals.

8.5.2 Controllers creating an inclusive interface between the players and the game

The means through which the players interacted with the digital environment provokes some interesting considerations in terms of players being able to participate in the game. This study found that accessibility meant different things to different players, with the most important thing in terms of game control being choice. Garzotto (2007) positioned accessible controls and user interfaces as key determinants in the effectiveness of DGBL. Multiple control options should be available because players have different levels of fine motor control and preferences for physical or touch-based inputs. The Wii U Gamepad, shown again in Figure 8.8, provides an excellent example of the different ways that players can control their avatars and interface with the virtual environment.

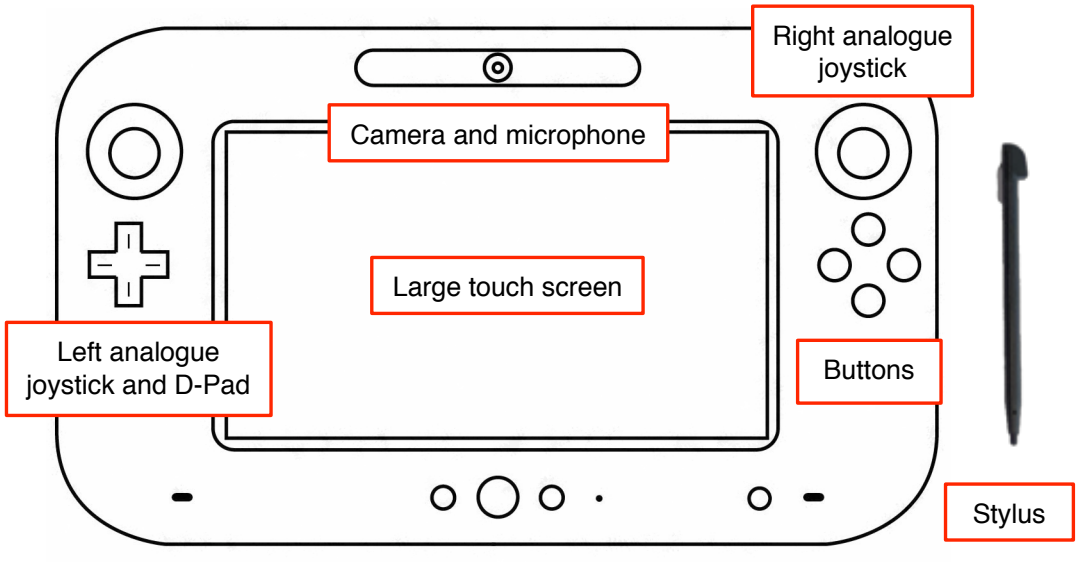


Figure 8.8. Controllers such as the Wii U Gamepad allow for multiple means of interface between the player and the virtual environment. Adapted from Elcandil.info (2019).

Some players stated that they preferred the use of the touch screen, either through a direct interface via their finger or through using the stylus. While using their fingers would be a more familiar experience for students who regularly use a tablet or smartphone, fingers can also block the screen. Using a stylus might largely address this issue, but in this study one student with fine motor control difficulties found this to be much more challenging than using direct touch. Traditional buttons and an analogue joystick were popular with the more experienced gamers and, surprisingly, also with the student with fine motor control difficulties. This could be due to the tactile feeling when they press a button, a feature not possible with touch-based controls. The use of 'rumble' or force feedback was popular with all students, and this could be used strategically to provide haptic cues to players with visual processing challenges.

Some control schemes, such as using touch screens, can actually present barriers for players. In this study, it was found that the strengths of each respective control scheme should be paired with different avatars with capabilities that are well suited to that control scheme. For example, the pilot in **Star Fox** uses a traditional button-based scheme to steer the *Arwing* aircraft, while the gunner uses motion-based controls and the analogue triggers

on the Wii U Gamepad to fulfil their role. **Rayman** also presents a different role for the player using the touch screen, controlling *Murfy,* who is unique in that this character can move instantly to any point on the screen that is touched by the player. As noted previously, *Murfy's* repertoire of moves and capabilities differs from that of players using the traditional button-based controls, yet both roles are integral to team success. Games that present interdependent mechanics for different avatars can provide a variety of roles, using a variety of input methods to ensure access for a range of functional needs.

The placement of the directional pad to the left and the two primary buttons to the right on the Wiimote represents a traditional layout for a game controller, and upholds conventions established since the original Nintendo Entertainment System released in 1984 (Pfau, 2008). While many modern videogame controllers use analogue sticks and many more buttons, the simplicity of this design was beneficial, allowing the players to learn quickly how to control their avatars in a new game. As the focus of this intervention was on promoting social interactions between players, it was ideal to minimise the time students spent coming to grips with how to control their avatars. Therefore the default control configurations should be similar to those of popular commercial games to reduce the barrier to learning a new game.

Game design recommendations for supporting collaboration

35. Multiple control options should be available to consider players with different levels of fine motor control and preferences for physical or touch-based inputs.
36. 'Rumble' or force feedback can be used strategically to provide haptic cues to players with visual processing challenges.
37. The default control configurations should be similar to those of popular commercial games to reduce the barrier to learning a new game.

8.5.3 Tools aiding multiple means of communication and planning

One of the strengths of design research is hearing the perceptions and preferences of the participants. One subtle but important finding from this research was the divergence in preferred means of communication. Rather than ignoring these preferences, games should find ways to accommodate them, as they can augment verbal communication and help in facilitating increased sophistication of communication. *Murfy* in **Rayman** was one game-based tool that could be used as a form of digital pointer, as shown in Figure 8.9. Including digital pointer tools is important in supporting players who preference visual communication over verbal communication.



Figure 8.9. Murfy being used as a digital pointer, instructing the other player to go through the doorway.

Opportunities for students to call time-outs when additional planning or processing time was required became an important feature of this intervention. While *Chapter 7* explored the facilitation of time-out breaks through the introduction of a system in the physical world,

games also have a role in allowing for pauses in the action. An in-game break card feature should be present in the design of games, to promote social interaction. This feature should allow any player to pause the game, but still view the screen and use the pointer tool.

Game design recommendations for supporting collaboration

38. A digital pointer tool is important in supporting players who preference visual communication over verbal communication.

39. An in-game break card feature should be present to allow players to pause the game but still use the pointer tool.

8.6 Summary of game design recommendations

This chapter has presented 39 distinct recommendations for the design of games that create the conditions for collaboration. These recommendations are organised under four broad themes:

1. player identity within the team;
2. rules of play to manufacture interaction;
3. level design that is conducive to social skills performance; and
4. game design as an enabler for including all players.

Using these themes, Table 8.2 presents all the recommendations, emphasising that they are intended to be considered together rather than in isolation.

Table 8.2. The 39 recommendations for collaborative game design emerging from this study.

Player identity within the team	Avatars shaping individual identity within the group	
	1. Familiar character designs are useful in allowing players to identify themselves and their allies in the virtual environment.	
	2. There needs to be a distinct visual difference between player avatars and enemies.	
	3. When players select their avatars, they should be offered choices of how they are represented aesthetically in the game.	
	The role of non-playable characters in forging a collective identity	
	4. Non-playable computer-controlled allies should provide players with advice and build the narrative but should have limited impact on the actual gameplay.	
	5. Some enemies should require multiple steps from multiple players to be defeated.	
	6. Boss battles should require group planning, problem-solving and coordination through the simultaneous application of previously rehearsed skills.	
	Game feedback on individual and team performance	
	7. Players should receive individual-level feedback, which is important to them in fulfilling their individual roles within the team during gameplay.	
	8. Feedback related to progress towards the collective goal should emphasise team-level feedback over individual-level feedback.	
	9. Feedback should be accessible to all players using multiple modes of representation and allow for sufficient processing time.	
Rules of play to manufacture interaction	Interdependent progress through designed constraint	
	10. Screen scrolling should require all avatars to be in close proximity to ensure more skillful players remain with less skillful players, and to provide opportunities for democratic decision-making.	
	11. Active participation should be manufactured through the use of puzzles or obstacles requiring the involvement of all players.	
	12. Specific capabilities should be distributed amongst the avatars so that they need to be combined with the capabilities of other avatars.	
	Limiting the use of shared avatars	
	13. Ideally games with shared avatars should allow players to progress through the level at their own pace without forced movement.	
	14. Games using shared avatars should provide differentiated roles for different skill levels.	

	Game mechanics promoting leadership and apprenticeship
	15. The game should support peer coaching by adopting established genre conventions, allowing experienced players to utilise their knowledge to coach novice players. 16. Players should have opportunities to switch between primary and secondary roles in the team. 17. The play mechanics should allow less skillful players to have a required and regular role in achieving the team goal.
	Failure as learning rather than punishment
	18. Players should have independent, individual health bars to ensure that more skilled players are not penalised by less skilled players. 19. When a player dies while their peers are still alive, the player should be able to respawn relatively quickly, and there should be an element of player interactivity in this waiting time. 20. There need to be multiple checkpoints within a level, so that when all of the players are killed, they can return to an area close to where they died.
Level design that is conducive to social skills performance	**Level signposting to support player progress**
	21. Levels should follow a largely linear path so that all players have a general understanding of the direction in which they need to move. 22. Hidden paths leading to special items or bonuses can be included, but players should always be able to return to the more linear sections of the level. 23. High stakes hazards, such as bottomless pits, should have a clear visual cue that these will cause instant failure and should be avoided.
	Environmental interactivity fostering player interaction
	24. Levels should include optional interactive objects that can assist the progress of another player, such as switches that provide a temporary bridge. 25. New interactive objects and obstacles should first be introduced with minimal pressure on the players, allowing them to coordinate their actions correctly until they are familiar with how they work. 26. Obstacles can also be placed in a level that mandates multiple player, coordinated interaction with the obstacle in order to proceed, such as the synchronised detonation of bomb blocks to destroy an impeding boulder.
	Inducing stressful situations
	27. In stressful situations, players should only have to use mechanics with which they are familiar, with sufficient ‘safe’ time allowed for practice. 28. The game should communicate to the players when stressful situations will end.

	29. Designed stressful situations should require input from all players and should allow players to offer in-game assistance to each other to reduce the immediacy of failure.
	Sustaining player motivation through the introduction of new mechanics
	30. New mechanics should be introduced regularly in order to maintain the sense of discovery, experimentation, assimilation and mastery. 31. Levels should begin with safe spaces for players to explore new gameplay mechanics so that they can practice these without the risk of failure. 32. Situations should be introduced in which the players are required to use new mechanics in isolation and then in combination with previously introduced mechanics.
Game design as an enabler for including all players	**The challenge of the third dimension**
	33. Games can contain elements of three-dimensional gameplay, but players should be restricted to moving on a two-dimensional axis. 34. Bonus levels and limited sections of a level can use three-dimensional movement, but these should be low risk in nature and optional to completing the primary goals.
	Controllers creating an inclusive interface between the players and the game
	35. Multiple control options should be available to consider players with different levels of fine motor control and preferences for physical or touch-based inputs. 36. 'Rumble' or force feedback can be used strategically to provide haptic cues to players with visual processing challenges. 37. The default control configurations should be similar to those of popular commercial games to reduce the barrier to learning a new game.
	Tools aiding multiple means of communication and planning
	38. A digital pointer tool is important in supporting players who preference visual communication over verbal communication. 39. An in-game break card feature should be present to allow players to pause the game but still use the pointer tool.

These 39 recommendations can assist educators in identifying videogames with the characteristics and features most likely to promote the types of social interactions conducive to an effective games-based social skills intervention. Both Ellington et al. (2013), and Bidarra et al. (2013), contended that educators have a strong interest in DGBL. For this interest to translate to practice, they require guidance from evidence-based resources such as these

recommendations to ensure that their implementation is likely to lead to the desired learning outcomes. Commercial game developers can also use these recommendations to design new games to reach new markets, such as schools and therapy groups. The final chapter of this thesis considers the implications of these game design recommendations and the intervention design shared in *Chapter 7.* It uses the *Compleat model* of design research (Middleton et al., 2008) to identify the next steps in more broadly testing the artefacts and theory developed in this study.

Chapter 9: Conclusions, limitations and future directions

9.1 Chapter introduction and structure

Primary research question:

How can children with social-emotional challenges develop targeted social skills through intervention using cooperative videogames?

In addressing the primary research question, the major assertion of this research study is that:

Cooperative videogames can create the conditions for collaboration, but educators need to optimise the systems of intervention in order to develop the targeted social skills.

The guiding questions help in identifying how this may be achieved. Through addressing guiding questions **a**, **b**, and **c**, this study has produced a structure and a set of guidelines for a social skills intervention using cooperative videogames as a tool for promoting social interactions.

Guiding questions:
a) What methods of instruction can be used to optimise the learning of targeted social skills? b) How can targeted social skills be practised and performed during cooperative gameplay? c) What is the role of teaching staff in supporting students' social skill development in this intervention?

Should these guidelines be validated in broader contexts, they will assist educators in understanding which skills to target, the methods of instruction for these skills, and the role of the game.

This study also sought to identify the role of game design in promoting interactions and the inclusion of all players, as shown in guiding questions **d** and **e**.

Guiding questions:
d) How do the rules and mechanics of different games impact upon social interactions? e) How can game design create the conditions for inclusion?

This chapter presents conclusions on each of these facets of the research and then identifies a number of limitations of this study resulting from the nature of the methodology and the practicalities of working within an established ecology. It concludes by returning to the *Compleat model* of design research to consider the future directions for this field of research in light of the results of this study.

9.2 Conclusions about the structure and guidelines of the designed social skills intervention

At the centre of this thesis is the concept that all students require social skills in order to be fully active participants in society. To achieve this, social skills interventions are required to assist students with functional social-emotional challenges or differences. As identified through this research, and discussed specifically in *Chapter 7*, a significant challenge is getting these learners to voluntarily engage with their peers in order for them to have the opportunity to perform and reflect upon these important skills. Once the students are participating in the task, the teaching staff can then facilitate and promote the target skills in a context that is relevant to students with an interest in gaming.

With this purpose in mind, the distinct three-stage approach (skill instruction, cooperative play and group reflection) builds upon the existing social skills research and combines strategies from the literature that have an evidence-base showing them to be effective in developing social capabilities. When used in conjunction with the affordances of well-designed multiplayer games and utilising an affinity for gaming and gamer culture, the participants were more likely to persist in developing the targeted skills. This was particularly evident in the use of video footage in **Stage A** (skill instruction). Through the use of video modelling, the student participants could see and hear themselves performing the targeted skills in a context that was more likely to capture their interest and made the performance of the skill meaningful to them. Once these students understood the purpose of the skill in one game-based context, video review allowed them to better understand other contexts within cooperative gameplay where the skill may have been appropriate to perform. This transition from teacher-led modelling to teacher-guided application responded to the changing needs of the students as they developed a more sophisticated understanding of the targeted skills.

Central to building towards independent and increasingly sophisticated skill performance was the way in which the teaching staff positioned themselves during the cooperative gameplay. Optimising the systems for promoting interactions through cooperative gameplay involved the teaching staff knowing when and how to intervene during interactions between the players. In the scaling of this prototype to other contexts, foreseeably this could be the most variable factor between different ecologies as, inevitability, the relationships between learners and teaching staff will differ from classroom to classroom. This prototype provides a solid starting point by suggesting the use of visual tools to remind the players of their individual goals and to assist them in monitoring which skills they have been using during play. Planned, regular time-out breaks provide an opportunity for teaching staff to remind

students of their individual and team goals, the meaning and value of the targeted skills and allow for guided emotional regulation if required. As students develop a more sophisticated understanding of the skills, there is a transition from the teaching staff leading these formative evaluations of performance to the students being encouraged to lead this process. Even as students become more proficient in leading these discussions, this study found that the teaching staff still had an active role in ensuring that all participants had the opportunity to share their perspectives, concerns and understandings.

This transition from teacher-led to student-led evaluation of performance was mirrored in the post-play reflections of **Stage C**, but this is the area of the intervention that would possibly benefit the most from additional iterations. Due to the practical limitations of the technology being used to capture the video, the combined footage of the physical and virtual environments was not available for the students during this stage for any of the ten lessons. This meant that students had to recall the events from **Stage B**, which resulted in students discussing the events with which they had the deepest emotional connection. While these events afforded many opportunities to discuss the use or non-use of skills in context, many of the subtler moments of play were missed. This was unfortunate as these less memorable moments of play often had examples of more sophisticated performance of the targeted skills. While these examples were still discussed in the subsequent lesson during **Stage A** (skill instruction), there was a delay between the event and the reflection. This made it more difficult to elicit the non-verbalised reasoning from the students as to why they decided to use a particular skill in a particular context.

9.3 Conclusions about game design creating the conditions for collaboration

Thirty-nine recommendations were developed through findings of the design experiment phase of this research project. While only tested in one ecology, the fundamental ideas found within these recommendations build on the findings of previous studies of effective game design or effective instructional design, although cross germination between these two fields of study remains uncommon. Where these recommendations are truly novel is in the specific focus on manufacturing social interactions between players who otherwise may be reluctant to do so.

This study has shown that player identity can be a powerful thing, as it can provide a level of confidence required to fulfill a leadership role within a team. While it is easy to focus on the label of autism or Down syndrome as defining the participants in this study, this research has shown that the label of 'gamer' is what really holds social currency in this ecology. Identity can also be constraining, as shown in this study when players quietly accepted passive roles within the group if they saw themselves, or were seen by their peers, as novices. Even though these players may have had knowledge that might have been useful to the team, they lacked the social capital of those students who were recognised as being the experts. The findings do not indicate that game design can shift group dynamics that have been long established within an ecology. Where design might be able to shape the perceptions of novice players is through creating individual defined roles for every participant and making each role indispensable in progressing through the game.

Independence is manufactured through the design of the mechanics and rules of the game that demand contributions from multiple players, but this study highlighted that some

mechanics are more effective than others. Providing avatars of players with unique move sets that allowed for differentiated roles within the team was one way that design encouraged the inclusion of players across a range of skill levels. Level design likewise was shown to have an influence on the performance of social skills by creating conditions conducive to peer tutelage and collaborative problem-solving. The extent to which genuine consultation is possible in other contexts is unclear, as while the design of the game might remain the same, inevitably the existing social dynamics within the group will change from setting to setting.

9.4 Challenges and limitations of this study

In addition to the complex ethical considerations outlined in *Chapter 4*, a number of other study challenges and limitations must be addressed. While they do not devalue the important work of this study, these challenges and limitations need to be acknowledged to ascertain the boundaries of what can be concluded from the findings of this research project.

9.4.1 Self-study by the teacher-researcher

Clandinin and Connelly (1998, p. 161) recognised the value of a researcher who understands the ecology, cautioning against researchers being "parachuted in to solve whatever problems been identified externally." Instead, they highlighted the need for understanding the historical developments of a setting, which allows the teacher-researcher to fully grasp the context in which their research is taking place. Wyatt (2010) also saw merit in the teacher-researcher, pointing to the flow on benefits for both the teacher and the students of a self-reflective practitioner who is engaged in interventionist research. He highlighted the particular effectiveness of teachers recording their practice and reviewing this record before planning

their next lesson. This form of retrospective analysis is built into Dolk et al.'s (2010) model of design research.

In any form of interventionist research, personal biases can never be fully mitigated. It is important to reflect upon the teacher-researcher's constructions of reality, and to critically analyse the impact this might have upon the interpretation of the data generated. A perfect example of unconscious preconceived notions being projected upon other participants is in the initial interview with the teaching assistant Tetra.

Teacher:	Just to clarify the purpose of the interview is just between yourself and myself to improve the quality of this intervention, to make sure that we are teaching collaborative social skills, which as you know and I know can be a challenge.

Before the teacher-researcher had even asked a single question, he signalled an assumption that his understanding of the challenges encountered by the students were shared by the teaching assistants. This is why the secondary coding of a sample of the video data and the co-construction of the examples and non-examples for each indicative behaviour were so important. These steps provided a safeguard against unchecked assumptions by the teacher-researcher. They allowed someone who was unfamiliar with the students to review both the data and the application of the coding scheme. This ensured that the scheme was developed and applied in a manner that was consistent, relying on directly observable indicators that minimised interpretation by the teacher-researcher. Through minimising interpretation, the potential for conscious and unconscious biases that might influence the generation of data informing this study was at least reduced if not fully mitigated.

9.4.2 Reliability rather than replicability

As has been noted at length, design research is developed in a single ecology. One of the critiques of research developed within one context is that much of the qualitative 'textual data' generated through interviews involves a narrow band of participants. Consequently, contextual considerations may adversely skew the responses. For example, one of the days of data generation fell on a participant's birthday so all five students were feeling very excited about a party planned for the afternoon. So, while the interviewer can repeat the line of questioning, the exact conditions in which the original response was given cannot be replicated due to the uncontrollable ecological influences that make every point of data generation unique. As the design research in this study was conducted over ten lessons, the passage of time meant that participants were interacting with other actors between lessons. To varying degrees, this may have reshaped their perspectives, views and values and influenced their subsequent responses to the same line of questioning.

These critiques are also valid when generating video over multiple lessons in a single ecology. What is most important to remember is that this study focused on the first five of the seven phases of the *Compleat model* of design research. This limitation will be addressed in future studies when the final product of the design experiment stage, developed in this research project, is scaled and tested in a broader range of ecologies. For this study the most important consideration was the reliability of data, and the steps employed to ensure this are reported next.

9.4.3 Challenges of conducting design research within an established school structure

In any research conducted in formalised educational systems, there are bound to be certain limitations brought about by the entrenched systems and practices within the setting. This was certainly true for this research project. The structure of the school timetable was very important for supporting the students in knowing what to expect, but it limited the amount of time available for the generation of data.

The intervention also had to operate within the established power hierarchies of the school setting, which had been built up through both documented policies and the enacted culture of the school. While this study aspired to achieve the collaborative structural reform envisioned by a transformative research paradigm, there was a duelling ethical consideration to fit within the confines of these power structures. Even though the students were invited to help guide the design of the intervention, they were still aware of the expected roles of the teacher and the student within the setting. Likewise, it was well understood that the teaching assistants were expected to follow the direction set by the teacher, despite the best efforts in this study to position them as equal partners in the design process. Ultimately, the teacher-researcher still had the final decision as to the direction of the intervention, and even then he was bound to adhere to the policies of the school. Entrenched systemic boundaries limited the agency individual students had in using this research as a catalyst for more significant structural reforms in the school.

9.4.4 Challenges and limitations of generating data through video

One important consideration is the role of the researcher in deciding where the camera should be focused, and when the footage should start and stop being collected. Patton

contended that in all forms of qualitative inquiry “the researcher is the instrument” (2005, p. 14). Clarke et al. (2009) highlighted the directorial role of the researcher in video data collection. The researcher has the power to position video as a ‘window’ that provides a complete contextual record of an event, a selective ‘lens’ that obscures parts of the context deemed peripheral or irrelevant to the topic of research, or as a ‘distorting mirror’ that can capture the scene in an artificial manner to suit the biases of the researcher. These analogies provide powerful metaphors through which to examine the relationship between how video data is collected and the ability of the researcher to capture a ‘complete’ account of the social skills and behaviours being exhibited.

There is also the issue of the students feeling uncomfortable about being recorded. Although they are recorded regularly as part of the assessment practices at the school, potentially the visibility of the equipment and the presence of strangers might have interrupted their sense of normalisation, and hence impacted their behaviours. However, nothing in the analysed video footage seemed to suggest this. This challenge reflects the idea of the camera as “an actor in the research process”, with behaviour and observation occurring “in front of and behind the camera” (Shrum et al., 2005, p. 1). There is a general consensus within research theory of observed participants altering their behaviours to some degree, either consciously or subconsciously, because they are aware they are part of a study (Dowling & Brown, 2010, p. 53). This idea needs to be explored in the context of justifying the use of any observational method, as the possibility of artificial behaviour adjustment challenges the validity of the data being collected (Creswell, 2012; Komarova & Martina, 2014). One solution to this problem was setting up the camera for lessons before the beginning of data collection, simulating the experience, but not using any of this footage in the analysis process (Clarke, Keitel, &

Shimizu, 2006). While there is no perfect answer, this seemingly helped to normalise the presence of the cameras and, importantly, create a new sense of routine for the students.

9.4.5 Differences in communication for students with autism

Another important consideration relates to how the manifestations of autism, particularly the differences in communication, could make it difficult for the students to be understood by the teacher-researcher as the students intended. In order to address this, supports were offered to help the participants understand the intended topic of conversation, such as the cover for the videogame that the teacher-researcher wanted to discuss. As the quote below shows, this was not always successful, as sometimes they focused on unintended components of the support.

Teacher:	Did you find that easier? Using the game pad?
Pit:	Wait … there's numbers on the box. Look at these numbers.
Teacher:	Oh that means age, how old you can be.
Pit:	Yeah but zero.
Teacher:	Zero.
Pit:	That's why zero.
Teacher:	It means you can be a baby and play.

In this example, Pit was directed to refer to the cover to help him recall his experiences of playing this game in the earlier lessons. Instead, he focused upon the age rating, either not comprehending the purpose of the question or ignoring it in favour of something that interested him. Numerous examples of this communication breakdown were evident in the

concluding interviews. This sometimes made it challenging to elicit responses to the questions that the teacher-researcher thought were important to address. As this research project moves to further testing in other contexts, teaching staff who are familiar with the future participants will be required to help bridge the differences in communication that manifest as a result of autism.

9.4.6 Transportation of the targeted social skills beyond videogames

Ultimately, the objective of social skills intervention is for students to be able to perform the targeted skills, not just in the context of playing cooperative videogames together, but in a wide variety of contexts. As identified in the literature review, social skills are context dependent so the appropriate application of each skill will change depending on the relationship between the student participants and the situation in which they find themselves (Gresham & Elliot, 1987; Klieve, 2018; Winner, 2007). The mental flexibility required for translating social skills taught for one context to an appropriate form in another context is an area of particular challenge for many students with autism (Happé & Frith, 2006; Mišic et al., 2014), as is recognising when a social context has actually changed (Frith & Happé, 1994; Happé & Frith, 2006). Rather than the notion of skill 'generalisation', it is more useful to consider the teacher-guided transportation of these skills from one context to another and specifically teaching what these skills look like in each context. While this will require explicit instruction for the students in how to recognise the differences in situational context, at the very least, familiarity with the nature and reasons for performing these skills in a games-based context provides a solid point of reference. Future research is required to test the flexibility of skill transportation and the subsequent maintenance of these skills.

9.5 Future directions

It is important to note that this initially tested version of the intervention suggests the most effective components and game design in the specific ecological context of Hyrule School. In order to make judgments as to the effectiveness of the design or the generalisability of the results beyond this ecology, this research needs to be scaled to include more participants in more diverse contexts (Dolk et al., 2010; McKenny & Reeves, 2012; Middleton et al., 2008). What this research project does provide is a suggested blueprint for such a study using the components of this prototype intervention to implement Phases 6 and 7 of the *Compleat model* of design research (Middleton et al., 2008), as shown in Figure 9.1.

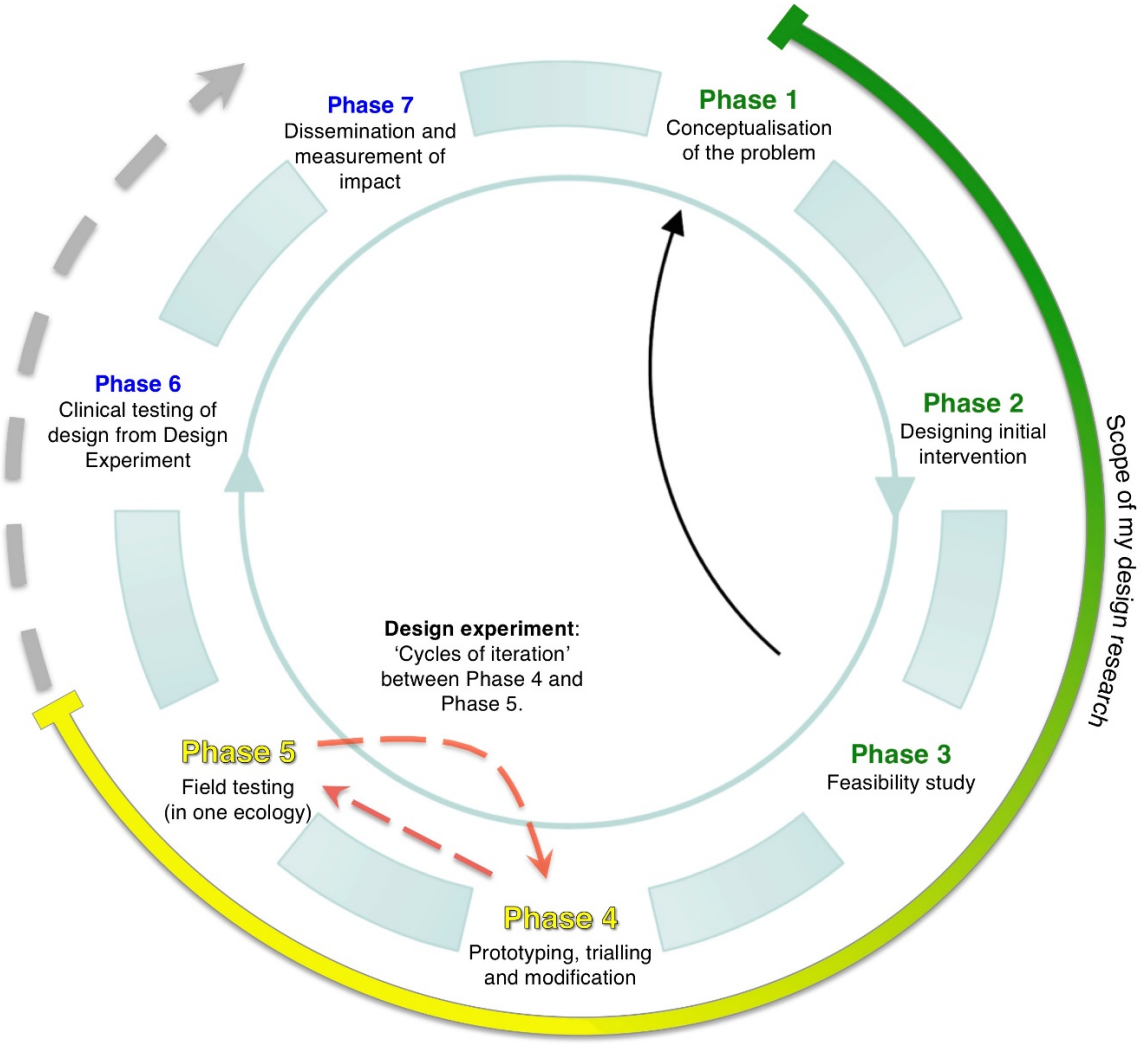


Figure 9.1. The *Compleat model* of design research (Middleton et al., 2008).

This research provides a tested structure, a set of skills and methods for developing the targeted skills that have been iteratively co-refined with participants with social-emotional challenges. As this design is tested in a more diverse range of ecologies in Phase 6, the boundaries in which it is effective will become clearer. Further refinements to the design will be made in response to the findings of this 'scaled-up' research as issues that were not seen in this study emerge as result of these different contexts.

In the event that wider clinical testing validates the products of this study, there are numerous future possibilities. Phase 7 of the *Compleat model* of design research involves the dissemination and measuring of impact of the findings of this study. As there are two primary products or artefacts of this research, these are the most obvious options to consider. The set of guidelines for conducting an intervention using existing commercially-developed videogames, such as those used in this research, could be shared with educators both in mainstream and specialist schools so that they can implement and further refine a structured, evidence-based social skills program.

A serious game could be developed specifically using the 39 recommendations contained in *Chapter 8*. Commercially developed games served this purpose in the current study, but a game tailored specifically for the purposes of facilitating the performance of social skills could further optimise the effectiveness of the teacher-guided intervention. While the literature reviewed in *Chapter 4* discussed games intended for achieving academic learning, social learning is an area in need of more attention from serious game designers. In addition a design research methodology was shown to be feasible in both a digital games-based intervention context and in an ecology where participants have lived experiences of disability.

Finally, this research was meaningful for the student participants. From the teacher-researcher's observations, social expectations and prejudices can make school a difficult and

lonely experience for children with disabilities. Social skills are the heart of positive relationships, which in turn help to provide a sense of belonging. For this group of students, the process of conducting this research has validated that their interests and passions are important to the teacher-researcher and the other teaching staff. This study built on areas of strength for these five students and allowed them to show their talents and expertise in gaming and gamer culture, things that have not always been valued. When describing her observations of the youngest student in this study, teaching assistant Marin highlighted how important being valued and included is to these students:

Marin:	He just loves playing with them. He loves playing in the group. He loves the achievement. He loves feeling like he can do it, he can do it well, it's a success for him, because there's things clearly for him that are a challenge. Like the reading - you know he can't read in the way that some of the other boys can, so he's at a disadvantage like that. But then he's eager to keep up, so he has a reason to work hard to do well. That keeps him motivated and he just wants to be part of that little posse.

References

Abrams, S. S., & Lammers, J. C. (2017). Belonging in a videogame space: bridging affinity spaces and communities of practice. *Teachers College Record*, *119*(12), 12.

Ackermann, J. (2014). Anything but speechless: Face-to-face communication during co-located gaming. In T. Quandt & S. Kröger (Eds.), *Multiplayer: The social aspects of digital gaming* (pp . 183-192). Abingdon, United Kingdom: Routledge.

Adjorlu, A., Hussain, A., Mødekjær, C., & Austad, N. (2018). Head-mounted display-based virtual reality social story as a tool to teach social skills to children diagnosed with autism spectrum disorder. In *K-12 embodied learning through virtual & augmented reality* [Conference proceedings] (pp. 1-4). Reutlingen, Germany: 2018 Institute of Electrical and Electronics Engineers Virtual Reality Workshop.

Aiken, C. A., Fairbrother, J. T., & Post, P. G. (2012). The effects of self-controlled video feedback on the learning of the basketball set shot. *Frontiers in Psychology*, *3*, 338.

All, A., Castellar, E. P. N., & Van Looy, J. (2016). Assessing the effectiveness of digital game-based learning: best practices. *Computers & Education*, *92*, 90-103.

Allsop, Y., & Jessel, J. (2015). Teachers' experience and reflections on game-based learning in the primary classroom: views from England and Italy. *International Journal of Game-Based Learning*, *5*(1), 1-17.

Amaze. (2017). Assessment & diagnosis. Retrieved from http://www.amaze.org.au/discover/about-autism-spectrum-disorder/assessment-diagnosis

American Psychiatric Association [APA]. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, Virginia: American Psychiatric Publishing.

American Psychiatric Association [APA]. (2017, October). *DSM history.* Retrieved from https://www.psychiatry.org/psychiatrists/practice/dsm/history-of-the-dsm

Anderman, E. M., & Anderman, L. H. (2014). *Classroom motivation* (2nd ed.). Upper Saddle River, New Jersey: Pearson.

Ang, C. S., Zaphiris, P., & Mahmood, S. (2007). A model of cognitive loads in massively multiplayer online role playing games. *Interacting with Computers*, *19*(2), 167-179.

Ang, C. S., & Zaphiris, P. (2008). Computer games and language learning. In *Handbook of research on instructional systems and technology* (pp. 449-462). Hershey, Pennsylvania: IGI Global.

Angelides, M. C., & Agius, H. (Eds.). (2014). *Handbook of digital games*. Hoboken, New Jersey: John Wiley & Sons.

Annetta, L., Mangrum, J., Holmes, S., Collazo, K., & Cheng, M. T. (2009). Bridging reality to virtual reality: investigating gender effect and student engagement on learning through video game play in an elementary school classroom. *International Journal of Science Education*, *31*(8), 1091-1113.

Annetta, L. A. (2010). The 'I's' have it: a framework for serious educational game design. *Review of General Psychology*, *14*(2), 105.

Anthropy, A., & Clark, N. (2014). *A game design vocabularly*. Harrisonburg, Virgina: Pearson Education.

Apple, A. L., Billingsley, F., Schwartz, I. S., & Carr, E. G. (2005). Effects of video modeling alone and with self-management on compliment-giving behaviors of children with high-functioning ASD. *Journal of Positive Behavior Interventions*, *7*(1), 33-46.

Armitage, G., Claypool, M., & Branch, P. (2006). *Networking and online games: understanding and engineering multiplayer Internet games*. Richmond, Australia: John Wiley & Sons.

Association for Children with a Disability [ACD]. (2018, December). *Applying for government special schools or units*. Retrieved from https://www.acd.org.au/applying-government-specialist-schools-units/

Attwood, T. (2016, March). *Strategies to reduce being bullied and teased* [Video podcast]. Retrieved from https://www.youtube.com/watch?v=Z88z_NbfvWo&t=553s

Australian Bureau of Statistics [ABS]. (2016). *ABS survey of disability, ageing and carers: summary of findings - 2015*. Canberra, Australia: Australian Bureau of Statistics.

Australian Government Department of Health [AGDH]. (2003). *Comorbid mental disorders and substance use disorders: epidemiology, prevention and treatment. Commonwealth of Australia*. Retrieved from http://www.health.gov.au/internet/publications/publishing.nsf/Content/drugtreat-pubs-comorbid-toc~drugtreat-pubs-comorbid-4~drugtreat-pubs-comorbid-4-3

Australian National Data Service [ANDS]. (2015). *De-identifying your data*. Retrieved from http://www.ands.org.au/working-with-data/enabling-data-reuse/de-identifying-data

Australian Government Department of Education and Training [AGDET]. (2014). *Nationally consistent collection of data on school students with disability - Broad categories of*

disability. Retrieved from http://www.schooldisabilitydatapl.edu.au/data-collection-steps/step-3---what-is-the-category-of-the-disability

Australian Medical Association. (2016). *Autism spectrum disorder*. Retrieved from https://ama.com.au/position-statement/autism-spectrum-disorder-2016

Balu, R., Zhu, P., Doolittle, F., Schiller, E., Jenkins, J., & Gersten, R. (2015). *Evaluation of Response to Intervention practices for elementary school reading*. Washington, DC: National Center for Education Evaluation and Regional Assistance.

Bandura, A. (1968). Social learning theory of identification processes. In D. A. Glass (Ed.), *Handbook of socialization theory and research* (pp. 213-263). Chicago, Illinois: Rand McNally.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, New Jersey: Prentice Hall.

Bandura, A. (1978). Social learning theory of aggression. *Journal of Communication*, *28*(3), 12-29.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*(2), 117-148.

Barab, S., Thomas, M., Dodge, T., Carteaux, R., & Tuzun, H. (2005). Making learning fun: Quest Atlantis, a game without guns. *Educational Technology Research and Development*, *53*(1), 86-107.

Barker, J., & Weller, S. (2003). 'Is it fun?' Developing children centred research methods. *International Journal of Sociology and Social Policy*, *23*, 33-58.

Barlow, A. T., Burroughs, E. A., Harmon, S. E., Sutton, J. T., & Yopp, D. A. (2014). Assessing views of coaching via a video-based tool. *ZDM*, 46(2), 227-238.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a 'theory of mind'? *Cognition*, *21*(1), 37-46.

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (AQ): Evidence from asperger syndrome/high-functioning autism, malesand females, scientists and mathematicians. *Journal of Autism and Developmental Disorders*, *31*(1), 5-17.

Baron-Cohen, S. (2017). Editorial perspective: Neurodiversity–a revolutionary concept for autism and psychiatry. *Journal of Child Psychology and Psychiatry*, *58*(6), 744-747.

Battaglia, A. A., & Radley, K. C. (2014). Peer-mediated social skills training for children with autism spectrum disorder. *Beyond Behavior, 23*(2), 4-13.

Baxter, L. L., Moran, T. H., Richtsmeier, J. T., Troncoso, J., & Reeves, R. H. (2000). Discovery and genetic localization of Down syndrome cerebellar phenotypes using the Ts65Dn mouse. *Human Molecular Genetics, 9*(2), 195-202.

Beaumont, R., & Sofronoff, K. (2013). Multi-modal intervention for social skills training in students with high-functioning ASD: the Secret Agent Society. In A. Scarpa, S. W. White, & T. Attwood (Eds.), *CBT for children and adolescents with high-functioning autism spectrum disorders* (pp. 173-198). New York, New York: Guilford Press.

Beaumont, R., Rotolone, C., & Sofronoff, K. (2015). The Secret Agent Society social skills program for children with high-functioning autism spectrum disorders: a comparison of two school variants. *Psychology in the Schools*, *52*(4), 390-402.

Bellini, S. (2004). Social skill deficits and anxiety in high-functioning adolescents with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities*, *19*(2), 78-86.

Bellini, S., & Akullian, J. (2007). A meta-analysis of video modeling and video self-modeling interventions for children and adolescents with autism spectrum disorders. *Exceptional Children*, 73(3), 264-287.

Bellini, S., Peters, J. K., Benner, L., & Hopf, A. (2007). A meta-analysis of school-based social skills interventions for children with autism spectrum disorders. *Remedial and Special Education*, *28*(3), 153-162.

Bellotti, F., Kapralos, B., Lee, K., Moreno-Ger, P., & Berta, R. (2013). Assessment in and of serious games: an overview. *Advances in Human-Computer Interaction, 2013*, *1*(1), 1-11.

Bennerstedt, U., Ivarsson, J., & Linderoth, J. (2012). How gamers manage aggression: situating skills in collaborative computer games. *International Journal of Computer-Supported Collaborative Learning*, *7*(1), 43-61.

Berliner, D. C. (2002). Comment: Educational research: the hardest science of all. *Educational Researcher*, *31*(8), 18-20.

Berman, J., & Graham, L. (2018). *Learning intervention: educational casework and responsive teaching for sustainable learning*. New York, New York: Routledge.

Bernardini, S., Porayska-Pomsta, K., & Smith, T. J. (2014). ECHOES: An intelligent serious game for fostering social communication in children with autism. *Information Sciences*, *264*, 41-60.

Bidarra, J., Rothschild, M., & Squire, K. (2011). Games and simulations in distance learning: The AIDLET model. In *Computer games as educational and management tools: uses and approaches* (pp. 67-85). Philadelphia, Pennsylvania: IGI Global.

Bidarra, J., Rothschild, M., Squire, K., & Figueiredo, M. (2013). The AIDLET model: A framework for selecting games, simulations and augmented reality environments in mobile learning. *International Journal of Web-Based Learning and Teaching Technologies*, *8*(4), 50-71.

Bitterman, M. E. (2006). Classical conditioning since Pavlov. *Review of General Psychology*, *10*(4), 365-376.

Blacher, J., & Christensen, L. (2011). Sowing the seeds of the autism field: Leo Kanner (1943). *Intellectual and Developmental Disabilities*, *49*(3), 172-191.

Blackorby, J., Knokey, A.-M., Wagner, M., Levine, P., Schiller, E., & Sumi, C. (2007). *What makes a difference? Influences on outcomes for students with disabilities*. Menlo Park, California: SRI International.

Blanck, P. (2014). The struggle for web eQuality by persons with cognitive disabilities. *Behavioral Sciences & the Law*, *32*(1), 4-32.

Bodin, M., Marty, J. C., & Carron, T. (2011, October). Specifying collaborative tools in game-based learning environments: clues from the trenches. In *European Conference on Game Based Learning* [Conference proceedings] (pp. 46-56). Athens, Greece: University of Athens.

Bond, C., Symes, W., Hebron, J., Humphrey, N., Morewood, G., & Woods, K. (2016). Educational interventions for children with ASD: a systematic literature review 2008–2013. *School Psychology International*, *37*(3), 303-320.

Bourdieu, P. (1986). The forms of capital. In J. G. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241–258). New York, New York: Greenwood.

Bossavit, B., & Parsons, S. (2018). Outcomes for design and learning when teenagers with autism codesign a serious game: a pilot study. *Journal of Computer Assisted Learning*, *34*(3), 293-305.

Bosser, A. G., & Nakatsu, R. (2006, September). Hardcore gamers and casual gamers playing online together. In *International Conference on Entertainment Computing* [Conference proceedings] (pp. 374-377). Berlin, Germany: Springer.

Brand, J. E., Todhunter, S., & Jervis, J. (2017). *Digital Australia 2018*. Eveleigh, Australia: Interactive Games & Entertainment Association.

Bronfenbrenner, U. (1994). Ecological models of human development. *International Encyclopedia of Education*, *3*(2), 37-43.

Brookhart, S. (2007). Feedback that fits all. *Informative Assessment*, *65*(4), 54-59.

Brooks, J. G., & Brooks, M. G. (1999). *In search of understanding: the case for constructivist classrooms*. Alexandria, Virginia: Association for Supervision and Curriculum Development.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-42.

Brown, H. J. (2014). *Videogames and education* (2nd ed.). Abingdon, United Kingdom: Routledge.

Burgers, C., Eden, A., van Engelenburg, M. D., & Buningh, S. (2015). How feedback boosts motivation and play in a brain-training game. *Computers in Human Behavior*, *48*, 94-103.

Burr, V. (2015). *Social constructionism*. Abingdon-on-Thames, United Kingdom: Routledge.

Burroughs, B., & Rama, P. (2015). The esports trojan horse: Twitch and streaming futures. *Journal For Virtual Worlds Research, 8*(2), 1-5.

Calvert, S. L., Appelbaum, M., Dodge, K. A., Graham, S., Nagayama Hall, G. C., Hamby, S., ... Hedges, L. V. (2017). The American Psychological Association task force assessment of violent video games: science in the service of public interest. *American Psychologist*, *72*(2), 126-143.

Camargo, S. P. H., Rispoli, M., Ganz, J., Hong, E. R., Davis, H., & Mason, R. (2014). A review of the quality of behaviorally-based intervention research to improve social interaction skills of children with ASD in inclusive settings. *Journal of Autism and Developmental Disorders*, *44*(9), 2096-2116.

Camargo, S. P. H., Rispoli, M., Ganz, J., Hong, E. R., Davis, H., & Mason, R. (2016). Behaviorally based interventions for teaching social interaction skills to children with ASD in inclusive settings: a meta-analysis. *Journal of Behavioral Education*, *25*(2), 223-248.

Castronova, E. (2005). *Synthetic worlds: the business and culture of online games*. Chicago, Illinois: The University of Chicago Press.

Chang, C. Y., & Hwang, G. J. (2019). Trends in digital game-based learning in the mobile era: a systematic review of journal publications from 2007 to 2016. *International Journal of Mobile Learning and Organisation*, *13*(1), 68-90.

Chang, Y. C., & Locke, J. (2016). A systematic review of peer-mediated interventions for children with autism spectrum disorder. *Research in Autism Spectrum Disorders*, 27, 1-10.

Chapman, R. S., & Hesketh, L. J. (2000). Behavioral phenotype of individuals with Down syndrome. *Mental Retardation and Developmental Disabilities Research Reviews*, *6*(2), 84-95.

Charsky, D., & Mims, C. (2008). Integrating commercial off-the-shelf video games into school curriculums. *TechTrends*, *52*(5), 38-44.

Chen, M. (2012). *Leet noobs: the life and death of an expert player group in World of Warcraft*. Bern, Switzerland: Peter Lang.

Chen, M., Leary, R., Peterson, J., & Simkins, D. W. (2018). Multi-player online role-playing games. In J. Zagal & S. Deterding (Eds.), *Role-playing game studies: transmedia foundations* (pp. 130-153). New York, New York: Routledge.

Chen, F., Planche, P., & Lemonnier, E. (2010). Superior nonverbal intelligence in children with high-functioning autism or Asperger's syndrome. *Research in Autism Spectrum Disorders*, *4*(3), 457-460.

Child, B. (2016). Global box office hit all-time high of $38bn in 2015. Retrieved from https://www.theguardian.com/film/2016/jan/04/global-box-office-hits-all-time-high-in-2015

Clandinin, D. J., & Connelly, F. M. (1998). Stories to live by: narrative understandings of school reform. *Curriculum Inquiry*, *28*(2), 149-164.

Clark, R., Kirschner, P. A., & Sweller, J. (2012). Putting students on the path to learning: the case for fully guided instruction. *American Educator, 3*, 6-11.

Clarke, D., Keitel, C., & Shimizu, Y. (Eds.). (2006). *Mathematics classrooms in twelve countries: the insider's perspective* (Vol. 1). Rotterdam, The Netherlands: Sense Publishers.

Clarke, D. J., Mitchell, C., & Bowman, P. (2009). Optimising the use of available technology to support international collaborative research in mathematics classrooms. In T. Janík & T. Seidel (Eds.), *The power of video studies in investigating teaching and learning in the classroom* (pp. 39-60). Münster, Germany: Waxmann Verlag.

Clarke, D. J. (2011). A less partial vision: Theoretical inclusivity and critical synthesis in mathematics classroom research. In J. Clark, B. Kissane, J. Mousley, T. Spencer & S. Thornton (Eds.) *Mathematics: Traditions and [new] practices. Proceedings of the 2011 AAMT–MERGA conference* [Conference processings] (pp. 192-200). Adelaide, Australia: The Australian Association of Mathemetics Teachers.

Clifford, S., Young, R., & Williamson, P. (2007). Assessing the early characteristics of autistic disorder using video analysis. *Journal of Autism and Developmental Disorders, 37*(2), 301-313.

Cobb, P., Confrey, J., DiSessa, A., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. *Educational Researcher*, *32*(1), 9-13.

Coles-Janess, B., & Griffin, P. (2009). Mapping transitions in interpersonal learning for students with additional needs. *Australasian Journal of Special Education*, 33(2), 141-150.

Collins, A., & Halverson, R. (2018). *Rethinking education in the age of technology: The digital revolution and schooling in America*. New York, New York: Teachers College Press.

Commonwealth of Australia. (2018). *2018 Guidelines for the nationally consistent collection of data on school students with disability*. Retrieved from

https://www.education.gov.au/what-nationally-consistent-collection-data-school-students-disability

Connolly, T. M., Hainey, T., Boyle, E., Baxter, G., & Moreno-Gee, P. (2014). *Psychology, pedagogy, and assessment in serious games*. Hershey, Pennsylvania: IGI Global.

Conzemius, A., & O'Neill, J. (2009). *The power of SMART goals: Using goals to improve student learning*. Bloomington, Indiana: Solution Tree Press.

Cook, T. D., Campbell, D. T., & Shadish, W. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, Massachusetts: Houghton Mifflin.

Cook, B. G., & Odom, S. L. (2013). Evidence-based practices and implementation science in special education. *Exceptional Children*, *79*(2), 135-144.

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, *59*(2), 661-686.

Cooperative Research Centre for Living with Autism [Autism CRC]. (2018). *A national guideline for the assessment and diagnosis of autism spectrum disorder in Australia* [Online document]. Retrieved from https://www.autismcrc.com.au/knowledge-centre/resource/national-guideline

Crawford, G. (2009). Forget the magic circle (or Towards a sociology of video games) – Keynote. In *Proceedings of the conference: Under the mask (Vol. 2)* [Conference proceedings] (pp. 1-15). Bedfordshire, the United Kindom: University of Bedfordshire.

Crawford, G. (2011). *Video gamers*. New York, New York: Routledge.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, Massachusetts: Pearson.

Crooke, P., & Winner, M. G. (2017). Social Thinking® in the landscape of evidence-based practices. *Word of Mouth*, *28*(5), 5-8.

Da Paz, N. S., & Wallander, J. L. (2017). Interventions that target improvements in mental health for parents of children with autism spectrum disorders: a narrative review. *Clinical Psychology Review*, *51*, 1-14.

Davis, M. A. C., Spriggs, A., Rodgers, A., & Campbell, J. (2018). The effects of a peer-delivered social skills intervention for adults with comorbid Down syndrome and autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *48*(6), 1869-1885.

Dawson, M., Soulieres, I., Gernsbacher, M. A., & Mottron, L. (2007). The level and nature of autistic intelligence. *Psychological Science*, *18*, 657–662.

DeCamp, W., & Ferguson, C. J. (2017). The impact of degree of exposure to violent video games, family background, and other factors on youth violence. *Journal of Youth and Adolescence*, *46*(2), 388-400.

Delano, M. E. (2007). Video modeling interventions for individuals with autism. *Remedial and Special Education*, *28*(1), 33-42.

DeLeeuw, K. E., & Mayer, R. E. (2008). A comparison of three measures of cognitive load: evidence for separable measures of intrinsic, extraneous, and germane load. *Journal of Educational Psychology*, *100*(1), 223.

Department of Education and Early Child Development [DEECD]. (2011). *Abilities based learning & education support (ABLES): an introductory guide for Victorian government schools*. Melbourne, Australia: State of Victoria.

Department of Education Victoria [DETV]. (2018). *Abilities based learning and education support (ABLES).* Retrieved from https://www.education.vic.gov.au/school/teachers/learningneeds/Pages/ables.aspx

Department of Education New South Wales [DENSW]. (2018, November). *Cognitive load theory in practice: examples for the classroom [Online document]. Centre for Education Statistics and Evaluation*. Retrieved from https://www.cese.nsw.gov.au/images/stories/PDF/Cognitive_load_theory_practice_guide_AA.pdf

Derry, S., Pea, R., Barron, B., Engle, R., Erickson, F., Goldman, R., & Sherin, M. G. (2010). Conducting video research in the learning sciences: guidance on selection, analysis, technology, and ethics. *The Journal of the Learning Sciences*, *19*(1), 3-53.

Di Tore, P. A., Giuseppe, T. D., & Corona, F. (2017). Autism spectrum as an empathy disorder. *Autism-Open Access*, *7*(1), 1-3.

Dolk, M., Widjaja, W., Zonneveld, E., & Fauzan, A. (2010). Examining teachers' role in relation to their beliefs and expectations about students' thinking in design research. In R. K. Sembiring, K. Hoogland & M. Dolk (Eds.), *A decade of PMRI in Indonesia* (pp. 175-187). Bandung, Indonesia: APS International.

Dowling, P., & Brown, A. (2010). *Doing research/reading research: re-interrogating education*. New York, New York: Routledge.

Down Syndrome Australia. (2017). Research and statistics: Down syndrome population statistics. Retrieved from https://www.downsyndrome.org.au/research_and_statistics.html

Down Syndrome Western Australia. (2015). What is Down syndrome? Retrieved from http://www.dsawa.asn.au/information/what-is-down-syndrome

Dowrick, P. W. (1999). A review of self modeling and related interventions. *Applied and Preventive Psychology*, *8*(1), 23-39.

Ducheneaut, N., & Moore, R. J. (2005). More than just 'XP': learning social skills in massively multiplayer online games. *Interactive Technology and Smart Education*, *2*(2), 89-100.

Duchesne, S., & McMaugh, A. (2016). *Educational psychology for learning and teaching* (5th ed.). South Melbourne, Australia: Cengage Learning Australia.

Durkin, K., & Barber, B. (2002). Not so doomed: Computer game play and positive adolescent development. *Journal of applied developmental psychology*, *23*(4), 373-392.

Dyke, P., Leonard, H., Bourke, J., Bebbington, A., & Bower, C. (2007). Down syndrome needs opinions wishes survey. Down Syndrome Association of Western Australia. Retrieved from http://www.dsawa.asn.au/wp-content/uploads/2015/12/ds_now_report.pdf

Echeverría, A., Améstica, M., Gil, F., Nussbaum, M., Barrios, E., & Leclerc, S. (2012). Exploring different technological platforms for supporting co-located collaborative games in the classroom. *Computers in Human Behavior*, *28*(4), 1170-1177.

Eder, M. S., Diaz, J. M. L., Madela, J. R. S., Mag-usara, M. U., & Sabellano, D. D. M. (2016). Fill me app: an interactive mobile game application for children with autism. *International Journal of Interactive Mobile Technologies*, *10*(3), 59-63.

Elcandil.info. (2019). *Coloriage tablette coloriage sur tablette Wii U Wallpaper 4*. Retrieved from http://elcandil.info/coloriage-tablette/coloriage-tablette-coloriage-sur-tablette-wii-u-wallpaper-4

Elksnin, L. K., & Elksnin, N. (1998). Teaching social skills to students with learning and behavior problems. *Intervention in School and Clinic*, *33*(3), 131-140.

Ellington, H., Fowlie, J., & Gordon, M. (2013). *Using games and simulations in the classroom: a practical guide for teachers*. London, United Kingdom: Routledge.

Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., & Kyngäs, H. (2014). Qualitative content analysis: A focus on trustworthiness. *SAGE Open*, 4(1).

Elsabbagh, M., Divan, G., Koh, Y. J., Kim, Y. S., Kauchali, S., Marcín, C., … Yasamy, M. T. (2012). Global prevalence of autism and other pervasive developmental disorders. *Autism Research*, *5*(3), 160-179.

Erickson, F. (2011). Uses of video in social research: a brief history. *International Journal of Social Research Methodology, 14*(3), 179-189.

Eseryel, D., Law, V., Ifenthaler, D., Ge, X., & Miller, R. (2014). An investigation of the interrelationships between motivation, engagement, and complex problem solving in game-based learning. *Journal of Educational Technology & Society*, *17*(1), 42-53.

Fairbanks, S., Sugai, G., Guardino, D., & Lathrop, M. (2007). Response to intervention: examining classroom behavior support in second grade. *Exceptional Children*, *73*(3), 288-310.

Faucett, H. A., Ringland, K. E., Cullen, A. L., & Hayes, G. R. (2017). (In)visibility in disability and assistive technology. *ACM Transactions on Accessible Computing* (TACCESS), *10*(4), 1-17.

Feinstein, A. (2011). *A history of autism: Conversations with the pioneers*. Chicago, Illinois: John Wiley & Sons.

Fidler, D., Hepburn, S., & Rogers, S. (2006). Early learning and adaptive behaviour in toddlers with Down syndrome: evidence for an emerging behavioural phenotype? *Down Syndrome Research and Practice*, *9*(3), 37-44.

Fitzgerald, E., Yap, H. K., Ashton, C., Moore, D. W., Furlonger, B., Anderson, A., ... English, D. L. (2018). Comparing the effectiveness of virtual reality and video modelling as an intervention strategy for individuals with autism spectrum disorder: brief report. *Developmental Neurorehabilitation*, *21*(3), 197-201.

Freyholtz, J. (2014). *Genre definitions*. Retrieved from http://www.mobygames.com/glossary/genres

Friend, M., & Cook, L. (2007). *Co-teaching interactions: collaboration skills for professionals* (5th ed.). Boston, Massachusetts: Pearson.

Frith, U., & Happé, F. (1994). Autism: beyond 'theory of mind'. *Cognition, 50*(1-3), 115-132.

Fuchs, D., & Fuchs, L. S. (2006). Introduction to Response to Intervention: what, why, and how valid is it? *Reading Research Quarterly*, *41*(1), 93-99.

Fukkink, R. G., Trienekens, N., & Kramer, L. J. (2011). Video feedback in education and training: putting learning in the picture. *Educational Psychology Review*, *23*(1), 45-63.

Gallagher, D. J., Connor, D. J., & Ferri, B. A. (2014). Beyond the far too incessant schism: special education and the social model of disability. *International Journal of Inclusive Education*, *18*(11), 1120-1142.

Gallagher, H. L., & Frith, C. D. (2003). Functional imaging of 'theory of mind'. *Trends in Cognitive Sciences*, *7*(2), 77-83.

Garcia, E. F., Breslau, J., Hansen, R., & Miller, E. (2012). Unintended consequences: an ethnographic narrative case series exploring language recommendations for bilingual families of children with autistic spectrum disorders. *Journal of Medical Speech-Language Pathology*, *20*(2), 10-17.

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: a research and practice model. *Simulation & Gaming*, *33*(4), 441-467.

Garzotto, F. (2007). Investigating the educational effectiveness of multiplayer online games for children. In *Proceedings of the 6th international conference on Interaction design and children* [Conference proceedings] (pp. 29-36). New York, New York: ACM.

Gass, K. R., Kennedy, J. R., Hastie, S., & Wentworth, H. M. (2013). Somatic assessment of nonverbal social skills in children with Down syndrome: using the Kestenberg Movement Profile as a tool for treatment planning. *Body, Movement and Dance in Psychotherapy*, *8*(1), 17-33.

Gee, J. (2003). From video games, learning about learning. *Chronicle of Higher Education*, *49*(2), 8-13.

Gee, J. P. (2007a). *Good video games + good learning: collected essays on video games, learning, and literacy*. Bern, Switzerland: Peter Lang.

Gee, J. P. (2007b). *What video games have to teach us about learning and literacy*. Basingstoke, United Kingdom: Palgrave Macmillan.

Gee, J. P. (2012). *Situated language and learning: a critique of traditional schooling*. Milton Park, United Kingdom: Taylor and Francis.

Gee, J. P., & Hayes, E. (2012). Nurturing affinity spaces and game-based learning. In. C. Steinkuehler, K. Suire & S. Barab (Eds.), *Games, learning, and society: learning and meaning in the digital age* (pp. 1-40). Cambridge, United Kingdom: Cambridge University Press.

Gee, J. P. (2013). *Good video games + good learning: collected essays on video games, learning and literacy* (2nd ed.). Bern, Switzerland: Peter Lang.

Gee, J. P. (2018). Affinity spaces: how young people live and learn on line and out of school. *Phi Delta Kappan*, *99*(6), 8-13.

Gesthuizen, R., Harrison, M., & Latheef, I. (2018, October). Exploring social regulation in Minecraft. In *Australian Council for Computers in Education 2018 Conference Proceedings* [Conference proceedings] (pp. 17-37). Sydney, Australia: ICT Educators NSW.

Gersten, R., Fuchs, L. S., Compton, D., Coyne, M., Greenwood, C., & Innocenti, M. S. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, *71*(2), 149-164.

Ghaziuddin, M., & Mountain-Kimchi, K. (2004). Defining the intellectual profile of Asperger syndrome: comparison with high-functioning autism. *Journal of Autism and Developmental Disorders*, *34*(3), 279-284.

Gil-Doménech, D., & Berbegal-Mirabent, J. (2019). Stimulating students' engagement in mathematics courses in non-STEM academic programmes: a game-based learning. *Innovations in Education and Teaching International*, *56*(1), 57-65.

Gillott, A., Furniss, F., & Walter, A. (2001). Anxiety in high-functioning children with autism. *Autism*, *5*, 277–286.

Glaser, R. (1963). Instructional technology and the measurement of learning outcomes: some questions. *American Psychologist*, *18*(8), 6-8.

Glaser, R. (1981). The future of testing: a research agenda for cognitive psychology and psychometrics. *American Psychologist*, *36*(9), 923.

Glass, G. V. (1976). Primary, secondary, and meta-analysis of research. *Educational Researcher, 5*(10), 3-8.

Godwin-Jones, R. (2014). Emerging technologies games in language learning: opportunities and challenges. *Language Learning & Technology*, *18*(2), 9-19.

Goldsmith, S. F., & Kelley, E. (2018). Associations between emotion regulation and social impairment in children and adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 48*(6), 2164-2173.

González-González, C., & Blanco-Izquierdo, F. (2012). Designing social videogames for educational uses. *Computers & Education, 58*(1), 250-262.

González-González, C., Toledo-Delgado, P., Collazos-Ordoñez, C., & González-Sánchez, J. L. (2014). Design and analysis of collaborative interactions in social educational videogames. *Computers in Human Behavior*, *31*, 602-611.

Graham, L., Berman, J., & Bellert, A. (2015). *Sustainable learning: inclusive practices for 21st century classrooms*. Port Melbourne, Australia: Cambridge University Press.

Grandin, T. (2006). *Thinking in pictures: my life with autism* (2nd ed.). New York, New York: Vintage Books.

Grau, V., & Whitebread, D. (2012). Self and social regulation of learning during collaborative activities in the classroom: the interplay of individual and group cognition. *Learning and Instruction*, *22*(6), 401-412.

Great Britain Department for Education and Skills [GBDES]. (2002). *Autism spectrum disorders good practice guidance: pointers to good practice*. Nottingham, United Kingdom: Great Britain Department for Education and Skills.

Green, V. A., Prior, T., Smart, E., Boelema, T., Drysdale, H., Harcourt, S., ... Waddington, H. (2017). The use of individualized video modeling to enhance positive peer interactions in three preschool children. *Education and Treatment of Children*, *40*(3), 353-378.

Greitemeyer, T., & Osswald, S. (2009). Prosocial video games reduce aggressive cognitions. *Journal of Experimental Social Psychology*, *45*(4), 896-900.

Greitemeyer, T., & Osswald, S. (2010). Effects of prosocial video games on prosocial behavior. *Journal of Personality and Social Psychology*, *98*(2), 211.

Gresham, F. M. (1986). Conceptual and definitional issues in the assessment of children's social skills: implications for classifications and training. *Journal of Clinical Child Psychology*, *15*(1), 3-15.

Gresham, F. M., & Elliott, S. N. (1987). The relationship between adaptive behavior and social skills: issues in definition and assessment. *The Journal Of Special Education*, *21*(1), 167-181.

Gresham, F. M., Sugai, G., & Horner, R. H. (2001). Interpreting outcomes of social skills training for students with high-incidence disabilities. *Exceptional children*, *67*(3), 331-344.

Gresham, F. M., Elliott, S. N., Cook, C. R., Vance, M. J., & Kettler, R. (2010). Cross-informant agreement for ratings for social skill and problem behavior ratings: an investigation of the Social Skills Improvement System—Rating Scales. *Psychological Assessment*, *22*(1), 157.

Griffin, P., Murray, L., Care, E., Thomas, A., & Perri, P. (2010). Developmental assessment: lifting literacy through professional learning teams. *Assessment in education: principles, policy & practice*, *17*(4), 383-397.

Griffin, P. (2018). *Assessment for teaching.* Port Melbourne, Australia: Cambridge University Press.

Grossard, C., Grynspan, O., Serret, S., Jouen, A. L., Bailly, K., & Cohen, D. (2017). Serious games to teach social interactions and emotions to individuals with autism spectrum disorders (ASD). *Computers & Education*, *113*, 195-211.

Gu, L., & Jia, A. L. (2018, June). *Player activity and popularity in online social games and their implications for player retention*. In 2018 16th Annual Workshop on Network and Systems Support for Games (NetGames) (pp. 1-6). IEEE.

Hadwin, J., Baron-Cohen, S., Howlin, P., & Hill, K. (1996). Can we teach children with autism to understand emotions, belief, or pretence? *Development and Psychopathology, 8*(2), 345-365.

Haegele, J. A., & Hodge, S. (2016). Disability discourse: overview and critiques of the medical and social models. *Quest*, *68*(2), 193-206.

Hainey, T., Connolly, T., Stansfield, M., & Boyle, E. (2011). The differences in motivations of online game players and offline game players: a combined analysis of three studies at higher education level. *Computers & Education*, *57*(4), 2197-2211.

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep Medicine Reviews*, *21*, 50-58.

Hall, K. (2005). Gaming's grand master. Bloomberg Businessweek Online. Retrieved from https://www.bloomberg.com/news/articles/2005-11-06/gamings-grand-master

Halladay, A. K., Bishop, S., Constantino, J. N., Daniels, A. M., Koenig, K., Palmer, K., ... Taylor, J. L. (2015). Sex and gender differences in autism spectrum disorder: summarizing evidence gaps and identifying emerging areas of priority. *Molecular Autism*, *6*(1), 7-12.

Hammond, J., & Gibbons, P. (2005). What is scaffolding. In A. Burns & H. de Silva Joyce (Eds.), *Teachers' voices 8: Explicitly supporting reading and writing in the classroom* (pp. 8-16). Sydney, Australia: National Centre for English Language Teaching and Research.

Hammond, R. K., Campbell, J. M., & Ruble, L. A. (2013). Considering identification and service provision for students with autism spectrum disorders within the context of Response to Intervention. *Exceptionality, 21*(1), 34-50.

Happé, F., & Frith, U. (2006). The weak coherence account: detail-focused cognitive style in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 36(1), 5-25.

Harjusola-Webb, S., Hubbell, S. P., & Bedesem, P. (2012). Increasing prosocial behaviors of young children with disabilities in inclusive classrooms using a combination of peer-mediated intervention and social narratives. *Beyond Behavior*, *21*(2), 29-36.

Harteveld, C., & Bekebrede, G. (2011). Learning in single-versus multiplayer games: the more the merrier? *Simulation & Gaming*, *42*(1), 43-63.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81-112.

Hattie, J. (2009). *Visible learning: a synthesis of over 800 meta-analyses relating to achievement*. New York, New York: Routledge.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. New York, New York: Routledge.

Hawken, L. S., Vincent, C. G., & Schumann, J. (2008). Response to intervention for social behavior: challenges and opportunities. *Journal of Emotional and Behavioral Disorders*, *16*(4), 213-225.

Hayes, E. R., & Duncan, S. C. (2012). *Learning in video game affinity spaces (new literacies and digital epistemologies)*. New York, New York: Peter Lang.

Heath, C., Hindmarsh, J., & Luff, P. (2010). *Video in qualitative research*. New York, New York: SAGE Publications.

Hehir, T., & Katzman, L. I. (2012). *Effective inclusive schools designing successful schoolwide programs* [Online document]. San Francisco, California: Jossey-Bass. Retrieved from http://site.ebrary.com/id/10650970

Hehir, T., Grindal, T., Freeman, B., Lamoreau, R., Borquaye, Y., & Burke, S. (2016). *A summary of the evidence on inclusive education*. São Paulo, Brazil: Instituto Alana.

Henriksen, K., & Kaup, M. L. (2010). Supportive learning environments for children with autism spectrum disorders. *Undergraduate Research Journal for the Human Sciences*, *9*(1), 198-206.

Herrington, J., McKenney, S., Reeves, T., & Oliver, R. (2007). Design-based research and doctoral students: guidelines for preparing a dissertation proposal. In C. Montgomerie & J. Seale (Eds.) *EdMedia: World Conference on Educational Media and Technology* (pp. 4089-4097). Waynesville, North Carolina: Association for the Advancement of Computing in Education (AACE).

Hess, T., & Gunter, G. (2013). Serious game-based and nongame-based online courses: learning experiences and outcomes. *British Journal of Educational Technology*, *44*(3), 372-385.

Hesse, F., Care, E., Buder, J., Sassenberg, K., & Griffin, P. (2015). A framework for teachable collaborative problem solving skills. In P. Griffin & E. Care (Eds.), *Assessment and teaching of 21st century skills : methods and approach* (pp. 37-56). Dordrecht, Germany: Springer.

Hew, K. F., & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: a review of the research. *British Journal of Educational Technology*, *41*(1), 33-55.

Ho, B. P., Stephenson, J., & Carter, M. (2014). Cognitive-behavioral approach for children with autism spectrum disorders: a meta-analysis. *Review Journal of Autism and Developmental Disorders*, *1*(1), 18-33.

Hollensen, S. (2013). The Blue Ocean that disappeared – The case of Nintendo Wii. *Journal of Business Strategy*, *34*(5), 25-35.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children*, *71*(2), 165-179.

Huberman, A. M., Miles, M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Thousand Oaks, California: Sage.

Huizinga, J. (1955). *Homo ludens: a study of the play element in culture*. Boston, Massachusetts: Beacon Press.

Hwang, G. J., & Wu, P. H. (2012). Advancements and trends in digital game-based learning research: a review of publications in selected journals from 2001 to 2010. *British Journal of Educational Technology*, *43*(1), E6-E10.

Infante, C., Weitz, J., Reyes, T., Nussbaum, M., Gómez, F., & Radovic, D. (2010). Co-located collaborative learning video game with single display groupware. *Interactive Learning Environments*, *18*(2), 177-195.

Jackson, L. (2002). *Freaks, geeks, and asperger syndrome*. London, United Kingdom: Jessica Kingsley Publishers.

Jahromi, L. B., Gulsrud, A., & Kasari, C. (2008). Emotional competence in children with Down syndrome: negativity and regulation. *American Journal on Mental Retardation*, *113*(1), 32-43.

Jalink, M. B., Goris, J., Heineman, E., Pierie, J. P. E., & Henk, O. (2015). Face validity of a Wii U video game for training basic laparoscopic skills. *The American Journal of Surgery*, *209*(6), 1102-1106.

Jarvin, L. (2015). Edutainment, games, and the future of education in a digital world. *New Directions for Child and Adolescent Development*, *147*, 33-40.

Johnson, L., Becker, S. A., Estrada, V., & Freeman, A. (2014). *The New Media Consortium Horizon Report: 2014*. Austin, Texas: The New Media Consortium.

Jones, G., Baker, L., English, A., & Lyn-Cook, L. (2012). *AET national autism standards for schools and educational settings*. London, United Kingdom: National Autism Trust.

Jones, J. L., Gallus, K. L., Viering, K. L., & Oseland, L. M. (2015). 'Are you by chance on the spectrum?': adolescents with autism spectrum disorder making sense of their diagnoses. *Disability & Society*, *30*(10), 1490-1504.

Kafai, Y. B., Heeter, C., Denner, J., & Sun, J. Y. (2008). *Beyond Barbie [R] and Mortal Kombat: new perspectives on gender and gaming*. Boston, Massachusetts: MIT Press.

Kandalaft, M. R., Didehbani, N., Krawczyk, D. C., Allen, T. T., & Chapman, S. B. (2013). Virtual reality social cognition training for young adults with high-functioning autism. *Journal of Autism and Developmental Disorders*, *43*(1), 34-44.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child*, *2*(3), 217-250.

Kapp, S. K., Gillespie-Lynch, K., Sherman, L. E., & Hutman, T. (2013). Deficit, difference, or both? Autism and neurodiversity. *Developmental Psychology*, *49*(1), 1-13.

Kasari, C., & Freeman, S. F. (2001). Task-related social behavior in children with Down syndrome. *American Journal on Mental Retardation*, *106*(3), 253-264.

Kasari, C., Freeman, S. F., & Hughes, M. A. (2001). Emotion recognition by children with Down syndrome. *American Journal on Mental Retardation*, *106*(1), 59-72.

Kasari, C., Freeman, S. F., & Bass, W. (2003). Empathy and response to distress in children with Down syndrome. *Journal of Child Psychology and Psychiatry*, *44*(3), 424-431.

Kawa, S., & Giordano, J. (2012). A brief historicity of the Diagnostic and Statistical Manual of Mental Disorders: issues and implications for the future of psychiatric canon and practice. *Philosophy, Ethics, and Humanities in Medicine*, *7*(1), 1-9.

Kelly, A. (2013). When is design research appropriate. *Educational Design Research*, 135-150.

Kickmeier-Rust, M. D., Marte, B., Linek, S. B., Lalonde, T., & Albert, D. (2008, October). The effects of individualized feedback in digital educational games. In *Proceedings of the 2nd European Conference on Games Based Learning* (pp. 227-236). London, United Kingdom: Academic Publishing Limited.

Kim, J. A., Szatmari, P., Bryson, S. E., Streiner, D. L., & Wilson, F. J. (2000). The prevalence of anxiety and mood problems among children with autism and Asperger syndrome. *Autism*, 4(2), 117-132.

Kim, B. (2001). Social constructivism. *Emerging Perspectives on Learning, Teaching, and Technology*, *16*(1), 1-10.

Kim, C. (2010). *Designing for learning: multiplayer digital game learning environments* (Doctoral dissertation). Berkeley, California: UC Berkeley. Retrieved from https://escholarship.org/uc/item/4zt2k00k

King, M., & Bearman, P. (2009). Diagnostic change and the increased prevalence of autism. *International Journal of Epidemiology, 38*(5), 1224-1234.

Kirchner, J., Ruch, W., & Dziobek, I. (2016). Brief report: character strengths in adults with autism spectrum disorder without intellectual impairment. *Journal of Autism and Developmental Disorders*, *46*(10), 3330-3337.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, *41*(2), 75-86.

Kirriemuir, J., & Mcfarlane, A. (2004). *Literature review in games and learning* (Report No, 8). London, United Kingdom: NESTA Futurelab.

Klett, L. S., & Turan, Y. (2012). Generalized effects of social stories with task analysis for teaching menstrual care to three young girls with autism. *Sexuality and Disa*bility, *30*(3), 319-336.

Klin, A., Danovitch, J. H., Merz, A. B., & Volkmar, F. R. (2007). Circumscribed interests in higher functioning individuals with autism spectrum disorders: an exploratory study. *Research and Practice for Persons with Severe Disabilities*, *32*(2), 89-100.

Klieve, S. (2018, August 11). The importance of collaboration to the practice of special educators. Lecture presented for Learning Intervention practicum, Melbourne Graduate School of Education, Melbourne, Australia.

Kohler, C. (2007). On ‘videogame’ versus ‘video game’. Retrieved from https://www.wired.com/2007/11/on-videogame-ve

Komarova, M., & Martina, M. (2014). *Using digital photography and video in participant observation of contentious events. SAGE Research Methods Cases*. London, United Kingdom: SAGE Publications.

Kowert, R., Breuer, J., Festl, R., & Quandt, T. (2015). Women are from FarmVille, men are from ViceCity: the cycle of exclusion and sexism in video game content and culture. In R. Kowert, J. Breuer, & T. Quandt (Eds.), *New perspectives on the social aspects of digital gaming* (pp.136-150). London, United Kingdom: Routledge.

Kretchmar, J. (2008). *Social learning theory (research starters)*. Great Neck, New York: Great Neck Publishing.

Kretzschmar, M., & Stanfill, M. (2019). Mods as lightning rods: a typology of video game mods, intellectual property, and social benefit/harm. *Social & Legal Studies*, *28*(4), 517-536.

Kröger, S., & Quandt, T. (2014). Get together: console playing as a group experience. In T. Quandt and S. Kröger (Eds.), *Multiplayer: the social aspects of digital gaming* (pp. 147-161). New York, New York: Routledge.

Kvasbo, A. (2007). MOOSES game concepts: game concepts for the multiplayer on one screen entertainment system. Retrieved from http://www.diva-portal.org/smash/get/diva2:348496/fulltext01.pdf

Lacasa, P., Méndez, L., & Martínez, R. (2008). Bringing commercial games into the classroom. *Computers and Composition*, *25*(3), 341-358.

Lamberg, T. D., & Middleton, J. A. (2009). Design research perspectives on transitioning from individual microgenetic interviews to a whole-class teaching experiment. *Educational Researcher*, *38*(4), 233-245.

Lave, J., & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*. Cambridge, United Kingdom: Cambridge University Press.

Lee, M. J. W., Eustace, K., Fellows, G., Bytheway, A., & Irving, L. (2005). Rochester Castle MMORPG: instructional gaming and collaborative learning at a Western Australian school. *Australasian Journal of Educational Technology, 21*(4), 446-469.

Lincoln, S. Y., & Guba, E. G. (1985). *Naturalistic inquiry*. Thousand Oaks, California: Sage.

Lindsay, S., Proulx, M., Scott, H., & Thomson, N. (2014). Exploring teachers' strategies for including children with autism spectrum disorder in mainstream classrooms. *International Journal of Inclusive Education, 18*(2), 101-122.

Linn, R. L., Baker, E. L., & Betebenner, D. W. (2002). Accountability systems: implications of requirements of the no child left behind act of 2001. *Educational Researcher, 31*(6), 3-16.

Lisk, T. C., Kaplancali, U. T., & Riggio, R. E. (2012). Leadership in multiplayer online gaming environments. *Simulation & Gaming*, *43*(1), 133-149.

Livingstone, S., Bober, M., & Helsper, E. (2005). *Internet literacy among children and young people: findings from the UK Children Go Online project*. London, United Kingdom: OFCOM.

Lobel, A., Engels, R. C., Stone, L. L., Burk, W. J., & Granic, I. (2017). Video gaming and children's psychosocial wellbeing: a longitudinal study. *Journal of Youth and Adolescence*, *46*(4), 884-897.

Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting and task performance*. Upper Saddle River, New Jersey: Prentice-Hall.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: a 35-year odyssey. *American Psychologist*, *57*(9), 705.

MacKay, T., Knott, F., & Dunlop, A. W. (2007). Developing social interaction and understanding in individuals with autism spectrum disorder: a groupwork intervention. *Journal of Intellectual and Developmental Disability*, *32*(4), 279-290.

Maiano, C., Normand, C. L., Salvas, M. C., Moullec, G., & Aimé, A. (2016). Prevalence of school bullying among youth with autism spectrum disorders: a systematic review and meta-analysis. *Autism Research*, 9(6), 601-615.

Maione, L., & Mirenda, P. (2006). Effects of video modeling and video feedback on peer-directed social language skills of a child with autism. *Journal of Positive Behavior Interventions*, *8*(2), 106-118.

Malinverni, L., Mora-Guiard, J., Padillo, V., Valero, L., Hervás, A., & Pares, N. (2017). An inclusive design approach for developing video games for children with autism spectrum disorder. *Computers in Human Behavior, 71*, 535-549.

Maras, D., Flament, M. F., Murray, M., Buchholz, A., Henderson, K. A., Obeid, N., & Goldfield, G. S. (2015). Screen time is associated with depression and anxiety in Canadian youth. *Preventive Medicine*, *73*, 133–138.

Markey, P. M., Markey, C. N., & French, J. E. (2015). Violent video games and real-world violence: rhetoric versus data. *Psychology of Popular Media Culture*, *4*(4), 277.

Mason, R. A., Davis, H. S., Ayres, K. M., Davis, J. L., & Mason, B. A. (2016). Video self-modeling for individuals with disabilities: a best-evidence, single case meta-analysis. *Journal of Developmental and Physical Disabilities*, *28*(4), 623-642.

Masson, M. E., Bub, D. N., & Lalonde, C. E. (2011). Video-game training and naïve reasoning about object motion. *Applied Cognitive Psychology*, *25*(1), 166-173.

Mattila, M. L., Hurtig, T., Haapsamo, H., Jussila, K., Kuusikko-Gauffin, S., Kielinen, M., ... Pauls, D. L. (2010). Comorbid psychiatric disorders associated with Asperger syndrome/high-functioning autism: a community-and clinic-based study. *Journal of Autism and Developmental Disorders*, *40*(9), 1080-1093.

McCall, J. (2016). Teaching history with digital historical games: an introduction to the field and best practices. *Simulation & Gaming*, *47*(4), 517-542.

McFall, R. M. (1982). A review and reformulation of the concept of social skills. Behavioral Assessment, 4,1–33.

McGonical, J. (2011). *Reality is broken. Why games make us better and how they can change the world*. London, United Kingdom: Vintage Digital.

McKenney, S., & Reeves, T. C. (2012). *Conducting educational design research*. New York, New York: Routledge.

McLellan, H. (1996). *Situated learning perspectives*. Englewood Cliffs, New Jersey: Education Technology Publications.

Mechling, L. C., & Swindle, C. O. (2013). Fine and gross motor task performance when using computer-based video models by students with autism and moderate intellectual disability. *The Journal of Special Education*, *47*(3), 135-147.

Melbourne Graduate School of Education Human Ethics Advisory Group [MGSE HEAG]. (2016). *Human Research Ethics 2016 Information Kit* (Online Version). Retrieved from http://education.unimelb.edu.au/research/graduate-research-students/human_ethics_research

Merriam, S. B. (1998). *Qualitative research: a guide to design and implementation. Revised and expanded from qualitative research and case study applications in education*. San Franscisco, California: Jossey-Bass.

Mesibov, G. B., Shea, V., & Schopler, E. (2005). *The TEACCH approach to autism spectrum disorders*. Berlin, Germany: Springer Science & Business Media.

Metz, C. (2018, March). *Donkey Kong Country: Tropical Freeze - co-op review*. Co-optimus. Retrieved from https://www.co-optimus.com/review/1338/page/1/donkey-kong-country-tropical-freeze-co-op-review.html

Middleton, J., Gorard, S., Taylor, C., & Bannan-Ritland, B. (2008). The 'compleat' design experiment: from soup to nuts. In A. Kelly, R. Lesh, & J. Baek (Eds.), *Handbook of design research methods in education: innovations in science, technology, engineering, and mathematics learning and teaching* (pp. 21-46). Abingdon, United Kingdom: Routledge.

Miller, T., & Bell, L. (2002). Consenting to what? Issues of access, gate-keeping and 'informed' consent. *Ethics in Qualitative Research,* (17), 53-69.

Mišic, B., Doesburg, S. M., Fatima, Z., Vidal, J., Vakorin, V. A., Taylor, M. J., & McIntosh, A. R. (2014). Coordinated information generation and mental flexibility: large-scale network disruption in children with autism. *Cerebral Cortex*, *25*(9), 2815-2827.

Mitchell, D. (2014). *What really works in special and inclusive education: using evidence-based teaching strategies*. Abingdon-on-Thames, United Kingdom: Routledge.

Moss, P. A., Pullin, D. C., Gee, J. P., Haertel, E. H., & Young, L. J. (2008). *Assessment, equity, and opportunity to learn*. Cambridge, United Kingdom: Cambridge University Press.

Mudaly, N., & Goddard, C. (2006). *The truth is longer than a lie: children's experiences of abuse and professional interventions*. London, United Kingdom: Jessica Kingsley Publishers.

Mudaly, N. (2015). The rights of pre-verbal children involved in video-recorded research. *The International Journal of Children's Rights*, *23*(2), 391-404.

Mundy, P., Sigman, M., Kasari, C., & Yirmiya, N. (1988). Nonverbal communication skills in Down syndrome children. *Child Development*, *59*(1), 235-249.

Murthy, D. (2008). Digital ethnography an examination of the use of new technologies for social research. *Sociology*, *42*(5), 837-855.

Must, A., Phillips, S., Curtin, C., & Bandini, L. G. (2015). Barriers to physical activity in children with autism spectrum disorders: relationship to physical activity and screen time. *Journal of Physical Activity and Health*, *12*(4), 529-534.

Mysirlaki, S., & Paraskeva, F. (2011, October). Massively multiplayer online games as activity systems: the relationship between motivation, performance and community. In *Proceedings of the 5th European Conference on Games Based Learning* [Conference proceedings] (pp. 412-421). Athens, Greece: University of Athens.

National Autistic Society. (2016, November). SPELL. Retrieved from https://www.autism.org.uk/spell

National Disability Insurance Agency [NDIA]. (2016). *Towards an ordinary life: annual report 2015-16* [Online document]. Retrieved from https://www.ndis.gov.au/medias/documents/ha5/h04/8798853726238/NDI7040-AnnualReport2016-vFaccessible.pdf

National Health and Medical Research Council [NHMRC]. (2018). *National Statement on Ethical Conduct in Human Research.* Retrieved from https://www.nhmrc.gov.au/guidelines-publications/e72

Nebel, S., Schneider, S., & Rey, G. D. (2016). Mining learning and crafting scientific experiments: a literature review on the use of Minecraft in education and research. *Journal of Educational Technology & Society*, *19*(2), 355.

Neely, L., Gerow, S., Rispoli, M., Lang, R., & Pullen, N. (2016). Treatment of echolalia in individuals with autism spectrum disorder: a systematic review. *Review Journal of Autism and Developmental Disorders*, *3*(1), 82-91.

Newman, J. (2002). The myth of the ergodic videogame. *Game Studies*, *2*(1), 1-17.

Newzoo. (2018). *2018 Global games market report*. Amsterdam, the Netherlands: Newzoo Europe.

Nintendo. (2012). *New Super Mario Bros. U* [Videogame]. Retrieved from https://www.nintendo.com/games/detail/new-super-mario-bros-u-wii-u

Nintendo. (2013). *Super Mario 3D World* [Videogame]. Retrieved from https://www.nintendo.com.au/catalogue/super-mario-3d-world

Nintendo. (2015). *Kirby and the Rainbow Paintbrush* [Videogame]. Retrieved from https://www.nintendo.com.au/catalogue/kirby-and-the-rainbow-paintbrush

Nintendo. (2016). *Star Fox Zero* [Videogame]. Retrieved from https://www.nintendo.com.au/catalogue/star-fox-zero

Nintendo. (2017). *1-2 Switch* [Videogame]. Retrieved from https://www.nintendo.com/games/detail/1-2-switch

Nintendo. (2018). *Donkey Kong Tropical Freeze* [Videogame]. Retrieved from https://www.nintendo.com/games/detail/donkey-kong-country-tropical-freeze-switch

Odom, S. L., Collet-Klingenberg, L., Rogers, S. J., & Hatton, D. D. (2010). Evidence-based practices in interventions for children and youth with autism spectrum disorders. *Preventing school failure: alternative education for children and youth*, 54(4), 275-282.

Otero, J. (2013, August). *Rayman Legends review*. IGN. Retrieved from https://au.ign.com/articles/2013/08/26/rayman-legends-review

Papastergiou, M. (2009). Digital game-based learning in high school computer science education: impact on educational effectiveness and student motivation. *Computers & Education*, *52*(1), 1-12.

Papert, S., & Harel, I. (1991). Situating constructionism. *Constructionism*, 36(2), 1-11.

Patton, M. (2005). *Qualitative research and evaluation methods*. Thousand Oaks, California: SAGE.

Peterson, T., & Hogan, J. W. (2006). *Should kids play video games? A persuasive text*. New York, New York: Mondo.

Petrina, N., Carter, M., Stephenson, J., & Sweller, N. (2017). Friendship satisfaction in children with autism spectrum disorder and nominated friends. *Journal of Autism and Developmental Disorders, 47*(2), 384-392.

Pfau, J. (2008, December). *The game controller: from the beginning*. Joukowsky Institute for Archaeology & the Ancient World. Retrieved from https://www.brown.edu/Departments/Joukowsky_Institute/courses/13things/7643.html

Pires, K., & Simon, G. (2015, March). YouTube live and Twitch: a tour of user-generated live streaming systems. In *Proceedings of the 6th ACM Multimedia Systems Conference* [Conference proceedings] (pp. 225-230). New York, New York: Association for Computing Machinery.

Pitts, R. (2013). *The birth of Xbox Live*. Retrieved from http://www.polygon.com/features/2013/11/11/4849940/xbox-live-millennium-e

Plomb, T. (2013). Educational design research: an introduction. In T. Plomp & N. Nieveen (Eds.), *Educational design research* (pp. 11-46). Enschede, Netherlands: Netherlands Institute for Curriculum Development.

Plunkett, L. (2013, November). *Super Mario 3D World: The Kotaku review*. Kotaku. Retrieved from https://www.kotaku.com.au/2013/11/super-mario-3d-world-the-kotaku-review

Plunkett, L. (2016, July). 'The Wii U has no games', A study. Retrieved from https://www.kotaku.com.au/2016/07/the-wii-u-has-no-games-a-study

Porayska-Pomsta, K., Alcorn, A. M., Avramides, K., Beale, S., Bernardini, S., Foster, M. E., ... & Kossyvaki, L. (2018). Blending human and artificial intelligence to support autistic children's social communication skills. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *25*(6), 1-35.

Preece, J., Rogers, Y., & Sharp, H. (2002). *Interaction design: beyond human-computer interaction.* New York City, New York: John Wiley and Sons

Premack D., Woodruff G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, *1*, 515–526.

Prensky, M. (2006). *Don't bother me, Mom, I'm learning! How computer and video games are preparing your kids for 21st century success and how you can help!* St. Paul, Minnesota: Paragon House.

Preston-Werner, T. (2009). *Semantic versioning 2.0.0*. Retrieved from https://semver.org

Przybylski, A. K., & Weinstein, N. (2017). *Digital screen time limits and young children's psychological well-being: evidence from a population-based study*. *Child development* (Report No. 29235663). Bethesda, Maryland: Society for Research in Child Development, Inc.

Qarabash, H., Heslop, P., Kharrufa, A., Balaam, M., & Devlin, M. (2018). Group tagging: using video tagging to facilitate reflection on small group activities. *British Journal of Educational Technology*, *1,* 1-17.

Quandt, T., & Kroger, S. (2014). *Multiplayer: the social aspects of digital gaming*. New York, New York: Routledge.

Quinn, M. M., Kavale, K. A., Mathur, S. R., Rutherford Jr, R. B., & Forness, S. R. (1999). A meta-analysis of social skill interventions for students with emotional or behavioral disorders. *Journal of Emotional and Behavioral Disorders*, 7(1), 54-64.

Quinton, S., & Smallbone, T. (2010). Feeding forward: using feedback to promote student reflection and learning–a teaching model. *Innovations in Education and Teaching International*, *47*(1), 125-135.

Rankin, J. A., Weber, R. J., Kang, E., & Lerner, M. D. (2016). Parent-and self-reported social skills importance in autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *46*(1), 273-286.

Rasch, G. (1960). *Probabilistic models for some intelligence and attainment tests*. Copenhagen, Denmark: Danmarks Paedagogiske Institut.

Rasch, G. (1980). *Probabilistic models for some intelligence and attainment tests*. Chicago, Illinois: University of Chicago Press.

Rao, P. A., Beidel, D. C., & Murray, M. J. (2008). Social skills interventions for children with Asperger's syndrome or high-functioning autism: a review and recommendations. *Journal of Autism and Developmental Disorders*, *38*(2), 353-361.

Rayner, C., Denholm, C., & Sigafoos, J. (2009). Video-based intervention for individuals with autism: key questions that remain unanswered. *Research in Autism Spectrum Disorders*, *3*(2), 291-303.

Rayner, C. S. (2011). *Video-based intervention for individuals with Autism* (Doctoral dissertation). University of Tasmania. Retrieved from https://eprints.utas.edu.au/12498/2/Whole_excluding_appendices_G_and_H-Video-based_intervention_for_individuals_with_autism_-_Chris.pdf

Reagon, K. A., Higbee, T. S., & Endicott, K. (2006). Teaching pretend play skills to a student with autism using video modeling with a sibling as model and play partner. *Education and Treatment of Children*, 29(3), 517-528.

Rebstein, B. (2012). Videography in migration research: a practical example for the use of an innovative approach. *Qualitative Sociology Review*, *8*(2), 130-151.

Redemption. (2016). Star Fox Zero walkthrough and guide. Neoseeker. Retrieved from https://www.neoseeker.com/star-fox-zero/walkthrough/Features

Reer, F., & Krämer, N. C. (2017). The connection between introversion/extraversion and social capital outcomes of playing World of Warcraft. *Cyberpsychology, Behavior, and Social Networking*, *20*(2), 97-103.

Reeves, T.C. (2006). Design research from a technology perspective. In J. van den Akker, K. Gravemeijer, S. McKenney & N. Nieveen (Eds.), *Educational design research* (pp. 52-66). London, United Kingdom: Routledge.

Rehfeldt, R. A., Dillen, J. E., Ziomek, M. M., & Kowalchuk, R. K. (2007). Assessing relational learning deficits in perspective-taking in children with high-functioning autism spectrum disorder. *The Psychological Record*, 57(1), 23-47.

Reichow, B., & Volkmar, F. R. (2010). Social skills interventions for individuals with autism: evaluation for evidence-based practices within a best evidence synthesis framework. *Journal of autism and developmental disorders*, *40*(2), 149-166.

Resnick, M. (2004). Edutainment? No thanks. I prefer playful learning. *Associazione Civita Report on Edutainment, 14*, 1-4.

Rieber, R. W., & Carton, A. S. (1993). The psychology and pedagogy of children's handicaps. In Carton, A. S., & Rieber, R. W. (Eds.), *The collected works of LS Vygotsky: the fundamentals of defectology (abnormal psychology and learning disabilities)* (pp. 76-93). Boston, Massachusetts: Springer.

Riffel, L. A., & Eggleston, J. R. (2018). *Evidence based interventions for classroom management: research to practice*. Overland Park, Kansas: Behavior Doctor Seminars.

Ringland, K. E., Wolf, C. T., Faucett, H., Dombrowski, L., & Hayes, G. R. (2016, May). Will I always be not social? Re-conceptualizing sociality in the context of a Minecraft

community for autism. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* [Conference proceedings] (pp. 1256-1269). New York, New York: Association for Computing Machinery.

Rohmer, O., & Louvet, E. (2018). Implicit stereotyping against people with disability. *Group Processes & Intergroup Relations, 21*(1), 127-140.

Romero, M., Usart, M., Ott, M., Earp, J., & de Freitas, S. (2012). Learning through playing for or against each other? Promoting collaborative learning in digital game based learning. *Learning*, *5*(2012), 15-2012.

Rothman, S. B. (2007). Understanding data quality through reliability: A comparison of data reliability assessment in three international relations datasets. *International Studies Review*, 9(3), 437-456.

Rosenshine, B. (2012). Principles of instruction: research-based strategies that all teachers should know. *American Educator*, *36*(1), 12.

Rotter, J. B. (1982). *The development and application of social learning theory: selected papers*. New York, New York: Praeger.

Ruzich, E., Allison, C., Smith, P., Watson, P., Auyeung, B., Ring, H., & Baron-Cohen, S. (2015). Measuring autistic traits in the general population: a systematic review of the Autism-Spectrum Quotient (AQ) in a nonclinical population sample of 6,900 typical adult males and females. *Molecular Autism*, *6*(1), 2.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemporary Educational Psychology, 25*(1), 54-67.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: a self-determination theory approach. *Motivation and Emotion*, *30*(4), 344-360.

Salen, K., & Zimmerman, E. (2004). *Rules of play: game design fundamentals*. Cambridge, Massachusetts: MIT press.

Salen, K. (2008). Toward an ecology of gaming. In K. Salen (Ed.), *The ecology of games: connecting youth, games, and learning* (pp. 1-17). Cambridge, Massachusetts: MIT press.

Salter, A., & Blodgett, B. (2012). Hypermasculinity & dickwolves: the contentious role of women in the new gaming public. *Journal of Broadcasting & Electronic Media*, *56*(3), 401-416.

Saridaki, M., Gouscos, D., & Meimaris, M. G. (2009). Digital games-based learning for students with intellectual disability. In T. Connolly, M. Standfield, & L. Boyle (Eds.), *Games-based learning advancements for multi-sensory human computer interfaces: techniques and effective practices* (pp. 288-303). Hershey, Pennsylvania: IGI Global.

Schmierbach, M., Xu, Q., Oeldorf-Hirsch, A., & Dardis, F. E. (2012). Electronic friend or virtual foe: exploring the role of competitive and cooperative multiplayer video game modes in fostering enjoyment. *Media Psychology*, *15*(3), 356-371.

Schrader, G., & McCreery, M. (2008). The acquisition of skill and expertise in massively multiplayer online games. *Educational Technology Research and Development*, 56(5), 18.

Schultheiss, D. (2017). 'From the weaker sex to hardcore gaming': female gaming patterns on the Internet. *Computers in Entertainment*, *15*(2), 5.

Schunk, D. H., & Ertmer, P. A. (1999). Self-regulatory processes during computer skill acquisition: goal and self-evaluative influences. *Journal of Educational Psychology*, *91*(2), 251.

Schwensfeier, T. (2019). *Prediction of player moves in collectible card games* (Doctoral dissertation). Magdeburg, Germany: Otto von Guericke University Magdeburg.

Sedgewick, F., Hill, V., Yates, R., Pickering, L., & Pellicano, E. (2016). Gender differences in the social motivation and friendship experiences of autistic and non-autistic adolescents. *Journal of Autism and Developmental Disorders, 46*(4), 1297-1306.

Sencibaugh, J. M., & Sencibaugh, A. M. (2016). An analysis of cooperative learning approaches for students with learning disabilities. *Education, 136*(3), 356-364.

Shaffer, D. W., Squire, K. R., Halverson, R., & Gee, J. P. (2005). Video games and the future of learning. *Phi Delta Kappan*, *87*(2), 105-111.

Shaw, A. (2010). What is video game culture? Cultural studies and game studies. *Games and Culture*, *5*(4), 403-424.

Shaw, A. (2012). Do you identify as a gamer? Gender, race, sexuality, and gamer identity. *New Media & Society*, *14*(1), 28-44.

Shepherd, A., Hoban, G., & Dixon, R. (2014). Using slowmation to develop the social skills of primary school students with mild intellectual disabilities: four case studies. *Australasian Journal of Special Education*, *38*(2), 150-168.

Sherman, S. L., Allen, E. G., Bean, L. H., & Freeman, S. B. (2007). Epidemiology of Down syndrome. *Mental Retardation and Developmental Disabilities Research Reviews*, *13*(3), 221-227.

Shipley-Benamou, R., Lutzker, J. R., & Taubman, M. (2002). Teaching daily living skills to children with autism through instructional video modeling. *Journal of Positive Behavior Interventions*, *4*(3), 166-177.

Shrum, W., Duque, R., & Brown, T. (2005). Digital video as research practice: methodology for the millennium. *Journal of Research Practice*, *1*(1), 1-19.

Shukla-Mehta, S., Miller, T., & Callahan, K. J. (2010). Evaluating the effectiveness of video instruction on social and communication skills training for children with autism spectrum disorders: a review of the literature. *Focus on Autism and Other Developmental Disabilities*, *25*(1), 23-36.

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, *78*(1), 153-189.

Shute, V. J., Rieber, L., & Van Eck, R. (2011). Games ... and ... learning. In R. Reiser & J. Dempsey (Eds.), *Trends and issues in instructional design and technology* (3rd ed.), (pp. 321–332). Upper Saddle River, New Jersey: Pearson Education.

Sigman, M., Ruskin, E., Arbelle, S., Corona, R., Dissanayake, C., Espinosa, M., ... Robinson, B. F. (1999). Continuity and change in the social competence of children with autism, Down syndrome, and developmental delays. *Monographs of the Society for Research in Child Development*, i-139.

Silberman, S. (2015). *Neurotribes: the legacy of autism and the future of neurodiversity*. London, United Kingdom: Penguin.

Simpson, A. (2017). The misdirection of public policy: comparing and combining standardised effect sizes. *Journal of Education Policy*, *32*(4), 450-466.

Siisiainen, M. (2003). Two concepts of social capital: Bourdieu vs. Putnam. *International Journal of Contemporary Sociology*, *40*(2), 183-204.

Slavin, R. (2018, June). *John Hattie is wrong* [Blog]. Retrieved from https://robertslavinsblog.wordpress.com/2018/06

Sliva, M. (2015, February). *Kirby and the Rainbow Curse review. IGN*. Retrieved from https://au.ign.com/articles/2015/02/19/kirby-and-the-rainbow-curse-review

Smith, A. (2009). The empathy imbalance hypothesis of autism: a theoretical approach to cognitive and emotional empathy in autistic development. *The Psychological Record*, *59*(3), 489-510.

Sousa, A. C. (2011). From refrigerator mothers to warrior-heroes: the cultural identity transformation of mothers raising children with intellectual disabilities. *Symbolic Interaction, 34*(2), 220-243.

Squire, K. (2005). Changing the game: what happens when video games enter the classroom? *Innovate: Journal of Online Education*, *1*(6), 1-8.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: techniques and procedures for developing grounded theory* (2nd ed.). Thousand Oaks, California: SAGE.

Suárez, L., Thio, C. F. W., & Singh, S. (2013). Why people play massively multiplayer online games? *International Journal of e-Education, e-Business, e-Management and e-Learning*, *3*(1), 7-12.

Suh, S., Kim, W. S., & Kim, J. N. (2010). Effectiveness of MMORPG-based instruction in elementary English education in Korea. *Journal of Computer Assisted Learning*, *26*(5), 370-378.

Sun, C. T., Ye, S. H., & Wang, Y. J. (2015). Effects of commercial video games on cognitive elaboration of physical concepts. *Computers & Education*, *88*, 169-181.

Susaeta, H., Jimenez, F., Nussbaum, M., Gajardo, I., Andreu, J. J., & Villalta, M. (2010). From MMORPG to a classroom multiplayer presential role playing game. *Journal of Educational Technology & Society*, *13*(3), 257.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and instruction*, *4*(4), 295-312.

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. New York, New York: Springer-Verlag.

Takahashi, D. (2016, June). *PwC: Game industry to grow nearly 5% annually through 2020.* Retrieved from https://venturebeat.com/2016/06/08/the-u-s-and-global-game-industries-will-grow-a-healthy-amount-by-2020-pwc-forecasts/

Tavinor, G. (2008). Definition of videogames. *Contemporary Aesthetics*, *6*(1), 16-37.

Thomas, R. (1998). *Conducting educational research: a comparative view*. Westport, Connecticut: Greenwood Publishing Group.

Thompson, L. S. C. A. (2016). Moving beyond the limits of disability inclusion: using the concept of belonging through friendship to improve the outcome of the social model of disability. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 10*(5), 1488-1491.

Thornberg, R., Wänström, L., Pozzoli, T., & Gini, G. (2018). Victim prevalence in bullying and its association with teacher–student and student–student relationships and class moral disengagement: a class-level path analysis. *Research Papers in Education*, *33*(3), 320-335.

Travers, C. J., Morisano, D., & Locke, E. A. (2015). Self-reflection, growth goals, and academic outcomes: a qualitative study. *British Journal of Educational Psychology*, *85*(2), 224-241.

Tsai, F. H., Tsai, C. C., & Lin, K. Y. (2015). The evaluation of different gaming modes and feedback types on game-based formative assessment in an online learning environment. *Computers & Education*, *81*, 259–269.

Tsekleves, E., Cosmas, J., & Aggoun, A. (2016). Benefits, barriers and guideline recommendations for the implementation of serious games in education for stakeholders and policymakers. *British Journal of Educational Technology*, *47*(1), 164-183.

Ubisoft. (2013). *Rayman Legends* [Videogame]. Retrieved from https://www.nintendo.com/games/detail/rayman-legends-wii-u

United Nations General Assembly [UNGA]. (2006). Convention on the rights of persons with disabilities (CRPD). *Treaty Series*, 2515, 3.

United Nations Department of Economic and Social Affairs [UNDESA]. (2018). *Convention on the rights of persons with disabilities*. Retrieved from https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html

University of North Carolina School of Medicine. (2019). *Advancing social-communication and play.* Department of Allied Health Sciences. Retrieved from https://www.med.unc.edu/ahs/asap/files/2017/09/Play-Hierarchy.pdf

Vasalou, A., Khaled, R., Holmes, W., & Gooch, D. (2017). Digital games-based learning for children with dyslexia: a social constructivist perspective on engagement and learning during group game-play. *Computers & Education*, *114*, 175-192.

Van Eck, R. (2006). Digital game-based learning: it's not just the digital natives who are restless. *Educause Review*, *41*(2), 1-16.

Vangrieken, K., Dochy, F., Raes, E., & Kyndt, E. (2015). Teacher collaboration: a systematic review. *Educational Research Review*, *17*, 17-40.

Vate-U-Lan, P. (2015). Transforming classrooms through game-based learning: a feasibility study in a developing country. *International Journal of Game-Based Learning (IJGBL)*, *5*(1), 46-57.

Vičić, A., Hafner, T., Vlatković, I. B., Korać, P., Habek, D., & Stipoljev, F. (2017). Prenatal diagnosis of Down syndrome: a 13-year retrospective study. *Taiwanese Journal of Obstetrics and Gynecology*, *56*(6), 731-735.

Vickerstaff, S., Heriot, S., Wong, M., Lopes, A., & Dossetor, D. (2007). Intellectual ability, self-perceived social competence, and depressive symptomatology in children with high-functioning autistic spectrum disorders. *Journal of Autism and Developmental Disorders*, *37*(9), 1647-1664.

Virvou, M., & Katsionis, G. (2008). On the usability and likeability of virtual reality games for education: the case of VR-ENGAGE. *Computers & Education*, *50*(1), 154-178.

Vivanti, G., Dissanayake, C., Duncan, J. F., Capes, K., Upson, S., & Bent, C. A. (2018). Outcomes of children receiving Group-Early Start Denver Model in an inclusive versus autism-specific setting: a pilot randomized controlled trial. *Autism*, *3(1)*, 1-11.

Volet, S., Vauras, M., & Salonen, P. (2009). Self-and social regulation in learning contexts: an integrative perspective. *Educational Psychologist*, *44*(4), 215-226.

Voulgari, I., & Komis, V. (2010). 'Elven Elder LVL59 LFP/RB. Please PM me': immersion, collaborative tasks and problem-solving in massively multiplayer online games. *Learning, Media and Technology*, *35*(2), 171-202.

Vygotsky, L. S. (1978). *Mind in society*. Cambridge, Massachusetts: Harvard University Press.

Wagner, D. (2007). Students' critical awareness of voice and agency in mathematics classroom discourse. *Mathematical Thinking and Learning*, 9(1), 31-50.

Walker, H. M., Marquez, B., Yeaton, P., Pennefather, J., Forness, S. R., & Vincent, C. G. (2015). Teacher judgment in assessing students' social behavior within a response-to-intervention framework: using what teachers know. *Education and Treatment of Children*, *38*(3), 363-382.

Wang, P., & Spillane, A. (2009). Evidence-based social skills interventions for children with autism: a meta-analysis. *Education and Training in Developmental Disabilities*, 318-342.

Wang, T. H. (2011). Implementation of web-based dynamic assessment in facilitating junior high school students to learn mathematics. *Computers & Education*, *56*(4), 1062-1071.

Weintraub, K. (2011). The prevalence puzzle: autism counts. *Nature News*, *479*(7371), 22-24.

Wenger, E. (1999). *Communities of practice: learning, meaning, and identity*. Cambridge, United Kingdom: Cambridge University Press.

Wenger, E., McDermott, R. A., & Snyder, W. (2002). *Cultivating communities of practice: a guide to managing knowledge*. Watertown, Massachusetts: Harvard Business Press.

White, S. W., Oswald, D., Ollendick, T., & Scahill, L. (2009). Anxiety in children and adolescents with autism spectrum disorders. *Clinical Psychology Review*, *29*(3), 216-229.

Whitebread, D., Coltman, P., Jameson, H., & Lander, R. (2009). Play, cognition and self-regulation: what exactly are children learning when they learn through play? *Play and Learning in Educational Settings*, *26*(2), 40-52.

Widjaja, W. (2018, July). *Design-based research in education: Methodological potential and issues* [Powerpoint slides]. Retrieved from https://unimelbcloud-my.sharepoint.com/:b:/g/personal/matthew_harrison_unimelb_edu_au/EbgW97lufCBLuaElaj6_LOYBVWe5bAsvAAGX4H9L6bDMDg?e=QkAa4H

Wiliams, D. (2008). Changing classroom practice. *Educational Leadership*, *65*(4), 36-59.

Williams, K. R., Wishart, J. G., Pitcairn, T. K., & Willis, D. S. (2005). Emotion recognition by children with Down syndrome: investigation of specific impairments and error patterns. *American Journal on Mental Retardation*, *110*(5), 378-392.

Wing, L., & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: epidemiology and classification. *Journal of Autism and Developmental Disorders*, *9*(1), 11-29.

Wing, L., Gould, J., & Gillberg, C. (2011). Autism spectrum disorders in the DSM-V: better or worse than the DSM-IV? *Research in Developmental Disabilities*, *32*(2), 768-773.

Winner, M. G. (2007). *Thinking about you thinking about me*. San Jose, California: Think Social.

Winner, M. G., & Crooke, P. J. (2009). Social thinking: a training paradigm for professionals and treatment approach for individuals with social learning/social pragmatic challenges. *Perspectives on Language Learning and Education, 16*(2), 62-69.

Winner, M. G. (2013). *Why teach social thinking? Questioning our assumptions about what it means to learn social skills.* San Jose, California: Think Social.

Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., ... Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: a comprehensive review. *Journal of Autism and Developmental Disorders*, *45*(7), 1951-1966.

Wong, M. Y. (2016). Teacher–student power relations as a reflection of multileveled intertwined interactions. *British Journal of Sociology of Education*, *37*(2), 248-267.

Wood, D. J., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychiatry and Psychology*, *17*(2), 89-100.

Wood, K. R. (2011). *Simulation video games as learning tools: an examination of instructor guided reflection on cognitive outcomes* (Doctoral dissertation). Georgia State University. (3471652 Ph.D.), Retrieved from https://pdfs.semanticscholar.org/3295/62d4bc8cbf782b971abfc8f56a118a39b87c.pdf?_ga=2.241048707.1676217269.1556999709-1876274387.1556999709

Woods, K., Coles-Janess, B., & Roberts, E. (2010). Mining the gold: assessing students by ability, not disability. *Teacher*, *4*, 34-37.

Woods, R. (2017). Exploring how the social model of disability can be re-invigorated for autism: in response to Jonathan Levitt. *Disability & Society*, *32*(7), 1090-1095.

Woolfolk, A., & Margetts, K. (2016). *Educational psychology* (4th ed.). Melbourne, Australia: Pearson.

World Health Organization [WHO]. (1993). *ICD-10 classification of mental and behavioural disorders: diagnostic criteria for research*. Albany, Switzerland: World Health Organization.

World Health Organization [WHO]. (2018). *International classification of diseases and related health problems (ICD) 11th revision.* Albany, Switzerland: World Health Organization.

Wright, W., & Bogost, I. (2007). *Persuasive games: the expressive power of videogames*. Cambridge, Massachusetts: MIT Press.

Wu, M. L., Richards, K., & Saw, G. K. (2014). Examining a massive multiplayer online role-playing game as a digital game-based learning platform. *Computers in the Schools*, *31*(1-2), 65-83.

Wu, Y. T. (2015). Using educational computer games for science teaching: experiences and perspectives of elementary science teachers in Taiwan. In A. DeMarco (Ed.), *STEM Education: Concepts, Methodologies, Tools, and Applications* (pp. 345-357). Hershey, Pennsylvania: IGI Global.

Wyatt, M. (2010). Teachers researching their own practice. *ELT Journal*, *65*(4), 417-425.

Yang, K. H. (2017). Learning behavior and achievement analysis of a digital game-based learning approach integrating mastery learning theory and different feedback models. *Interactive Learning Environments*, *25*(2), 235-248.

Yates, G. C., & Hattie, J. (2014). *Visible learning and the science of how we learn*. New York, New York: Routledge.

Yin, R. K. (2009). How to do better case studies. In L. Bickman & D. J. Rog (Eds.), *The SAGE handbook of applied social research methods*, (2nd ed.) (pp. 254-282). Thousand Oaks, California: SAGE Publications.

Yin, R. K. (2011). *Qualitative research from start to finish*. Chicago, Illinois: Guilford Publications.

Yin, R. K. (2013). *Case study research: design and methods*. New York, New York: SAGE Publications.

Young, M., Schrader, P. G., & Zheng, D. (2006). MMOGs as learning environments: an ecological journey into 'Quest Atlantis' and 'The Sims Online'. *Innovate: Journal of Online Education*, *2*(4).

Zea, N. P., Sánchez, J. L. G., Gutiérrez, F. L., Cabrera, M. J., & Paderewski, P. (2009). Design of educational multiplayer videogames: a vision from collaborative learning. *Advances in Engineering Software*, *40*(12), 1251-1260.

Appendices

Appendix A: The social dimensions of the Collaborative problem-solving empirical progressions (Hesse et al., 2015).

Level	Participation	Perspective-taking	Social regulation
F – Cooperation & shared goals		The student can tailor communication with their partner based on their awareness of their partner's understanding from the start of the task. The student incorporates the contributions from their partner to suggest new solution paths or modify incorrect ones. They use solutions provided by their partner and work more collaboratively through the problem-solving process.	The student assumes group responsibility for the success of the task. They can manage conflicts with partners successfully, resolving differences before proceeding on a possible solution path. The student is able to evaluate their overall performance in the task. They are also able to evaluate the strengths and/or weaknesses of their partner based on their performance during the task.
E – Appreciated & valued	The student is able to actively participate in unfamiliar tasks. The student initiates and promotes interaction with their partner often before entering their own answer.	The student acknowledges and responds to contributions from their partner but does not make changes to their original plan.	The student attempts to resolve differences in understanding with their partner but resolution of differences is not reached. The student is able to comment on their partner's performance during the task.
D – Mutual commitment	The student perseveres to solve the task by repeating attempts and/or multiple strategies.	The student modifies communication with their partner to improve common understanding and share resources and information.	The student comments on or shares information with their partner regarding their own performance while attempting the task. The student is aware of their partner's performance on the task.
C – Awareness of partnership	The student demonstrates effort towards solving the problem. The student discusses the task with their partner by responding to communication cues and requests.	The student makes contributions to their partners understanding.	They have a common understanding with their partners in regard to the problem. The student reports to their partner regarding their own activities on the task.
B – Supported working	The student actively participates in the task when it is familiar. Interaction between partners occurs more frequently but it is limited to only when it is necessary for completing the task.	The student is not overtly responsive to their partner, often taking a long time to respond or not responding at all and tends to ignore their partners contributions.	The student still works largely independently taking responsibility for their own actions during the task. The student is aware of their own level of performance during the task.
A – Independent working	The student commences the task independently focusing on the instructions provided. Interaction with their partner is limited to the beginning of a task and only in those situations where the instructions are clear.		

Appendix B: Thematic guides for interviewing teaching assistants during the design process.

Thematic Guide for Semi-Structured Interviews for Teaching Assistants

Intervention design in progress

- Interview conducted with game footage available (without sound) for the teaching assistant but paused when asking questions/response.
- The teaching assistant will be told they can show me sections from the game footage on the laptop (fast-forwarding/rewinding footage) if needed.

Checklist of points for explanation before interview commences:

- Purpose of interview.
- Clarification of topic under discussion.
- Format of the interview.
- Approximate length of the interview.
- Assurance of confidentiality.
- Purpose of digital recorder – ask permission to use it. Explain that only myself and my supervisors will have access to the recording.
- Assure participant that he or she may decline to answer a question.
- Assure participant that they may ask questions or finish interview at any time.

Themes as listed in the Ethics Application

a) *Evaluating perceptions of the game played in the session*: Exploring their observations of the engagement of my students in playing the various games and the reasons why they believe this was the case. This includes seeking perspectives on the way the mechanics of play, the difficulty and the scaffolding within the game impacted upon their enjoyment of the experience for my students playing with their peers.

b) *Perceptions of interpersonal interactions*: Exploring how the teaching assistant's perceptions of the level of cooperation between the students within the game and how this compared with other activities. There will be an emphasis on their perceptions of the causes of any conflicts during the session, and the strategies they observed to resolve these conflicts.

c) *Reflections upon the application of the targeted skills:* Exploring the connections my teaching assistants made between the pre-play discussions of social skills and the ways my students attempted to apply them when playing the game.

Theme A: Evaluating perceptions of the game played in the session
(Use the game footage and the game case as a prompt). • Do you think all the students enjoyed this game? Why or why not? • What elements of the game do you think the students enjoyed the most? • What elements of the game do you think the students found the most challenging?
• Did the game encourage the players to work together? Why do you say this? • If so, how did the game do this? • If not, how could the game be improved to encourage more teamwork?
• Did the game give the players enough assistance in supporting them to work as a team? Why is this so? • Was the game appropriately challenging, or was it too easy or too difficult?
Theme B: Perceptions of interpersonal interactions
• How well did the students work as a team to finish the levels today? What makes you say this? • Did anything surprise you about the way students worked together today?
• What are some important things to do with your teammates to help you finish the levels?
• Were there any times that the students did not work well as a team? What do you think caused this?
Theme C: Reflections upon the application of the targeted skills
(Have the PCS for the five 'Working as a Team' skills available for reference). • Which of these skills did you see the students using today? Do you remember the situation they were facing in the game?
• Which of the other skills did you see the students use today? • What other social skills do you think our students need to develop? This may be as a group or individual students. • Did the game help the students develop the social skills outside of the game, or do you think they will only use the skills they demonstrated today when playing these types of games? • If yes, when do you think they will use these skills?

Concluding the Interview

• *Do you have any questions you want to ask me about today or this research?* • *Anything else you want to say about today?* • *Thank you for talking with me today!* • *If you want to discuss anything from today later please let me know, or you can talk to your classroom teacher.*

Appendix C: Thematic guides for interviewing teaching assistants at the conclusion of the design process.

Thematic Guide for Semi-Structured Interviews for Teaching Assistants

Conclusion of design process (End of intervention)

- Interview conducted with game footage available (without sound) for the teaching assistant but paused when asking questions/response.
- The teaching assistant will be told they can show me sections from the game footage on the laptop (fast-forwarding/rewinding footage) if needed.

Checklist of points for explanation before interview commences:

- Purpose of interview.
- Clarification of topic under discussion.
- Format of the interview.
- Approximate length of the interview.
- Assurance of confidentiality.
- Purpose of digital recorder – ask permission to use it. Explain that only myself and my supervisors will have access to the recording.
- Assure participant that he or she may decline to answer a question.
- Assure participant that they may ask questions or finish interview at any time.

Themes as listed in the Ethics Application

a) *Exploring perceptions of the games played over the course of the research project*: Which games do they believe were the most popular with the students? Which elements of the respective games did they enjoy or not enjoy? How did they feel about the way the games positioned them to play together?
b) *Perceptions on the skills they used to work together*: What skills did they think that each game required them to use to play together and be successful? What were some of the skills they used the most when playing together? How well did they personally use each of the targeted skills from the program?
c) *Reflections upon the entirety of the program*: How well did they think that the program worked as a way of practicing working as a team. What would they want to do again in the future and why? What elements do they believe should be changed when this program is conducted in the future?

Theme A: Exploring perceptions of the games played over the course of the research project
(Have game cases available for reference). • Which games do they believe were the most popular with the students? Why was this so? • How did the games encourage the players to work together? • Did the students have any difficulties accessing any of the games? For example, did any students struggle with controlling the games?
(Questions for each game, again with the game cases as a prompt). • Which elements of the respective games did they enjoy or not enjoy? • What job did each player have in this game? • What did the students watching the game do while they were waiting for their turn?

Theme B: Perceptions on the skills used/collaborative problem solving
Student social skills: • What are the social strengths and challenges for (STUDENT NAME)? How does this affect his ability to work with others?
Skills: (Provide PCS for each of the ten 'Working as a Team' skills) • Can you tell me what each of these skills mean to you? • Can you tell what you think they mean to the students? • Which skills do you think are most important for our students to be able to work together? • Can you give me an example of how the students used each of these skills whilst playing the games? • What other skills did you observe the students using when playing the games?
Communication methods: • How did the students communicate whilst playing together? • Did the students use complete sentences or part sentences/single words when verbally communicating to each other? • Did you notice the students using any gestures whilst playing the games? • What supports could we use with the students next time to better support their communication?
Collaborative problem-solving framework: (Provide *Collaborative Problem-Solving Empirical Progressions* rubric) • Where would you place each student? Why? • Do you see any problems with how these levels of sophistication are ordered?
Video modelling: • Did showing the students some of the video from the week before help the students talk about the skills? • Do you think it helped them to understand what these skills would look like in action?
Theme C: Reflections upon the entirety of the program
• How well did the pre-teaching and the group discussion of the skills prepare the students for using the skills in the game? • How could the pre-teaching and the group discussion be improved?
• How likely do you think the students are to apply these social skills in other contexts outside of the game?

Concluding the Interview

- *Do you have any questions you want to ask me about today or this research?*
- *Anything else you want to say about today?*
- *Thank you for talking with me today!*
- *If you want to discuss anything from today later please let me know, or you can talk to your classroom teacher.*

Appendix D: Thematic guide for interviewing individual students at the conclusion of the intervention.

Thematic Guide for Semi-Structured Interviews for Students

Conclusion of design process (End of intervention)

- Interview conducted with game footage available (without sound) for the student but paused when asking questions/response.
- The teaching assistant will be told they can show me sections from the game footage on the laptop (fast-forwarding/rewinding footage) if needed.

Checklist of points for explanation before interview commences:

- Purpose of interview.
- Clarification of topic under discussion.
- Format of the interview.
- Approximate length of the interview.
- Assurance of confidentiality.
- Purpose of digital recorder – ask permission to use it. Explain that only myself and my supervisors will have access to the recording.
- Assure participant that he or she may decline to answer a question.
- Assure participant that they may ask questions or finish interview at any time.

Themes as listed in the Ethics Application

a) *Exploring perceptions of the games played over the course of the research project*: Which games were their favourite to play? Which elements of the respective games did they enjoy or not enjoy? How did they feel about the way the games positioned them to play together?
b) *Perceptions on the skills they used to work together*: What skills did they think that each game required them to use to play together and be successful? What were some of the skills they used the most when playing together? How well did they personally use each of the targeted skills from the program?
c) *Reflections upon the entirety of the program*: How well did they think that the program worked as a way of practicing working as a team. What would they want to do again in the future and why? What would they change if they completed this program again?

Theme A: Exploring perceptions of the games played over the course of the research project
(Have game cases available for reference). • Which game was your favourite to play? What made you feel this way? • Which game do you think helped you the most to work with your teammates? Why? • How did each game help you to work together? Why is this so? • Would you rather play games with your friends online or in the same room? Why?
(Questions for each game, again with the game cases as a prompt). • What did you like about this game? • What did you not like about this game? • What job did each player have in this game? • What did the people watching the game do while they were waiting for their turn? • Would it be easier to complete this game by yourself or with your teammates playing with you?

Theme B: Perceptions on the skills used/collaborative problem solving
(Provide PCS for each of the five 'Working as a Team' skills). • Can you tell me what each of these skills mean to you? • Can you give me an example of how you used each of these skills whilst playing the games? • How well do you think your teammates did at using these skills? • What other skills did you use when we have been playing games?
(Questions for each game, again with the game cases as a prompt as well as the five 'Working as a Team' skills PCS clearly displayed as a point of reference). • Which of our 'Working as a Team' skills do you think you used for this game? • Which of these skills do you think is the most important to finish this game together? Why?
• Were there any times that you did not work well with your team? • What was the most difficult part of working with the other students whilst playing these games? • Did you ever feel upset with your teammates? What caused this? How did you calm yourself down?
Theme C: Reflections upon the entirety of the program
• What did you do in these classes? • What did the teacher do in these classes? • What did the teaching assistant do in these classes?
• What was your favourite part of these classes? • If you were the teacher what would you change about these classes? • What did you learn in these classes?

Concluding the Interview

- *Do you have any questions you want to ask me about today or this research?*
- *Anything else you want to say about today?*
- *Thank you for talking with me today!*
- *If you want to discuss anything from today later please let me know, or you can talk to your classroom teacher.*

Appendix E: Examples of supporting visuals for concluding interviews with students.

Which game was your favourite? WHY?









How did you work with your friends in these games?



Appendix F: The distress protocol.

Distress Protocoll: Managing distress in the context of my research project.

(Modified from : Draucker, C.B., Martsolf D. S. & Poole, C. (2009). Developing Distress Protocols for research on Sensitive Topics. *Archives of Psychiatric Nursing*. 23(5), 343-350)



Appendix G: Plain language script that the classroom teacher read to the students to explain the research project and to seek their assent.

This assent script was developed in partnership with the school's speech pathologist to ensure that the language used will be understood by the students at our school.

It is imperative to have a verbal assent script as it is agreed by the speech pathologist, the classroom teachers and myself that our students do not have the literacy levels to access a written consent/assent form.

The following will be read to the potential participants by their classroom teacher:

When Matt comes to your class you play video /computer games.

You play games with your friends in class.

We play videogames in class to help you practise working as a team.

When you play games together, Matt and Jenny are in the classroom.

Matt and Jenny help you to think about how to play games together.

Matt would like to use a video camera to record how you play together.

Matt wants to record you to help people understand how kids play games together. This is part of his research at University. A University is like a big school for grown-ups.

Research is where you find out something by looking at it carefully (investigating).

When Matt records you playing games there might be some other people in the room from the University.

People from the University might help Matt get the video camera ready.

You can choose to be recorded (say yes) or not (say no).

You will play the games with Matt if you say yes or no.

If you feel sad or worried about the camera you can tell Matt. Matt will turn off the camera.

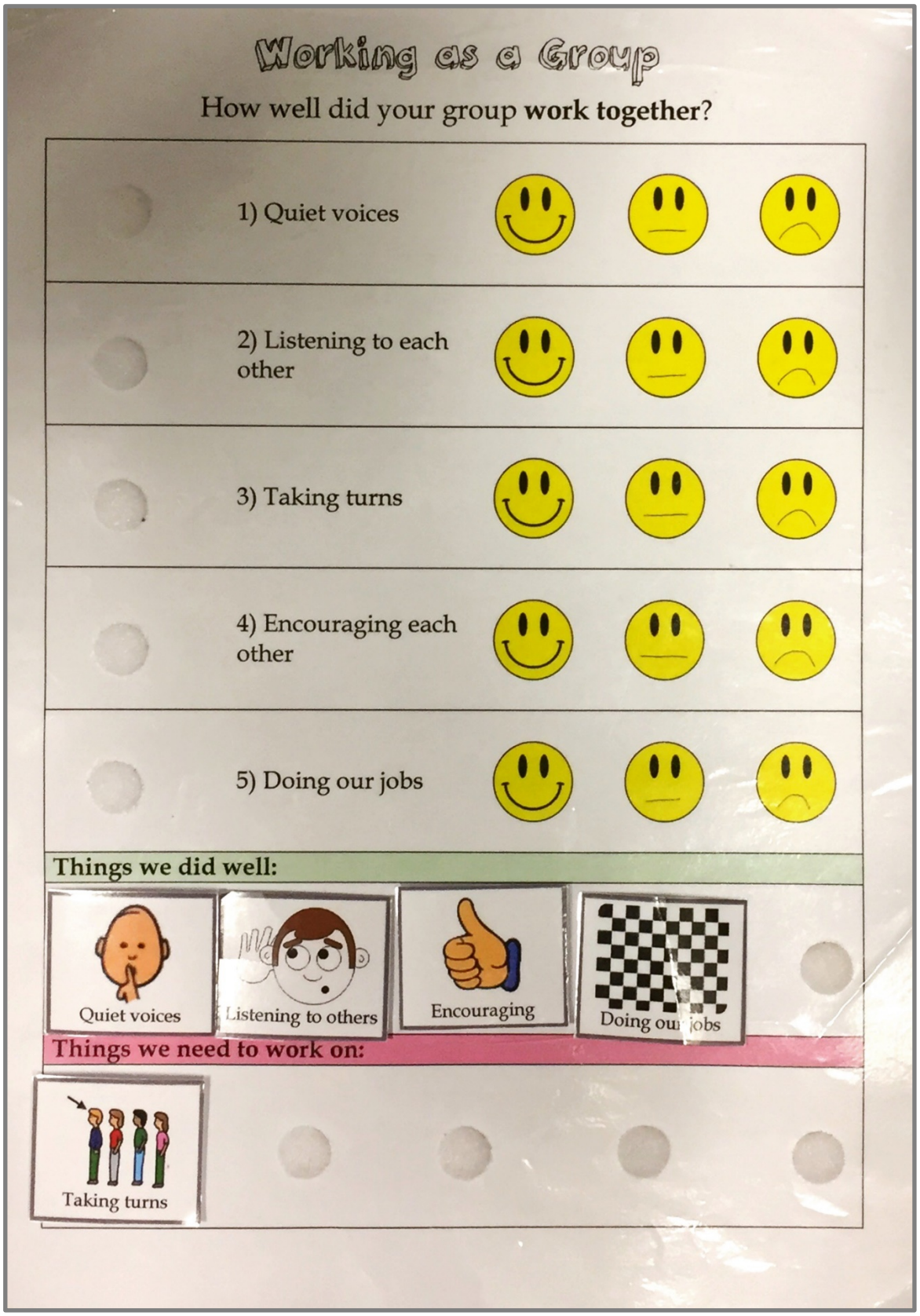
Matt will do lots of writing/write a report about when you play the game together. Matt will not let people see your names or your school name.

Matt and his teachers (Natasha and David) will see the video. The video will be deleted after five years.

Appendix H: Visual sticker chart used to track individual goals and performance of skills (Stages B and C).



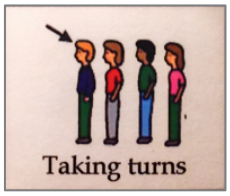
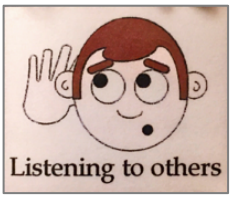
*Appendix I: Original 'Reflecting on our play' chart for students (**Stage C**).*

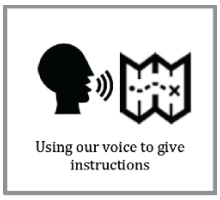
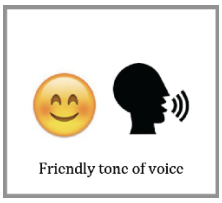


*Appendix J: Revised 'Reflecting on our play' chart for students (**Stage C**).*



Appendix K: All 15 focus social skills coded in the post-data generation coding.

		Skill definition (not used with students):	**Indicative behaviour** (for coding instance of skill application):
Skill 1		➢ Making sure that everyone has a fair turn. ❓ Waiting for your turn to play the game. ❓ Telling your friends that they can choose where to go in the game.	🔍 Voluntarily verbally or physically offering to relinquish control to another player. 🔍 Verbally communicating that other players can make a decision.
Skill 2		➢ Thinking about what someone else has said. ❓ Waiting for someone else to finish talking before you talk. ❓ Letting the other person know you have heard them.	🔍 Verbally or physically acknowledging that the student heard their peer. 🔍 Changing actions in the game to comply with their peer.
Skill 3		➢ Help everyone to feel good about themselves. ❓ If they are playing well, tell them they are doing well. ❓ If they are not playing well, tell them to keep trying.	🔍 Making a positive comment about the performance of a player. 🔍 Verbally reassuring a player when they make a mistake.
Skill 4		➢ Use a volume of voice so that everyone can hear, but also does not hurt anyone's ears. ❓ If someone is making you feel upset, use the timeout card to pause the game.	🔍 Student is using a volume that allows other students to be heard.
Skill 5		➢ Trying your best to help your team finish the game. ❓ Think about how you can work towards the team goal.	🔍 Playing the game while attempting to accomplish the team goal.
Skill 6		➢ Ask another person for help. ❓ If you don't know what to do or how to do something, you should ask for help. ❓ You can use your voice or a help card.	🔍 Verbally communicating to another player or the group that they need help with the mechanics of the game. 🔍 Picking up the help card.

Skill 7		➢ If you see someone doing something wrong or not moving, you can offer them help. ❓ You can use your voice to offer them help.	🔍 Asking another player or the group if they need assistance with the mechanics of the game. 🔍 Physically communicating to another player that they can help them.
Skill 8		➢ Using your voice to tell the other players to do something. ❓ Other players cannot read your mind, so you need to tell them using words.	🔍 Verbally communicating instructions to another player or the group.
Skill 9		➢ Asking the other players for ideas or suggestions. ❓ If you get to a puzzle or all the players are stuck, you can ask the other players as they might have an idea.	🔍 Verbally requesting from an individual or the group a solution to a novel puzzle or challenge within the game.
Skill 10		➢ Using a friendly tone of voice to help the other players feel comfortable. ❓ Take a deep breath and then speak slowly and keep your voice at the same volume.	🔍 Using a lower pitch and a slower pace of voice when speaking, while smiling when appropriate.
Skill 11	Sharing task information *(No visual)*	➢ Communicating to the other players how to play the game, solve a problem or information about a goal.	🔍 Verbally informing another player about the rules or mechanics of the game, or the team goal.
Skill 12	Requesting task information *(No visual)*	➢ Asking the other players how to play the game, solve a problem or information about a goal.	🔍 A question directed from one player to another player or the group about the rules or mechanics of the game, or the team goal.
Skill 13	Providing performance feedback *(No visual)*	➢ Evaluating their own or another player's performance. This can be performance within the game or application of social skills within the physical environment.	🔍 One player verbally communicating to another player or the group their perceptions of an individual or the team's level of performance, either within the game or in using the social skills.

Skill 14	Requesting performance feedback *(No visual)*	➢ Asking the other players to evaluate their own or another player's performance.	🔍 One player verbally asking another player or the group for feedback on performance (for example, "How am I going?").
Skill 15	Giving non-verbal instructions *(No visual)*	➢ Using body language or gestures to instruct another player.	🔍 Pointing at the screen or to the controller with a hand, head or foot gesture.

Appendix L: Illustrative examples and non-examples of each targeted social skill.

	Skill example	Skill non-example
Skill 1: Taking turns	✓ Player A independently telling another player that they can choose where to go in the game.	☒ Player A passing the controller to another player when instructed to do so by a member of the teaching staff.
Skill 2: Listening to others	✓ Player A asking a follow up question or making a comment about something that another player has said.	☒ Player A speaking after another player has spoken about a different topic.
Skill 3: Encouraging	✓ Player A telling another player they are performing their role well.	☒ Player A saying that they like another player *(not game related)*.
Skill 4: Quiet voices	✓ Player A using the timeout card to ask other players to stop talking so they can say something using their normal volume voice.	☒ Player A not speaking to the other players.
Skill 5: Doing our jobs	✓ Player A trying to follow the instructions of other players and attempting to make progress in the game.	☒ Player A putting their controller on the ground.
Skill 6: Asking for help	✓ Player A asking Player B for help with learning the controls of the game *(asking one specific player)*.	☒ Player A asking the group the best way to solve a puzzle *(addressed to whole team)*.
Skill 7: Offering help	✓ Player A using their voice to offer Player B help learning the controls of the game *(addressed to one specific player)*.	☒ Player A telling Player B they are not good at the game.
Skill 8: Using our voice to give instructions	✓ Player A verbally telling Player B what they need to do to make progress in the game *(mechanics of play focused)*.	☒ Player A taking the controller from Player B.
Skill 9: Asking your friends for ideas	✓ Player A asking the group the best way to solve a puzzle *(addressed to whole team)*.	☒ Player A asking Player B for help with learning the controls of the game *(asking one specific player)*.
Skill 10: Friendly tone of voice	✓ Player A using a friendly tone of voice *(culturally subjective)*.	☒ Player B using an aggressive tone of voice *(culturally subjective)*.

Skill 11: Sharing task information	✓ Player A communicating (verbally or non-verbally) to the group that the players should move towards the top of the level to find the exit *(goal setting)*.	☒ Player A verbally telling Player B what they need to do to make progress in the game *(mechanics of play focused)*.
Skill 12: Requesting task information	✓ Player A asking the other players information about where to find the exit for the level *(goal clarification)*.	☒ Player A asking Player B for a turn to player the game.
Skill 13: Providing performance feedback	✓ Player A telling Player B that they need to jump across the platforms faster *(performance focused)*.	☒ Player A communicating (verbally or non-verbally) to the group that the players should move towards the top of the level to find the exit *(goal setting)*.
Skill 14: Requesting performance feedback	✓ Player A asking Player B whether they were faster than other players opening all of the doors *(performance focused)*.	☒ Player A asking the other players information about where to find the exit for the level *(goal clarification)*.
Skill 15: Giving non-verbal instructions	✓ Player A pointing to a secret area.	☒ Player A reaching for Player B's controller because they want a turn now.

Appendix M: Summary of recommendations for scaffolding and nurturing the development of the targeted skills.

Recommendations for supporting participation

1. As a prerequisite for the use of all social skills, educators should be strategic in selecting games that guide players towards working together to complete the team goals.
2. Educators should guide players to discuss their role and the roles of their peers within the team prior to gameplay or during time-out breaks.
3. Specialised terminology for each role needs to be practised and modelled by the teacher prior to every session of play.

Recommendations for supporting students to consider fairness and multiple perspectives

4. Students need to be explicitly taught the contextual rules for recognising when another student might want a turn.
5. The functional limitations of games, such as a limited number of players or power-ups, should be used as a context for discussions of fairness from multiple peoples' perspectives.
6. When players are required to take turns within the game, educators can support waiting expert players in coaching novice players and highlight the importance of all players in achieving the team goal.

Recommendations for supporting students to recognise when to give instructions and share information

7. Educators should use slower-paced tutorial levels to coach players in recognising when and how to provide instructions and share information with peers.
8. Peer-mediated instruction can be introduced to position expert players as mentors, with educators providing close support to the mentor in checking for understanding and modifying their language.
9. Educators should model their internal cognitive processes aloud, guiding students through the steps for checking for understanding.

Teaching recommendations for creating environments for constructive communication

10. Students should be prompted to provide a verbal acknowledgement if they have recognised that someone is attempting to communicate with them.
11. Educators should focus on modelling and encouraging a friendly tone during skill instruction, time-out breaks and the group reflection but prioritise 'quiet voices' during gameplay.
12. Regular time-out breaks allow educators to support students in regulating their emotional states and planning their verbal communication in advance.

Teaching recommendations for drawing upon individual and collective expertise

13. Educators need to make explicit connections between the collective knowledge of the team and group success.

14. Footage of contexts in which the players appear stuck should be replayed to highlight indicators that, individually, players might not have the solution to a problem.

15. Teaching staff should model their own processes by 'thinking aloud' about having insufficient knowledge to solve a problem, and then modelling the language used to obtain this knowledge from other players.

Teaching recommendations for supporting participation

16. Educators should positively reinforce instances of students acknowledging the successes of others, encouraging them to link their positive performance feedback to the specific actions of their peers.

17. The language for providing constructive feedback needs to be taught and modelled explicitly, with regular breaks during play for rehearsing the required language to express and receive feedback.

18. Examples of more complex forms of feedback should be highlighted during video review, with this feedback being positioned as essential for effective teamwork and achieving success in the game.