GAME-BASED LEARNING PRACTICES AND STUDENTS' DISCURSIVE PSYCHOLOGICAL PRODUCTION OF MEANING

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No compulsory learning can remain in the soul . . . In teaching children, train them by a kind of game, and you will be able to see more clearly the natural bent of each. (Plato, 1943, cited in Malone, 1981)

Abstract

Games are promoted as a classroom learning tool. A considerable literature suggests that games increase student motivation to persevere with their learning. Few studies have explored student agency when using games in the sociocultural space of the school classroom. Existing empirical evidence from studies of digital games used in schools cite increased retention of conceptual knowledge, with claims that such digital games are fun for students and are stealth learning tools that can 'sneak in learning' on the teacher's behalf. Missing from the existing literature is the considered sociocultural student experience of games and a teacher's' reasons for selecting specific games as classroom pedagogy.

The effectiveness of games needs to be empirically researched to provide an understanding of student and teacher practices with games, beyond being labeled fun. As a teacher I saw a range of benefits for students when using games during classroom experiences, including increased confidence with content knowledge. Students' and teachers' practices with games needed to be explored to inform practice and policy. The following research question guided this thesis; How do game-based learning experiences contribute to student perception of self as a learner?

There is little empirical research focused on how students carry their actions within site-based performances. Employing a methodology informed by discursive psychology, this study used positioning theory to analyse the teachers' and students' fine-grained accounts of their use of different games. Participants reported a range of practices supported by the games involved. Further, underpinned by practice theory, the participants' accounts suggested that these games offered ontological sites that supported meaning making, the reclamation of agency, and the recovery of change for both students and teachers.

The thesis provides insight into the nature of being (ontology) of game-based learning experiences from the perspective of the students and teachers in the study schools. The student and teacher accounts of iPad mathematics applications, Lego Robotics, and Gamemaker: Studio are presented as case studies in a critical realist analysis of the influence of digital games in educational agency and change in schools. Discursive psychology is particularly suited to research conducted in schools as it attends to in-the-moment meaning making that builds domain knowledge between teachers, students, and artefacts.

The three empirical case studies presented in this thesis explore the curriculum-making experiences of teachers and students as an agential enactment of their practical intelligence. Insights gained through the analysis of the students' reflections included their explicit understanding of content knowledge and 21c skills. The reflections illuminate that in game actions support students' ability to describe their learning as both a process and product, within the sociocultural space of their classroom lives.

My contribution to new knowledge includes the construction of a theoretical framework that considers classroom interactions as located in dynamic sociocultural settings. The cogenerated interview data was analysed to attend to the agency of participants in this research and is reflective of the agency students and teachers enact in classroom activities when using games. This discursive psychological approach supported the analysis of the site-based learning practices using digital games. The analysis of the data has supported a new way of thinking about the pedagogy of game-based learning experiences as a practice site where students make connections to domain knowledge and make meaning as agentive learners with valued skills.

Declaration

This is to certify that

- this thesis comprises only my original work towards the degree of Doctor of Philosophy;
- due acknowledgment has been made in the text to all other material used;
- the thesis is fewer than 100,000 words, exclusive of tables, figures, reference list, and appendices.

Fiona Trapani

Preface

Copyediting support was provided in the final stages of drafting of this thesis by Pamela Firth, who worked in accordance with the Australian Standards of Editing practice. Such support did not include any alterations to the content of the thesis and was provided with the knowledge of the current University of Melbourne Graduate Research Training Policy (MPF1321)- Editing of thesis by third parties.

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List of Abbreviations

21c	21st century
DET	Department of Education and Training
HEAG	Human Ethics Advisory Group
IT	information technology
ITS	Information Technology Systems
IDPE	investigate, design, produce, evaluate
MAD	Making a Difference
NAPLAN	National Assessment Program—Literacy and Numeracy
PMM	personal meaning making
ZPD	zone of proximal development

Part 1

This thesis is presented in two parts. Part 1 introduces the nature of this empirical study. It begins with an overview of the study and the research questions. Next, the key terms and theoretical frameworks are outlined to establish the context and scope of this thesis. My position as a teacher, teacher educator, and researcher is shared to exemplify the social location and unique skillset I accessed to make a case for this research. The conceptualisation of students as active agents in their own learning is central to my work as a teacher and researcher; the theoretical frameworks that underpin the study are explored in Chapter 3. Part 1 concludes by detailing the research methods, introducing the students in the sample, and describing the school settings and game-based experiences under investigation.

Part 2 of the thesis presents the detailed findings across three data chapters. It begins with an introduction to support the reader to navigate the presentation of findings. Each data chapter is then presented through teacher and student narratives, which are analysed to expose the positioning and storylines of the game-based learning experiences from students' and teachers' perspectives. The discursive analysis within the data chapters is then taken further in Chapter 8 to present an understanding of the students' agentive practices as a form of curriculum making when engaged in game-based learning experiences. The thesis concludes with a representation of the ontological site offered by game-based learning experiences and the implications this may hold for educational research and teachers and students in school settings.

Chapter 1: Introduction

1.1 Thesis Overview

Games are promoted as a classroom learning tool. A considerable literature suggests games increase students' motivation to persevere with their learning. Few studies have explored student agency in the use of games in the sociocultural space of the school classroom. Empirical evidence from studies of digital games used in schools cites increased retention of conceptual knowledge, with claims that such digital games are 'fun' for students and are 'stealth learning tools' that can 'sneak in learning' on the teacher's behalf. Missing from the literature is the considered sociocultural student experience of games and a teacher's reasons for selecting specific types of games as classroom pedagogy. This is problematic as games continue to be promoted in schools with little understanding of why they 'work' from a student perspective.

This gap in the literature is problematic as more schools and teachers promote the use of games in classrooms without understanding why games are powerful for the students. This study is both timely and important as it addresses the problem of providing highly differentiated activities for students as part of everyday teaching practice. In this thesis the student experience of game-based learning is shared through cogenerated dialogue, and analysed to reflect upon student agency.

As a teacher educator and researcher working across schools and university, I was well located to investigate the intelligence of practice amongst student and teacher users of three different game-based learning 'tools' in primary and secondary schools in Melbourne. I had used games across my teaching practice, and was always inquisitive as to why students responded so positively to learning activities presented as a game. I sought schools to study which were using games as part of their everyday classroom practice, and four schools responded to my invitation. I was not a teacher at these schools or of these students at the time of the research. The game-based learning experiences were sites occasioned for students by these schools and their teachers to transform the students' meaning making as learners.

This study is not a critique of game choice, pedagogy or learning retention. This study provides an analysis of positive uses of game-based learning experiences in everyday classrooms. The analysis exposes the nuances of existing practice in schools, to better understand why games are perceived to be a successful classroom activity. I am not aiming to present positive and negative accounts of game use, but to investigate the relationship which develops when games are implemented by teachers.

The students' and teachers' practices with games needed to be explored beyond teleoaffectivity. Little empirical research has focused on how students carry their actions within site-based performances. Employing a methodology informed by discursive psychology, this study used positioning theory (Harré & van Langenhove, 1999) to analyse the teachers' and students' fine-grained accounts of their use of different games. Participants reported a range of practices supported by the games involved. Further, underpinned by practice theory's fourfold classification of practices into practical understandings, rules, teleoaffective structures, and general understandings, participants' accounts suggested that the games used in school settings offered ontological sites that supported meaning making, the reclamation of agency, and the recovery of change in their learning as both students and teachers.

The thesis seeks to provide insight into the ontological nature of game-based learning experiences from students' and teachers' perspectives in the study schools. It is important to understand the role of student agency in the experience of game-based learning because if we understand the value students see in these interactions we may be able to harness these qualities in other pedagogical activities also. In this study the students' accounts of iPad mathematics applications, Lego Robotics, and GameMaker: Studio are presented as case studies in a critical realist analysis (Harvey, 2002; Scott & Bhaskar, 2015) of the influence of games software in educational agency and change in schools.

This ethnographic empirical study was guided by the overarching research question: How do game-based learning experiences contribute to student perception of self as a learner? The following subquestions provided guidance for further investigation:

- How do students identify and describe experiences of learning through games?
- Are there aspects of games which students identify that support them as learners?
- Why and how do teachers plan for their students' learning using game-based learning experiences?

To investigate these questions, I developed a methodology that embedded participants' agency as co-generators of practice. I suggest that the way we research classroom interactions needs to account for the sociocultural relationships that support learning. The theoretical frameworks that underpin the development of the research methods include Roberts' (1996) trialogue to visualise the interactions between teachers, students, and knowledge domains and Laurillard's (2009) collaborative model, which attends to the sociocultural nature of student interactions known to support classroom learning.

Co-constructed reflective dialogues of the students' and teachers' transactions with games software in specific concrete moments provided fine-grained perspectival accounts of their experiences. Student and teacher participants were invited to produce personal meaning-making maps (PMM maps) (Falk, Reinhard, Vernon, Bronnenkant, & Deans, 2007; Falk & Storksdieck, 2005) to describe their game-based learning experiences. The PMM maps were then used as the discussion point for Interview 1. Interview 2 with students used a game-like interview protocol, with sentence prompts delivered on dice. The prompts were written with attention to pronoun grammar to position the students' present, past, and future thinking about the knowledge and skills they encountered in the game. The students were agentive in this game-like interview, through rolling the paper dice and answering the prompts as they appeared.

The site dialogue was then analysed through positioning theory (Harré & van Langenhove, 1999; van Langenhove & Harré, 1999) and practice theory (Schatzki, 2010). This interpretive discourse analysis acknowledges participants' socially located selves within the school culture and their own biographies as learners. The varied nature of the game-based learning experiences is presented in the fine-grained discursive accounts of production of self and meaning making, allowing exploration of the dual social orders of practice, as in efficiency, for example, '**We** get better by the minute' (Jacob, Grade 3, PMM map), and honour, as in esteem, for example, 'The best thing about the game maker was when **I** had finished the whole thing and like seeing the write up and the sketches and the evaluation and then the game as well, really proud of **myself** after that' (Phoebe, Year 9, GameMaker: Studio, Transcript 5b; Lines 112–114).

The three different game types aimed to support students in their practice and development of specific and generic skills. Teachers implemented games that progressively developed the skills required of students. Younger students in the sample used iPad mathematics rote-learning games and game-based Lego Robotics to learn coding. Older students in the sample became creators of content through the production of new digital artefacts. All students in the sample were aware of the development of their own perceptions of learning in relation to their experiences. In each case, the practical intelligences described by the participants were used to interpret their emerging forms of praxis.

The thesis provides empirical evidence of the lived reality of students when using game-based learning software in their everyday educational context, giving a critical realist account of the site-based ontology of games. Evidence showed that the game types selected by teachers for classroom implementation supported students to access different age-appropriate outcomes. This productive use of games was expected, as games are promoted through educational policy. What my thesis offers is insights into the student experience which has not been articulated in previous research. I provide empirical evidence for teachers to more confidently implement games as pedagogy which may support students to access knowledge and skills related to topics of study and perhaps reflect on their own agency as learners.

Across all three game types, students described similar practical features. The students also projected future uses of the skills and knowledge developed through the games they used, suggesting that they valued game-based learning experiences to make meaning beyond the class use of the game. By identifying games in the everyday language of participants as 'tools' of human culture, the discursive accounts showed how students and teachers in their everyday semiotic transactions achieved a shared sociocultural meaning.

Students saw classroom game-based learning experiences as an agential opportunity to reclaim agency and recover change in their school education. In part, they did this by connecting their perceptions of success in the game with success in the school-based activity. Students also saw the game as a way to make the tacit, progressive teacher praxis explicit. The game offered dynamic conversational forms that students and teachers could use to further meaning making while rewarding and reinforcing success in learning pathways. In the conclusion, a call is made for further research that employs discursive psychology to attend to the relationships that form during concrete interactions between people and tools.

1.2 Outline of Thesis Chapters

Chapter 2 establishes the niche of my research in the wider literature landscape. I begin by defining the use of game-based experiences as a form of agentive and educative play in school environments. I establish the difference between two common terms in the literature—game-based learning and gamification—making a case for the use of the term game-based learning throughout my thesis. Emerging from the games literature, games in schools may be situated as socioconstructivist semiotic tools, which promote conversations and interactions between students and teachers to construct new knowledge. These games may be delivered in both analogue and digital formats to students. Teachers' intentions for game-based learning and their pedagogy with three specific game types are explored through the existing literature. The three different game types are rote-learning content with game-based learning experiences, games that promote content and wider skills for 21st century (21c) learners, and games as epistemic (real world) experiences for students. Motivational and agentive learning behaviours students may experience through game-based experiences are offered, problematising the space as there is little reflective evidence of students' experiences. Finally, the promotion of game-based learning in schools in Victoria is outlined. The need for empirical work that attends to the student experience as a site ontology of games is stated, and the extended research questions are presented.

Chapter 3 outlines the theoretical frameworks that guided development of the research methods and the data analysis in this research. The chapter begins with locating students and teachers as agentive beings in the sociocultural space of the classroom. I selected two theoretical models to situate the classroom as a sociocultural setting that occasions meaning making for students and their teachers. These are Roberts' (1996) trialogue, which depicts the discursive nature of meaning making in classrooms, and Laurillard's (2009) conversational framework, which develops the types of transactions that may be occasioned through classroom events. Meaning making in this context is interpreted through two further models: positioning theory (Harré & van Langenhove, 1999) and practice theory (Schatzki, 2010). Together, these four models supported the research methodology by attending to participants' agency while validating their reflections upon concrete moments during their game-based learning experiences.

Chapter 4 presents the research methodology used, including the instruments and site-specific methods used to co-generate the dialogical data. The ethics-approved research design and participant selection procedures are outlined. Samples of the PMM maps and interview questions are reported, and the participants' agentive nature in the co-generation of data is attended to. The analysis process for the data is explained. The research design's limitations and assumptions are also described. The chapter closes with an introduction to the sites, presenting the schools, games, students, and teachers in the sample.

Chapter 5 is the first of three findings and analysis chapters. The thematically organised findings of the Grade 1 teachers' and students' reflective dialogues about iPad mathematics applications as a rote-learning tool are presented. The pedagogy of the Grade 1 teacher Monique is shared, with her description of the games as an opportunity for students to show their 'learning in another form'. Students' reflections are then explored through the themes of learner behaviours, challenges, and anticipated future use of knowledge and skills. The data is then analysed using pronoun grammar and positioning theory (Harré & van Langenhove, 1999) and practice theory (Schatzki, 2010). Student storylines include in-game feedback and visible progress. The findings from this age group suggest that the use of game-based learning experiences for this age group goes beyond accessing a familiar skillset developed at home. Teleoaffective aspects of games included the immediate visible feedback and choices of increasing challenge as students progressed through levels of the game. This formed a common language where both students and teachers could make meaning about the students' mathematical concepts and skills.

In Chapter 6, the second of the three findings and analysis chapters, the Grade 3 students' Lego Robotics experience, is presented, using the same thematic headings as in Chapter 5 and the additional themes of identification of new knowledge and identification of 21c skills. The Grade 3 teacher Judith had planned to meet a range of 21c skills through the students building and programming their Lego robots. The student storylines analysed in this chapter include collaboration and problem-solving. Student and teacher reflections give insights into the complex transactions with the physical robots and digital software, which highlight student application of content knowledge from mathematics and their need to be cognitively engaged to solve problems. The meaning-making experiences for these students encompassed learning to code and supported their recognition of agency in a collaborative group.

Chapter 7, the last of the findings and analysis chapters, gives insight into the epistemic experiences of the Year 9 students who created their own digital games. Again, the themes of learner behaviour, identification of new knowledge, 21c skills, anticipated future use, and challenges guide the reader through the data analysis. Storylines of challenge, problem-solving, and pride in their work are explored. These 15-year-old students identified new knowledge of game design and programming, and expressed pride in their final game. When discussing their anticipated future use of coding and design, all three students hoped to use these skills again in their short- and long-term futures. While the project was only five weeks in duration, the skills they had learned affected the students' immediate meaning making as being successful learners in this project and on their longer term identity as citizens with skills valued in a 21c workplace.

Chapter 8 forms a discussion of the key findings, analysing them further through practice theory. There are two key contributions to new knowledge from this study. The first is the development of a research methodology that honours the sociocultural nature of students' classroom interactions and agency as learners. The second is the understanding of the game-based learning experience as a relationship with an ontological site, or a site of being. The students described their discursive relationship with the game and positioned the game as an interlocutor. The students reported on this relationship in positive ways, exhibiting cognitive connections, content understanding, and recognition of 21c skills in their reflections on learning. The game may be seen to represent a site that offers an asynchronous, shared meaning-making process for students and teachers. The practical intelligibility (personal understandings of interactions and expectations) of game use for students and teachers leads to a shared purpose to transform learning in classrooms.

Chapter 9 concludes the thesis. The key findings from the preceding chapters are synthesised to show how this research contributes to the teaching and research community. Contributions include that students saw the moral and affective experience of game use in classrooms as an agential opportunity for self-production. The game was a way for the tacit teacher praxis to become visible to students, setting a clear purpose, pathway, and language that students and teachers used to make meaning. This contribution builds on discursive psychology and moves research on student game use in classrooms beyond the cognitive–behaviourist model of learning to account for the individual's discursive development of self through concrete moments. A list of references and an appendix follow these chapters to complete the thesis.

This introductory chapter has given an overview of this study, including the problem of the existing assumptions about the reason for game-based learning experiences having a positive impact on student motivation in classrooms. The literature review and theoretical frameworks outline the need to not only identify the positive roles of games in classroom settings, but to tease out the relationships which occur between students, teachers and the games themselves. There was a need to develop research protocols which attended to student experience, and this study cogenerated reflective data through a personal meaning making map and interviews with the students and teachers. The data was then analysed and presented in three findings chapters, against the themes exposed in the literature review. The discussion and conclusion chapters include actions teachers may take to harness the positive use of games to help identify moments of learning and agency with students.

The chapters which follow detail the study outlined in this introduction to give a full account of my study and findings, with actionable suggestions for leveraging games as pedagogy in a classroom to enhance student agency. The next chapter provides a literature review of play, games and the Victorian educational landscape at the time of this study.

Chapter 2: Game-Based Practice in School Settings

The implementation of games as a learning tool is common in schools, yet there has been little research attending to student perceptions of their agency during learning when using games. My research sought to investigate students' perceptions of their learner agency during one of three game-based learning experiences. The strategy for accessing the literature reviewed in this chapter began by using key terms to search data bases, following up relevant references and using conference proceedings to research both the historical nature of games in education settings and current practices. This literature review is structured to begin with a definition of play as an expression of childhood agency. Games are situated as a specific type of play which are used as part of formal learning. The lack of understanding of the student perceptions of learning when using games is problematised in light of educational policy being developed which encourages the use of games without an understanding of why they are so successful for students. Literature pertaining to games as a classroom pedagogy is then discussed, and developed to lead to an understanding of the types of games which may support student agency as learners. This leads to a call for an understanding of the site offered by games to students in learning experiences to address the following research question: How do game-based learning experiences contribute to student perception of self as a learner?'.

In this chapter, I introduce games as a cultural tool in classroom settings, through the research into games as a learning tool. With the proliferation of digital games in the last 20 years, the definition and use of games in educational settings vary, beginning with research supporting the use of play and games in educational settings as learning experiences. I begin by using Bruner's (1983) definition of play as a cultural construct and a way of children expressing agency, which has been utilised in educational settings for over fifty years. I situate games as a specific type of play, understood across Western culture to have rules, goals, and regular feedback on progress. Research literature about the use of game-based learning experiences in educational settings is discussed, with a clear distinction drawn between the term ‘gamification’ and ‘game-based learning experience’.

Teacher and student perspectives of the affordances of game-based learning experiences found in the existing literature are then presented. Teachers consistently implement games in ways that support students as agential learners, with positive outcomes for students. The current literature focus on studies of teacher pedagogy and attributing student motivation and engagement when learning through game-based experiences is then discussed.

There is a semiotic space to be explored through the students’ discourse about learning with digital games that is not addressed by the current research into games as a learning tool. As researchers, we need to attend to student reflections upon their use of games as a learning tool, seeking to understand the contribution of games to learning beyond motivation and engagement. The ontological site of games is investigated to understand games as a tool that sustains meaning-making opportunities for students. I suggest that games need to be thought of more deeply than as a content delivery mode. I seek to better understand the ways students enact agency and build a learning relationship with the game to leverage sustained meaning-making opportunities.

The chapter closes by presenting the scope of this research, its aims, and the research questions guiding this study, with the students’ experiences of game-based learning the central focus of my research. Chapter 3 then explores the concept of agency and the sociocultural influences upon teacher and student expression of agency in classroom settings.

2.1 Defining Game-Based Experiences as a Form of Agentive Play

Play is a fundamental part of human experience in the world. Bruner (1983) concluded his exploration of play, thought, and language: 'Play under the control of the player gives to the child his first and most crucial opportunity to have the courage to think, to talk, and perhaps even to be himself' (p. 69). This section provides an understanding of play as an agentive act to situate the overarching research question: How do game-based learning experiences contribute to student perception of self as a learner?

In this statement, Bruner identified play as a vehicle for children to actively make meaning from their environment. He highlighted the importance of play in the development of a child's identity. That children may have courage to think and talk while immersed in play signifies an understanding of play as a safe exploratory context for children. When children control aspects of play they are expressing their agency. This agency through play supports children's cognitive, affective, and moral development. Play-based activities providing opportunities for children to enact agency include modelling, role play, and the use of structured games. Through these agentive actions, students make meaning of their sociocultural world and about their own emerging identity. Bruner validated play as a practical and purposeful activity vital to support children in learning to be themselves.

Bruner's words suggest that play is a natural learning process for children. We could substitute the word 'play' with 'learning' to get the following paraphrased quotation: '*Learning* under the control of the *learner* gives to the child their first and most crucial opportunity to have the courage to think, to talk, and perhaps even to be himself' (paraphrased Bruner, 1983, p. 69, emphasis added). This resonates with the use of play-based learning in a classroom, where play becomes a tool for both teachers and students to express different aspects of their agency as they make new meanings about themselves and their world. Agency is generally defined as the capacity of humans to interact within their environment to effect change. When we consider play and games, students may be provided with new opportunities to enact their learner agency in a classroom. Certainly access to games has changed since Bruner's time, and the types of games available to schools has also changed. What spans time is the effect of games on the motivation of children. The play based pedagogy which is being used currently in schools will be explained in section 2.1.3.

Agency is a core concept of my thesis. As a teacher, I endeavour to develop curricula that puts students at the centre of their own learning and supports them to be agentive. Games in my classroom are a successful pedagogy, as students seem to approach games with excitement and a feeling of potential success. Students' enthusiasm for game-based learning experiences has been documented for over fifty years in educational literature (Annetta, Minogue, Holmes, & Cheng, 2009; Hays, 2005). I believe that a student's opportunity for expressing agency as a learner through their game interactions may be one of the reasons that games are compelling when used as a classroom activity. The documented case studies include many of students increasing responsibility for their learning. We need to better understand the positive relationship that develops between a student and the game in the learning experience.

A 2012 research project commissioned by Victoria's Department of Education and Training (DET, n.d.-b) noted that game-based learning experiences support the following student behaviours:

> Most significant was the changing teacher/student relationship. The majority of teachers believed that using games in teaching and learning had led to a more student centred and student driven learning environment. Their role became one of facilitator, as their students took more responsibility for their own learning and

> as peer to peer teaching and collaborative learning increased markedly. (DET, n.d.-b, p. 3)

The student-centred nature of game-based pedagogy is noted to shift the focus of the classroom relationship. The games used in the DET research required students to collaborate with peers and move beyond simply consuming content. The game space supported students to take more responsibility for their learning through active work with peers. The students enacted their agency through these responsible behaviours in the classroom setting. This example highlights the positive learning behaviours that can support game-based learning; however, the students' experiences as they developed learning relationships with the game are absent from the research landscape.

The literature on game-based learning experiences over the last thirty years has repeatedly circled around the key ideas of engagement, challenge, and motivation. Since Malone's (1981) foundational thesis on games as intrinsically motivating instruction, research has continued to document that learning games are motivating because they allow students to transfer ideas about play and games into the classroom setting. While I agree that the familiarity of games is a support for students in classroom settings, I believe it is problematic to assume that this familiarity will automatically transfer to learning when games are used in the classroom. The purpose of the game for the students should be considered. The difference between the use of games as a leisure activity and games as a learning activity needs to be explored.

When used during leisure time, various forms of play may fulfil different purposes for players. Sutton-Smith (2001) referred to 'the ambiguity of play' as a theoretical summary of the purposes and patterns of play in society. The ambiguity referred to in this book's title implies that play is not a simple construct. The social use of play includes highly structured interactions that may lead to specific social and personal gains. The seven types of play, referred to by Sutton-Smith as the seven rhetorics, define the ways humans interact during leisure play, including structured sport, imaginative play, and solitary play. His account includes private and public play but does not consider educational games as we know them today. The ambiguity of play presented does not seem to account for the way play is used in classroom settings. While play in the world outside the classroom may be ambiguous, the types of play utilised in classroom game-based learning have clear purposes for teachers and students. The current pedagogy of play and teachers' reasons for their deliberate choice of game-based learning as pedagogy are discussed in Section 2.2.

While aspects of Sutton-Smith's (2001) rhetorics—for example, the use of private play—are applicable to the classroom, the purposes of play in educational settings are necessarily different. The implementation of game-based learning in classroom settings aligns with the concept of 'hard fun' (Papert, 2002, p. 1). Hard fun is when students cognitively engage in a problem-solving context through a game-based learning experience. More recent literature has morphed this concept of hard fun into the currently used terms 'serious play' and 'serious games' (Bedwell, Pavlas, Heyne, Lazzara, & Salas, 2012; Boyle, Connolly, & Hainey, 2011; Cohen, 2014; DET, n.d.-b; Dubbels, 2013; Kim, Park, & Baek, 2009; Landers, 2014). These concepts of serious play and serious games seek to legitimise the use of games that support students to address clear learning goals.

In the Victorian education system, this research literature has been used to develop educational policy. DET supports the implementation of a variety of serious games 'that are designed for a primary purpose other than pure engagement and in educational terms provide purposeful learning environment' (DET, n.d.-b, p. 5). The schools in my study were implementing serious game-based learning experiences as part of their everyday classroom programs.

Through acknowledging the purposes of play and serious games as learning tools in a classroom setting, teachers' implementation of pedagogy can now be considered. Dubbels (2016) addressed teacher pedagogy and play directly as a reaction to the increased culture of testing in Western schools. Play and games may contribute to an affective context for classroom learning through choice of content, clear rules, and outcomes and provide opportunities for self-assessment (Dubbels, 2013b, 2014). The ludic feeling, or fun feeling, that accompanies games is also noted as a positive aspect of play pedagogy for adults and students alike; in fact, it is recommended that the teacher also be playful in their approach to these classroom activities (Dubbels, 2013b).

From these varied understandings of the terms play and games, in this thesis, I research the use of serious games in classrooms. Throughout my thesis, I define play as a cultural tool, which may support a transfer of affective attributes to classroom learning. The types of games implemented in classroom settings have been signalled as different to the way students may play games in their leisure time. The use of serious games in classrooms is supported at both a policy and school level, with teachers developing their pedagogy to incorporate and leverage games as a learning tool. In referring to game use in classrooms, I deliberately chose to use the term game-based learning experiences over the alternate form of gamification. The next section outlines the distinction I apply to these terms in my thesis.

2.1.1 What is the difference between game-based learning and gamification?

Within the research literature, two commonly used terms to refer to game implementation in formal settings are game-based learning experiences and gamification. This section defines the difference I see between these terms and the parameters of the game-based learning experiences in my research.

The term gamification is not reflective of the nuanced way games are often used as learning tools in school settings (Klopfer, Osterweil, Groff, Haas, et al., 2009; Squire, n.d.; Whitton & Moseley, 2012). Gamification is often used by businesses and commercial enterprises as a way of structuring incentive-based behaviours and reward in a profit-driven environment (Dubbels, 2013, 2014; Giannakos, 2013; Landers, 2014; Watters, 2014), which is a different goal than that of game-based learning experiences in schools.

Some schools implement a form of gamification through their behaviour management systems, using points and rewards as incentives for positive learning behaviours in the school context. The focus of these rewards is students' compliancy in the school environment; however, whether gamification of behaviour management helps students to cognitively engage with their learning is uncertain. This type of gamification was not the focus of my study.

Instead, I explored specific game-based learning experiences (Dubbels, 2014; Giannakos, 2013) that teachers selected to support classroom learning, that is, pedagogical choices the teachers made to enhance the cognitive and affective engagement of their students with the content. I employ the term game-based learning experience in my thesis to describe the use of games as a student-centred classroom pedagogy.

Game-based learning experiences describe activities that in previous studies have been established as effective classroom pedagogy (All, Nuñez Castellar, & Van Looy, 2016; Annetta, Cheng, & Holmes, 2010; Malouf, 1988; S.-H. Wang & Wang, 2017). Teachers recognise that game-based learning experiences support students to engage with and persevere in their learning, apply content knowledge confidently, and meet challenges as they arise during game play. The reasons for this effectiveness may be better understood through consideration of games as offering a meaning making, or semiotic interaction, for students.

2.1.2 Situating games as socioconstructivist semiotic tools

The generally accepted reason for implementing game-based learning experiences is that more students will develop their skills than would occur through traditional teaching methods. The use of game-based learning experiences in classrooms may help students to be agentive and to make meaning about their world. It is intended that all classroom activities lead to this meaning making for students; however, games are noted by teachers to be particularly powerful in supporting more students to engage and make meaning from the experience (Annetta et al., 2009). It may be that the interaction within the socioconstructivist space afforded by games offers students a dynamic opportunity to make meaning.

This dynamic opportunity has been undermined by research that claims stealth learning is a feature of digital games (Shute, 2015; L. Wang, Shute, & Moore, 2015). As a teacher, teacher educator, and researcher, I understand that students who are supported to be agential in the process are more likely to engage with and retain new knowledge; students are less likely to acknowledge something they are unaware they have experienced. The everyday meaning making in a student-centred classroom is much less dramatic.

Implementing game-based learning experiences with students is not as simple as choosing any commercial game to use in the classroom (Marklund & Alkind, 2015, cited in Gauthier & Jenkinson, 2015). Students must also be supported to understand the educational value of their participation in the game. This is often easier with school-aged students. Studies of adults in higher education settings found that many adults were reluctant to engage with classwork presented as a digital game (Whitton, 2007a). This caution is important to note for all game audiences; even though games are popular across age groups and cultures, it is imperative to know the culture of your current classroom before attempting to implement serious games.

For the teacher to bring their own playful attitude to game-based learning experiences, they need support with time to prepare and to be confident with games as a pedagogical approach. This includes provision of explicit instruction as necessary, identifying learning goals and feeling comfortable in navigating when to teach and when to facilitate.

> Teachers need to have a certain amount of gaming literacy in order to actively supervise, support, and guide their students before, during, and after the play sessions. The teacher also needs to be proficient in setting up play sessions in a limited amount of preparation time and tackle eventual technical difficulties. Beyond these demands, teachers also need to serve as a conduit between the learning context and the play context, and need to know how to continuously contextualize game activities and the content that students experience in the subject matter being taught. (Marklund & Alkind, 2015, cited in Gauthier & Jenkinson, 2015, p. 359)

Research has often presented the use of digital games to support active meaning making by the student to construct knowledge, with Kimmons et al. (2011) describing; ‘Student engagement and self-recognition of progress and learning are important design factors when developing problem-based learning experiences’ (Kimmons et al., 2011, p. 341), and that games may support this meaning making process:

> Computer-based simulations and games . . . [are] used to support constructivist and socio constructivist learning, because they can be utilized to allow learners to experiment, problem solve, and role-play in settings that safely, inexpensively,

> and authentically replicate real-world scenarios in engaging ways. (Kimmons, Liu, Kang, & Santana, 2011, p. 342)

When students participate in a game-based learning experience, they can become cognitively involved to make meaning for themselves. The above quotations from Kimmons et al. (2011) resonates with Bruner's (1983) concept of play as a social and educational endeavour, presented at the beginning of this chapter.

Students' authentic involvement in real-world scenarios through digital games provides a different opportunity to make meaning and brings the real world into the classroom, allowing students to apply the knowledge and skills they are learning. This leads to games being theorised as semiotic tools suitable for classroom use (Gee, 2008; Taylor, 2012).

Game-based learning experiences provide specific opportunities for students to be active in their meaning making and subsequent learning (Gee, 2008; Scardamalia & Bereiter, 1993; Taylor, 2012; Zhang, Scardamalia, Lamon, Messina, & Reeve, 2007). Game-based learning experiences may help students develop content knowledge and additionally assist them to develop learner agency in the school context (Greenhow, Robelia, & Hughes, 2009). The way games are implemented into the student's authentic classroom may provide them with access to these semiotic domains and in doing so become aware of their own agency as learners.

The understanding offered above of student opportunities for agency and meaning making when using serious games in the classroom supports the exploration of how existing literature about games as a learning tool aligns with current education best practice.

2.1.3 Digital and analogue games as a learning tool

Games have been documented as a learning tool in schools for over fifty years (Annetta et al., 2009; Hays, 2005). The types of games available for classroom learning have changed since Bruner's work, however the experience of agency for students when using these games is the same. They are understood in society as goal- and rule-directed activities (Gee, 2003; McGonigal, 2011; Whitton & Moseley, 2012). When considered as a learning tool, the defining features of games, as described by McGonigal (2011), align with best practice learning pedagogy (Becker, 2009; Gee, 2008; Hattie, 2010; Squire, 2011a) in the following ways:

1. Games have a clear goal (McGonigal, 2011). In education settings, learning intentions are used to make the goal of the lesson clear for students (Hattie, 2010).

2. Games have rules and parameters that define the way goals can be met in a game (McGonigal, 2011). In education settings, teachers outline the success criteria for students to gauge their achievement of learning intentions (Becker, 2009).

3. Games have inbuilt feedback systems to allow players insight into progress and success towards meeting the game goals (McGonigal, 2011). In education settings, the main feedback mechanism may be the teacher, peers, or the self (Hattie, 2010).

4. Games require players to participate in a voluntary capacity (McGonigal, 2011). Using games as a learning tool can motivate and engage students to participate in the learning activity voluntarily (Gee, 2008; Squire, 2011a).

Games utilise these features whether they are presented in digital format or analogue (nondigital) formats. Games utilise the above features whether they have an educational purpose or not. Harnessing the above-listed features to promote student agency and participation in learning experiences has been widely documented as valuable for student engagement in their learning (Bourgonjon et al., 2013; Gee, 2011; Giannakos, 2013; Shaffer, Halverson, Squire, & Gee, 2005; Whitton & Moseley, 2012). This engagement equates to cognitive action and learning for the students. In the section that follows, I discuss research from game-based learning studies to highlight the gap in the literature around student and teacher use of game-based learning experiences.

Digital games are encompassed in literature about the proliferation of digital technologies in educational settings (Gee, 2007; Malone, 1981; Razak & Connolly, 2013; Squire, 2008; Whitton, 2007b). The use of portable devices in classrooms has made digital games in classrooms more accessible (Newhouse, 2014). It is important to separate game-based learning experiences from the more general digital technology literature. This thesis focuses on the generic game features that may support students' perceptions of learner agency. Digital or analogue, the game-based learning experience itself aligns to current learning theory. While there may be different affordances of a game presented through digital media—for example, enhanced haptic, visual, and aural feedback—the four points above outline the basic learning scaffolding present in either game format. In this thesis, I do not compare digital or analogue game formats; instead, I explore students' experiences of three common types of game-based learning in classrooms.

2.1.4 Digital games and assessment

The use of digital games for assessment and feedback on student progress is another area of research (Gikandi & Morrow, 2016; X. Huang, Craig, Xie, Graesser, & Hu, 2016; Scardamalia, Bransford, Kozma, & Quellmalz, 2012; Shute, 2015). This body of research on game-based learning experiences has focused on the implementation of digital games, culminating in tests of student retention of content knowledge immediately after the experience (Apperley, 2014; Christoph, Sandberg, & Wielinga, 2004; Egenfeldt-Nielsen, 2006; Hung, Young, & Lin, 2013; Newhouse, 2014; Ritzhaupt, Poling, Frey, & Johnson, 2014; So, Seah, & Toh-Heng, 2010). Retention of content knowledge is one measure of learning, and these studies do not attend to the wider skillset that students may be required to develop in their schooling. This research is based on an input–output model of learning. The existing findings help us to understand the features of games that may lead to retention of knowledge. However, they also seek to evaluate digital games' capacity to teach, which discounts the many other possible influences on learning in the classroom environment, for example, teacher interactions, peers, prior knowledge, and any learning difficulties a student may have.

The types of games suitable for use in school classrooms include student-centred opportunities to interact with content. The most researched types of games support cognitive connections for the development of literacy skills (Apperley & Beavis, 2013). Similarly, student-centred games have been found to support student understanding in mathematics (X. Huang et al., 2016; Hung, Sun, & Yu, 2015; Maloy, Razzaq, & Edwards, 2014). In these areas of literacy and numeracy, the games are invariably rote or repetitive presentations of content for students to practise their skills. These types of games are most popular in lower primary classrooms, with basic letter and number facts practised independently with the game.

Studies of assessment through digital games have offered a range of metrics for teachers to document student progress and retention, but they have not sought to understand students' affective experience within the game-based activity. As a result, many of these studies offer a limited understanding of why these game-based learning experiences may be compelling for students.

2.1.5 Digital games and affective experience

Some studies have attended to students' affective experience of games. Examples of affective influences include motivation (W.-H. Huang, 2011; Malone, 1981; Malouf, 1988), flow (Dubbels, 2014; Hamari et al., 2016; Hung et al., 2015) and ludic (fun) moments (Dubbels, 2013a; Echeverría et al., 2011; Whitton & Moseley, 2012). As noted by Selwyn (2002, 2013), there is a distinct gap in the research literature seeking student voice and experience of learning with digital technologies and games.

A case study of teacher and student experiences of game-based learning sought to capture the interactions of students and teachers who used a commercial game, Oregon Trail, in an American History classroom at a rural school in the Midwestern United States. Watson et al. (2011) found that the use of the game over three lessons changed the classroom dynamic to a student-centred focus. The study highlighted the teacher's perception of the game as a learning tool for students. Watson et al. (2011) did not seek to assess student understanding of the content but to capture the teacher and student interactions of using the game as a learning experience. The teacher believed that the implementation of the game-based learning experience would engage students in the topic.

Watson et al. (2011) defined student excitement to interact with the game as engagement, but they did not address student cognitive engagement. The teacher documented the student-centred classroom dynamic during the use of the game, noting he could move around and interact with students at their point of need. In conclusion, Watson et al. (2011) confirmed three key theoretical traits of games that had been put forward by other researchers in the preceding decade: 'Video games can enhance student engagement, video games can promote a learner-centred learning environment, and teacher facilitation is an important part of effectively using video games in the classroom' (p. 473).

The patterns in Watson et al.'s (2011) study resonate with the literature to date, confirming the importance of teacher pedagogy in the implementation of game-based learning experiences (Annetta et al., 2010; Beavis, Muspratt, et al., 2015; Gee, 2008; Whitton & Moseley, 2012). Continued teacher facilitation of learning activities is part of teaching best practice and is a pattern of the effective implementation of game-based learning.

This section presented an understanding of the place of play in Western culture. Games were discussed as a specific form of play, with clear rules and outcomes, which may be used in schools. The use of games in school classrooms is a compelling pedagogy that provides opportunities for students to enact agency in their learning experiences. Students' affective experiences in game-based learning are undertheorised. This thesis seeks to identify and interrogate the cognitive, affective, and moral learning relationships between the student and the game space. The next section provides an overview of the pedagogy of teachers and the ways teachers plan for and implement game-based learning experiences in the classroom.

2.2 Games as Pedagogy

Teachers use game-based learning experiences in school settings because they see them as an effective way to engage students in their own learning. The reasons teachers give for the use of game-based learning usually begin with the identification of games as cultural artefacts that are familiar to the students. Teachers then identify the engagement, persistence, differentiation, and cognitive gains for their students. Teachers have a tacit knowledge that games are an effective classroom tool but are often unable to explain exactly what makes them so effective. This section develops a starting point to address the research question: Why and how do teachers plan for their students' learning using game-based learning experiences?

This section explores teachers' pedagogy when implementing different types of game-based learning experiences. Teachers plan the use of a variety of games across year levels in schools, with wide-ranging learning goals for students, including rote learning, collaborative problem-solving, and epistemic experiences. It also explores how teachers make cognitive learning goals accessible when students use games as a cultural artefact.

2.2.1 Teacher intentions for game-based learning

Over the last decade, research studies of game-based learning have acknowledged games as cultural artefacts that have spanned generations (Apperley & Beavis, 2013; Botturi & Loh, 2008; Bourgonjon et al., 2013; Giannakos, 2013; Hamari et al., 2016; Kafai & Burke, 2015; Ma & Williams, 2014; Pearce & Artemesia, 2009; Peppler & Kafai, 2009; Siko & Barbour, 2014; Stieler-Hunt & Jones, 2015; Williamson, 2009). Teachers recognise that students are familiar with games in their leisure time and seek to leverage game-based learning in classrooms (Gee, 2008; Squire, 2011a; Williamson, 2009). Using game-based learning experiences, teachers aim to make cognitive content of lessons accessible to students.

There are currently no digital games mandated for school use in Victoria. Teachers decide and manage the implementation of games at the classroom level within schools. It is important to note that teachers must access and critique the games themselves to align them with their own pedagogies to support students' learning in an educational setting (DET, n.d.-b.; Klopfer, Osterweil, Groff, Hass, et al., 2009b; Laurillard, 2009; Sharaf & Musawi, 2012; Whitton & Moseley, 2012). A teacher's perception of the potential effectiveness of games in their classroom will influence the types of games and pedagogical approaches of the teacher and, indeed, if games are implemented as a pedagogy at all.

Teachers who implement game-based pedagogies perceive that using game-based learning adds value to the student experience (Giannakos, 2013) beyond motivation and engagement. One oft-noted value is that games can assist with differentiation of learning tasks in a mixed-ability classroom (Arens & Hasselhorn, 2015; Fullan & Langworthy, 2014; Redman & Trapani, 2012b; van Dijk, Eysink, & de Jong, 2016). For example, this may include the student's ability to choose aspects of the game to support their learning, personalising their experience (Hamlen, 2011; van Dijk et al., 2016). Or it may be that the game is adaptive, meaning it is programmed to adjust the level of challenge in response to the student's performance in the game (Fullan & Langworthy, 2014; Griff & Matter, 2013; Lehmann, Hahnlein, & Ifenthaler, 2014). These examples illustrate teachers are aware that game-based learning experiences can support differentiation by students in their own learning. Teachers are confident in using the adaptive aspects of games to add value to students' learning experiences.

Teachers may leverage the adaptive features of games to provide data about their students' cognitive progress. One common area of research highlights the use of games and digital technologies as stealth assessment tools (Shute, 2011, 2015; L. Wang et al., 2015). I felt it was important to separate my study from this area of literature. The ways teachers and students used game-based learning experiences in this study focused on students being aware of the activities' learning intentions and actively reflecting on their learning in class, during and after the game.

In this study, teachers used game-based learning experiences as a deliberate and visible pedagogical approach. Across the literature, clear teacher instruction and student debriefing with reference to learning intentions and student progress are best practice for the successful implementation of game-based learning (Gee, 2008; Klopfer, Osterweil, Groff, Hass, et al., 2009a; Shaffer, 2006; Shaffer et al., 2005; Squire, 2011a; Whitton & Moseley, 2012). The students and teachers in this study were part of a classroom culture that supported regular reflective practice to evaluate progress throughout the game-based learning experience.

2.2.2 Teacher pedagogy for three specific game types

That games are a familiar cultural tool for students is only one reason for the continued implementation and development of games for classroom learning. This section details studies that have specifically addressed some of the most common ways teachers can leverage game-based learning in classrooms to assist their students in agentive actions and meaning making.

Teachers' pedagogy when implementing game-based learning is often tacit. This means that teachers may not be explicit about the pedagogical reason the game is being implemented. Teachers will associate the game with a concept or skill but will rarely detail their choice more clearly. This is understandable as the exact nature of how games may enhance students' learning is still being researched. Teachers will often play the games themselves to understand how they can support learning for their students. Teachers then develop a lesson or series of lessons with the game integrated into their students' experience. Importantly, the game in these classrooms is not the only pedagogy employed by teachers; the game forms part of the pedagogy used, supported by explicit teaching and other classwork.

The three specific types of games used in this study's classrooms included age-appropriate use of rote-learning games for Grade 1 students (6 to 7 years old), a small-group collaborative experience that harnessed 21c skills for Grade 3 students (8 to 9 years old), and an epistemic game design project for Year 9 students (14 to 15 years old). I now discuss each game type to show the key research that supports classroom use of these game types.

2.2.2.1 Rote-learning content with game-based learning experiences

The structured nature of games may be supportive of 5- to 8-year-old students when they begin to experience independent learning time. The use of games in literacy and numeracy as repetitive and rote-learning tasks has been widely documented (Meletiou-Mavrotheris & Prodromou, 2016; Rosas et al., 2003; Schacter et al., 2016) and endorsed by policy (CEM, 2013; DET, 2013). In studies of preservice teachers' projected use of games in their future praxis, a strong perception is that games are most useful as rote-learning tools (Redman & Trapani, 2012a; Tondeur, Pareja Roblin, van Braak, Voogt, & Prestridge, 2016). This may be due to preservice teachers' experiences of seeing games used in this way in current classrooms. It is evident in the literature that the use of such games is understood to be supportive of students learning foundation literacy and numeracy skills.

Students are given rote- and repetitive-learning tasks to help build skills and confidence in the content (DET, 2013). In a study of game-based learning with Scottish primary school students, Razak and Connolly (2013) compared student participation in a game-based mathematics activity with a similar activity that did not use a game-based approach. They found that student engagement and learning of times tables were slightly increased in the game-based experience. Razak and Connolly (2013) concluded that this increase in student ability could have been due to the variety of different times table questions offered within the game, as the comparison class were required to participate in memorisation of times tables. Razak and Connelly (2013) also noted that teacher pedagogy when implementing the game-based experience may influence student learning.

2.2.2.2 Games promoting wider skills for 21st century learners

Teachers and researchers are aware of the wider opportunities for content and skill development that may be offered by game-based learning experiences (Annetta et al., 2010; Earp, Dagnino, Kiili, Kiili, & Whitton, 2013; Long, 2007; A. Miller, 2012; Torres, 2009; Yang, 2012). Such skills include peer collaboration, communication, and opportunities to solve problems. These opportunities shift students from process-oriented tasks, like repetitive rote-learning games, to assist students in developing skills for 21st century (21c) learning (Ingram, 2016). In the Lego Robotics game-based learning activity in this study, students were collaborative in all stages of the building and programming of the robots, including problem-solving.

When teachers implement game-based learning experiences as a collaborative tool, they seek to integrate both content knowledge and wider skills for their students. Game-based learning experiences that are designed to be used by small groups of students may promote teamwork and problem-solving skills (Earp et al., 2013; Meluso, Zheng, Spires, & Lester, 2012). These wider skills, which include communication, collaboration, and problem-solving, have been referred to as 21c skills (Dede, 2007; Scardamalia et al., 2012; Torres, 2009) and, more recently, enterprise skills (Ingram, 2016; The Foundation for Young Australians, 2016). In this thesis, I use the term 21c skills as this was the familiar term in use in schools during the 2012 to 2015 data generation period.

2.2.2.3 Games as epistemic experiences for students

The third type of game considered in my study was the implementation of game-based learning as an epistemic task. To define the game experience as epistemic, students need to explore and interact with the game to model the specific skills of working in that professional field. Epistemic game-based learning experiences combine an apprenticeship model of learning within a game-based experience (Gee, 2008; Klopfer, Osterweil, Groff, Haas, et al., 2009; Shaffer, 2006; Squire, 2008). Commercial and educational games offer these kinds of immersive epistemic experiences (Bielaczyc & Kapur, 2010; Klopfer, Osterweil, Groff, Hass, et al., 2009a; Tan & Seah, 2011; S.-H. Wang & Wang, 2016). The use of epistemic game-based experiences may be more appropriate in terms of content and roles for students in their later years of secondary education.

Epistemic games may be implemented into classrooms as a whole, or certain parts of the game may be used in different ways by the teachers and students (Klopfer, Osterweil, Groff, Haas, et al., 2009; Klopfer, Osterweil, Groff, Hass, et al., 2009b). In this way, the teacher may leverage the game as a gateway for students to experience aspects of real-world work through the game experience. Serious games may be implemented to help students understand the real-world work of scientists and mathematicians (Bielaczyc & Kapur, 2010) or the complexities of environmental advocacy (Squire, n.d.). Software specific to industry, like game development software, provides students with insight into the discourse and actions of commercial game designers (Games, 2009; Lim, 2008; Robertson & Howells, 2008). In my study, students used existing commercial games and software for epistemic design and programming experiences.

In summary of this subsection, with reference to the literature, the types of game-based learning experiences believed useful for students range from the basic, repetitive, rote style of game through to collaborative problem-solving games (Apperley & Beavis, 2013; Dede, 2009; Earp et al., 2013; Meluso et al., 2012). Teachers may leverage epistemic game-based learning experiences with older students (Bedwell et al., 2012; Landers, 2014).

In all cases, teachers validate their choice of games as pedagogy with reference to increased student engagement and successful progress in meaning making. Such increased engagement is ascribed to students being able to enact their agency within the game-based learning experience. Having agentive students who are aware of the skills and knowledge they are developing is an important part of developing the culture of learning expected in schools today. How do games support this agentive behaviour in students? What is the game to students? Section 2.3 explores the current research about these questions.

2.3 Games to Support Learner Agency

This section presents the background research giving insight into students as agentive learners. It begins with a broad understanding of play and games as motivational tools for students, followed by a consideration of student perceptions of motivation and engagement as affective domains to summarise current understandings of student enactment of learner agency in classroom settings. Finally, the concept of authenticity of game-based learning tasks is considered from the student viewpoint within the classroom setting. This section provides literature to situate the research question: How do students identify and describe experiences of learning through games?

2.3.1 Games and persistence

> Even the obstacles that we set up in play in order to surmount them give us pleasure in doing so. Indeed, the obstacles seem necessary, for without them the child quickly becomes bored. (Bruner, 1983, p. 61)

One of the commonly quoted reasons for using game-based learning in educational environments is that students will often persevere with a problem in a game longer than they would otherwise do (Annetta et al., 2010; W.-H. Huang, 2011; Lawlor, Marshall, & Tangney, 2015; Malouf, 1988; Olson, 2010). This phenomenon is not new. Bruner (1983) in the quotation above highlights that an obstacle, or challenge, is an expected and enjoyable feature of play for children. He noted that the outcome of such play is a child who is ‘frustration proof’ (p. 64). Today, the terms resilient, persistent, or perhaps intrinsically motivated are used to further describe the desirable frustration proof qualities of lifelong learners.

As we saw in Section 2.2, teachers are aware of how a range of wider knowledge and skills can be developed through game-based learning. Yet to be considered in this literature review is the use of games to invite students to be agentive in their learning. As a form of activity-based learning, games bring with them clear rules, goal structures, and outcomes (see Section 2.1.3, Digital and Analogue Games as a Learning Tool). Let us now consider research about active learner behaviours when using game-based learning to highlight the areas that may direct further research.

2.3.2 Student motivation in game-based learning experiences

Students are more likely to engage with a game as a learning tool (Beavis, Muspratt, & Thompson, 2015; Malouf, 1988; Peppler & Kafai, 2009; Squire, 2011a). Games are understood in this study as a familiar cultural tool (Bruner, 1996) in students’ lives outside of school, and that the generic features of games may be more easily transferred by students into classroom interactions (Amory, Naicker, Vincent, & Adams, 1999; Bourgonjon et al., 2013; Lacasa, Méndez, & Martínez, 2008). This section outlines additional reasons students may be motivated to engage with game-based learning experiences.

Teachers leverage both intrinsic and extrinsic motivational tools in their classroom praxis to support students in their learning. As part of a suite of pedagogies, games have long been noted as a useful intrinsic and extrinsic motivator (Annetta et al., 2010; Hays, 2005; Whitton & Moseley, 2012). This understanding is underpinned by the meta-analyses of research from the area of educational psychology (Deci, Koestner, & Ryan, 2001). Teachers understand intrinsic motivation to be more effective than the long-term use of extrinsic motivation. The emerging understandings of the pedagogy of play (Dubbels, 2014) highlights play and games as a support for both intrinsic and extrinsic motivation for learning. The use of pedagogies that make learning visible for students may also support intrinsic motivation to promote learner agency and self-efficacy for learning.

2.3.3 History of research linking games and motivation

Research that has sought to measure motivation in school students began with Malone's (1981) seminal study of digital games in a classroom. Malone's work is the foundation of many digital game studies as he investigated the intrinsically motivating features of interactive computer games. The methodology Malone implemented asked elementary-aged students to rate a list of digital games they were using in class that focused on numeracy and literacy skills. He also interviewed a percentage of the students about their ranking.

Malone's findings highlighted the aspects of educational games that made them fun for students, notably, challenge, curiosity, uncertainty of success, and variable difficulty levels. He sought to identify the motivational features of digital games to implement them into other learning environments. Malone's work is often quoted in the further development of digital games, carrying his assumptions of motivational features through to new generations of children. This may be problematic, as the types of games available, and used in education settings, have changed. The reasons games are motivating are still not well understood in the literature.

Further research into game-based learning in educational settings over the last 10 years include teacher and student game use in elementary and secondary schools (Cameron & Bennett, 2010; Hamlen, 2011; L. M. Miller, Chang, Wang, Beier, & Klisch, 2011; Rosas et al., 2003; Sung & Hwang, 2013; Watson et al., 2011). The construct of learner motivation has been defined in different ways across these studies, with a student's likelihood of persistence with the task (game or digital game) in the face of a challenge consistently cited. Few studies have sought students' voice to discuss their perceptions of learning when using games (Watson et al., 2011), with many studies using survey data and test scores to determine patterns of motivation after task completion.

In some studies, student motivation and longer term engagement in the game has been attributed to the use of competitive game elements (Hromek & Roffey, 2009; Hung et al., 2013). For example, a study of Grade 6 language students in Taiwan highlighted the need to provide challenge through the use of competitive game strategies (Hung et al., 2013). While competition is an important aspect of games and sports, in my study, the competitive element of games was not the focus for the teachers involved. Instead, the use of game-based learning sought either individual progress or group collaboration as a way of harnessing intrinsic motivation.

The range of research that has considered specific aspects of activities that could tap into student motivation to participate in games as learning experiences comes from many fields, including psychology (Boyle et al., 2011; Olson, 2010), neuroscience (P. Howard-Jones, 2008; P. A. Howard-Jones, Demetriou, Bogacz, Yoo, & Leonards, 2011; Sharples & Kelley, 2015; Toshalis & Nakkula, 2012; Tytler, 2013; Willis, 2011), and of course elementary, secondary, and tertiary education (All et al., 2016; Annetta et al., 2009; Erhel & Jamet, 2013; W.-H. Huang, 2011; Toshalis & Nakkula, 2012; Whitton, 2007a; Whitton & Moseley, 2012; Yang, 2012). Across these settings, student interactions within the game may encompass various low-risk activities, making the learning environment a safe place to fail and try again (Clifford, 1988; McGonigal, 2011; Squire, 2011a). How does academic risk taking influence students' motivational learning behaviours? This phenomenon has been the topic of research since the 1980s.

Games may inspire persistence and motivation because they are perceived by students to be a low-risk academic activity (Annetta et al., 2010; Hung et al., 2015; Kafai & Burke, 2015; Werner & Denning, 2009). Students' ability to be 'frustration proof' (Bruner, 1983, p. 64) when playing games may also be attributed to the game being perceived as a low-risk academic environment. To better understand what is meant by the phrase low-risk academic environment, it may be helpful to consider two foundation research studies by Clifford (1988) and Clifford and Chou (1991).

While the exact predictors of the qualities of games that will lead to student motivation are varied, some specific classroom environmental factors have been found to have negative impacts on students' class participation and learning motivation. Clifford (1988) used the terms failure tolerance (learning motivation) and academic risk taking (public participation in the classroom) to investigate gender and age differences in students' selection of mathematics, spelling, and vocabulary questions. Clifford found that, regardless of gender, students consistently attempted questions that were below their ability, leading to a successful completion between 77% and 92%. The tendency of students to complete tasks where they are certain of success gives insight into their perception of risk taking in the public classroom space. Students are often reluctant to attempt a problem in the public arena of the classroom. This makes the patterns of student engagement and persistence in game-based learning particularly notable.

One possible contributing factor of the success of games as pedagogy is that students have an additional way to interact with new content knowledge and skills. When students are invited to take part in a game, they understand they will be active participants in the proceedings (Lacasa et al., 2008). Students use the game-based learning experience to practise existing knowledge towards developing new knowledge (Issaieva, 2016; Nwokolo, Anemelu, & Queen, 2012; Resnick, Berg, & Eisenberg, 2000). They may exercise initiative (Wollny, Fay, & Urbach, 2016), make choices (Maloy et al., 2014), or select and meet challenges (Hung et al., 2015). While research has documented the patterns and impacts of students' actions with reference to learning outcomes, little research has sought to understand students' perceptions of themselves as learners during the implementation of game-based learning experiences.

This section highlighted pertinent studies that have explored the concept of motivation with reference to game use and educational settings. Games are beneficial to students to support their intrinsic motivation in classroom settings. A range of factors impact motivation including students' perception of risk in an activity or setting and the types of challenges students anticipate in the activity. These studies have considered the features of games that can influence students' engagement in the experience. To date, no literature has detailed students' affective perceptions of game-based learning experiences. Through this study, I aimed to better understand how students explain their learning during a game-based learning experience. I explored students' meaning making through the co-generation of dialogical data to understand their viewpoint about their learning when playing a game.

2.3.4 Student perception of learner agency in classroom settings

To understand how game-based learning experiences may enhance, complement, or otherwise support students in the classroom, we need an awareness of the kinds of experiences that we know support student agency in classrooms.

My research sought to contribute to a better understanding of how students perceive game-based learning experiences. Particular interactions in a classroom may be conducive for student learning. Literature concerning other factors that may influence student participation in classroom learning is now discussed. The factors that influence the expression of learner agency in a classroom setting fall into three main areas: student engagement, student affect, and student self-efficacy. Such factors may contribute to a student's perception of their own agency as learners in the classroom.

2.3.4.1 Facets of student engagement

Student engagement in school settings has been theorised as a 'multi-faceted construct' (Sullivan et al., 2009, p. 177) comprising three facets: behavioural engagement, emotional engagement, and cognitive engagement (Collie, Martin, Papworth, & Ginns, 2016; Kwah, Milne, Tsai, Goldman, & Plass, 2016; Sullivan et al., 2009). In a study of middle school students' engagement in an Australian rural school cluster, Sullivan et al. (2009) recognised that these three areas of engagement were connected to student opportunities for learning self-regulation. The combination of behavioural, emotional, and cognitive engagement was an important factor in students' positive participation and attitude towards the subjects (Sullivan et al., 2009). So, we see cognitive engagement as important in the classroom, but this cognitive aspect of engagement has not been investigated with reference to game-based learning experiences.

2.3.4.2 Student behavioural engagement

Student awareness of social support from teachers may also positively impact a student's affect (Schuitema, Peetsma, & van der Veen, 2016). Recognition of a positive teacher–student relationship may contribute to students' willingness to engage in classroom activities (Maulana, Opdenakker, & Bosker, 2013). This willingness to participate relates to the behavioural engagement actions a student may enact in a classroom setting. A student's perception of their relationship with peers and the social order of the classroom may also influence their affect in school settings (Collie et al., 2016). These teacher and peer relationships within classroom settings may influence student affect and impact student efficacy to enact behaviours that support them as a learner.

2.3.4.3 Student emotional engagement

It is well established that a student's emotional state influences their behavioural engagement in a classroom setting (Arens & Hasselhorn, 2015; Immordino-Yang & Damasio, 2007; Kayumova & Tippins, 2016; Owens, 1992; Scrimin, Mason, & Moscardino, 2014; Weidinger, Spinath, & Steinmayr, 2016; Zembylas, 2016). A student's emotional state, including self-confidence and motivation, is referred to as student affect. A student's affect in a school setting may be positively aided by student–teacher relationships (Maulana et al., 2013; Weidinger et al., 2016). This is another relationship where game-based learning may contribute towards a positive affect for the student.

2.3.4.4 Student efficacy as cognitive engagement

Student efficacy is another aspect of student self-perception documented to impact active learning behaviours, moments of applying content knowledge, and skills. Student efficacy may be measured by surveys (Issaieva, 2016; Meluso et al., 2012; Sung & Hwang, 2013) and may vary among subject areas (Meluso et al., 2012) or preference of technology use (Annetta et al., 2009; Sung & Hwang, 2013). This research focused on a student's agency as a learner to engage with the game-based learning experience. How a student enacts their efficacy when engaged with a game-based experience within the classroom may give insights into their actions and agency as a learner. The efficacy described here may also contribute to a student's willingness to engage with a game-based learning experience.

Game-based learning activities may provide an opportunity to support all three facets of engagement in the following ways: behavioural engagement includes visible active learner behaviours when the student interacts with the game, emotional engagement provides an opportunity for the student to invest themselves in affective interactions where they care about their success in the game, and cognitive engagement encompasses the student's self-efficacy displayed through a confidence that they will be successful in showing their learning through the game. In combination, these engagement behaviours when using the game may give insight into the student's agency as a learner.

In summary, teachers plan classroom experiences that support students to be agentive learners. The use of game-based experiences seems to support students to exhibit their agency as learners. Such pedagogy is similar to the task-based agency defined by Doyle (2015), where the classroom context was engineered to enable students to be agentive in their learning. Such interactions also align with Giddens (1991) concept of the 'reflexive self' (cited in Zhao & Biesta, 2012, p. 337), where student action is a result of their ongoing negotiation with the social context. By discussing students' perceptions of their learning when involved in game-based learning experiences, their reflection on themes of engagement and active learning behaviours may give insights into their learner agency in these experiences. Insights into the student's perception of

- their own learner behaviours;
- their identification of new knowledge and skills;
- wider 21c skills;
- anticipated future use of the knowledge and skills from the game; and
- their description of challenges during game play

were analysed to better understand the relationship between the game-based learning experience and the recognition of learner agency.

As evidenced throughout this literature review, a range of factors influence the student's learning experience. The school environment, teacher values, and expectations of student learning behaviours influence the types of learning experiences offered to students and their ability to be agentive. Section 2.4 presents the place of games in the local culture of this study's school settings in Melbourne, Victoria.

2.4 Game Use in Schools: Victoria, Australia

To generate data that contributes to new knowledge of how students make meaning through participation in game-based learning experiences, my research considered the practices in three school classrooms in Victoria, Australia. It is necessary to provide a description of the site where these practices take place. These practices are driven by state education policy and the professional standards for teachers. This section contributes to the problematising of the use of games in classrooms, as they offer little evidence of student perceptions of learning beyond the game being engaging and fun.

Game-based learning experiences are an encouraged pedagogical approach in schools across Victoria (CEM, n.d.; DET, n.d.-b). In a series of trials across Victorian schools, DET (n.d.-b) noted a range of positive learning behaviours exhibited in a variety of different game-based learning experiences, including increased quality of peer discussions, willingness to take academic risks, collaboration, and improved student confidence in directing their own learning. As in the research shared in Section 2.2.2, the particular nature of collaboration on student persistence in the game-based experience was noted by teachers in Victorian schools:

> One teacher felt that it was because 'the collaboration was authentic and in an interesting environment'. Teachers also believed it was leading more generally to greater student independence, better group work and improved communication and collaboration skills within their classroom. They were able to 'step back and allow the students to take ownership of their learning'. In a class using Serious Games, the students were now 'an enthused, engaged group. They help each

> other, get excited—high five each other when have successes—very positive relationships are being built'. (DET, n.d.-b, p. 24)

While the research literature demonstrates these themes of persistence, challenge seeking, and agency in learning, little pertains to the student's perception of their experience. Literature suggests that teachers value these particular uses of game-based learning; however, insights into the student's perception of the experience are lacking.

In my research, the schools' teachers had already planned the games. Initial data gathering documented five different game-based learning experiences. Of these, I chose three experiences as case studies that resonated closely with the ways games have been used in schools across the literature, selected to give further insights into commonly used game-based learning experiences in schools:

- Use of iPad mathematics applications for rote learning by Grade 1 students;
- Introduction to programming through the use of Lego Robotics kits with Grade 3 students; and
- Use of GameMaker: Studio to design and program digital games created by Year 9 students.

The game-based learning experiences in this study were clearly defined and aligned to students' educational outcomes. Teachers' intentions when planning game-based learning and students' perceptions when involved in game-based learning experiences were of interest. The analysis of students' reflections on their learning sought to theorise the impacts of these games on students' perceptions of learner agency in an educational setting. The thesis will contribute new knowledge through answering the final research question: Are there aspects of games which students identify that support them as learners?

2.5 Exploring the Site Ontology of Games

Collectively, the studies reviewed in this chapter identify a critical role for game-based learning experiences in a school context. Research across the variety of fields in this literature attests to something important happening when students engage with game-based learning. Teachers and students feel that games 'work', but there is an absence of explicit understanding of how games work as a learning tool. This becomes problematic as the assumptions of game-based learning are based on a variety of measures, including student test scores, stealth learning and teacher self-reports on student progress. Very few studies have sought to position the student as an agentive voice to give insight into why games may be useful from their perspective. In effect, though policy supports teachers use of game-based learning we need to better understand the student experience to gain insight into why these games are successful.

When considering the site ontology of games, the place of the game as a being the classroom is explored. The game may be understood as contributing to the storylines and lived experiences of the students and teachers. In this study the site ontology encompassed the practices and moral context of the school setting when using game-based learning experiences.

2.6 Aim and Research Questions

I aimed to explore students' awareness of learning content knowledge and 21c skills. The conversational data analysed in this thesis gives insights into the habits of interpretation, action, and belief that students have and apply when involved in game-based learning experiences. Next, I outline the aims and research questions that guided my study.

Through the consideration of the literature, the problem of not being able to identify why students might value and perceive game-based learning as successful, was brought to the fore. There is yet to be a study of the student's perception of their learner agency when experiencing game-based learning.

My research aimed to explore students' cognitive, affective, and moral understandings when using game-based learning experiences as part of their normal school activities and pedagogy planned by their teachers. It may be that the reasons for effectiveness given by students are different to those given by teachers, or that the games themselves may be considered as a contributor to the dynamic classroom learning relationships.

The research question guiding my study was 'How do game-based learning experiences contribute to student perception of self as a learner?' This was investigated through the following subquestions:

- How do students identify and describe experiences of learning through games?
- Are there aspects of games which students identify that support them as learners?
- Why and how do teachers plan for their students' learning using game-based learning experiences?

Through my research, I intended to contribute to the field in the following ways:

1. To provide a theoretical framework and research methodology that attends to the students and teachers as agentive co-contributors to this research;
2. To provide a working example of the application of positioning theory (Harré & van Langenhove, 1999) and practice theory (Schatzki, 2010) to explore the meaning-making relationships that may occur;

3. To provide an empirical research study that contributes to an understanding of students' cognitive, affective, and moral experiences as they engage with game-based learning pedagogy.

2.7 Summary

The literature review in this chapter sought to problematise game-based learning experiences as a potentially powerful but not well-understood pedagogy. I made a case for considering students' cognitive, affective, and moral experiences to inform the research of game-based learning experiences. Beyond stealth, it has not been well theorised why game-based learning experiences may be powerful pedagogy for students. Through this thesis I aim to theorise how game-based learning experiences support learner agency for students by exploring game-based learning as an ontological site.

From consideration of the literature, the following conclusions can be made:

- More students participate and persevere with problems in the game space. Students act in more positive agentive ways than in nongame scenarios. This may be to do with perceptions of themselves as learners when using game-based learning experiences.
- Teachers and researchers acknowledge game-based learning experiences as positive for students to engage with content and knowledge and to apply a wider skillset.
- Game-based learning experiences are flexible and adaptable across a range of digital and nondigital contexts.
- Teachers and students acknowledge games as more supportive of learning than other class activities, which may be understood through the students' perceived

risk, challenge, and success when undertaking game-based learning experiences.

- Game-based learning experiences can offer experiences from basic rote learning through to complex epistemic experiences that are not easily accessible in the traditional classroom. In all of these experiences, the students are active and aware of the semiotic space they have engaged with.

Game-based learning experiences may provide an opportunity for meaning making beyond the content by leveraging learning through play as human nature. These conclusions informed the development of this thesis, the research questions and the themes for analysis. They support an understanding of game-based learning experiences as providing opportunities for students to develop and express their learner agency. The next chapter presents a theoretical framework to attend to the complexity of classrooms as a sociocultural site.

Chapter 3: Theorising Agency as a Sociocultural Construct Within a Site

To answer the question 'How do game-based learning experiences contribute to student perception of self as a learner?' I needed to explore new ways of thinking about the relationship between games and the students in this context. The aim of this chapter is to provide the theoretical grounding I drew upon to better understand the site-based ontology of game-based learning experiences. My thesis situates the game-based learning experience as a site that may support students' agency within the sociocultural setting offered by the classroom. It may be through teachers offering experiences of games for students which provides them the opportunity to construct knowledge and exhibit agency in this sociocultural setting. By considering the game as a site, I argue, we will move towards better comprehending the contribution games seem to make to students' learning experiences.

To explore the idea of the game as a site, I drew upon over 20 years' of experience as a teacher, teacher educator, and researcher. In my experience, classrooms are sociocultural settings where students engage with a range of different activities to develop new knowledge and skills. Throughout this chapter, I develop a philosophical and theoretical position with respect to the research questions and methodology, drawing on the works of Harré and van Langenhove (1999) and Schatzki (2010), which may situate the game-based learning experience as a site that contributes to, and is constitutive of, students' agentive actions in their learning. By viewing the game-based learning experience as a site, it may be possible to understand why school-aged students are so willing to engage and persevere in these specific classroom activities.

This chapter has two sections to explain the importance of the moral and affective aspects of students' experiences. The first section operationalises the term *agency* as applied to teachers and students in a school setting. The second section theorises the school as a sociocultural setting through the lenses of Roberts' (1996) trialogue and Laurillard's (2009) conversational frameworks. After the game-based learning experience in the classroom, students' reflective dialogue was analysed using a combination of positioning theory (Harré & van Langenhove, 1999; van Langenhove & Harré, 1999) and practice theory (Schatzki, 2010). Positioning theory and pronoun grammar were used to analyse students' learning experiences of learning with games, while exploring how students position themselves and the games within the local moral order, which is the context for the moral space that influences their learning experiences. Practice theory built upon the positioning and educational theory to analyse the affective place of the game in the students' classroom interactions.

3.1 Agency in School Settings

This thesis presents a view of games as a site-based ontology to access what counts as student agency afforded by games. First, when considering the game as an ontological site, I refer to the game as a being, with a clear role within the site to support learners. It is necessary, then, to clarify what I mean by student agency in game-based learning experiences within the scope of this study. The student as an agentic being in the classroom is pivotal to understanding their actions and voice as a conscious participant in the site in negotiation with a dynamic, cultural tool.

To understand where current research falls short and why my research is important, I attend first in this chapter to students' agency, positioning, and expectations in schools. To do this, I begin with the conceptualisation of the school as an authentic sociocultural setting for students.

Schools are sociocultural settings, with teachers and students exercising or having the potential to exercise their agency. This is a location where students' everyday real-life academic, social, and cultural interactions take place. Teachers are charged with planning agentive interactions and experiences for students, occasioning opportunities for students to learn through activity-based experiences. This thesis considers each school's culture and setting as part of the analysis to better understand the opportunities for students to take up agentive roles in relation to the game-based learning experiences. How students take up these roles and make meaning from the experience is of interest in this thesis. First, let us consider what I mean by agency, then how agency may be realised by students in classroom settings.

3.1.1 Defining student and teacher agency in classroom experiences

A person may enact their agency through actions appropriate to the cultural setting in which they belong. Ratner (2000) defined agency as 'an intentional causal intervention in the world' (p. 413), which is affected by an individual's understanding of cultural norms. For example, in Western classrooms, hand raising is a common agentive behaviour, signalling a student's intention to speak during class. In another cultural setting, it may be inappropriate for a student to offer their contribution to a teacher-led class. Agency is not simply a reaction to a situation but is a considered set of behaviours an individual chooses to enact, and these actions will vary due to cultural location and personal understanding of norms or structures in place.

For Bhaskar (1979) agency has an unbreakable bond with structure (cited in Scott & Bhaskar, 2015). Together, the structure and agency dualism is a fundamental consideration of philosophy concerned with human actions in social experiences. Bhaskar (1979, cited in Scott & Bhaskar, 2015) defined structure as giving reasons for agency to be enacted:

> But of course if we look at agency itself this is a most marvellous thing. It depends on a process of intentional causality and agency occurs typically when we intend to do something for a reason. What we have when we are trying to understand

> social life in the first moment of stratification is to see action in terms of reasons. And then the second moment of stratification is to see how structures and structural change give agents reasons for doing things. (p. 38)

Agency drives human action to interact with and transform structures of the lived world. In his transformational model of social activity, Bhaskar (1989) highlighted that knowledge is developed through nonlinear interactions with structures within social systems. I was struck by how the programming of the game-based learning experiences provided the structure of a reciprocally interactive other within the classroom setting. Students may enact their agency through a dynamic interaction with the game-based learning experience. This dynamic social interaction leads to students' meaning making as transforming their knowledge or skills.

Bhaskar's model resonates with what is suggested as 'games as pedagogy' best practice, where students immerse themselves in the game, and a teacher guides reflection to highlight learning moments (Gee, 2007; Shaffer et al., 2005; Squire, 2011a; Watson et al., 2011). Such pedagogy supports students' agency by using their in-game experiences to explore connections to prior knowledge and skills, and provides structure for students to identify their new knowledge and skills developed through the game-based learning experience.

Bandura's (2001) conception of agency also supports this sociocultural theory of human agency: 'Agency thus involves not only the deliberative ability to make choices and action plans, but the ability to give shape to appropriate courses of action and to motivate and regulate their execution' (p. 8).

In this study, students' agency was identified through their reflective conversations (discursive act). Through the discursive psychological lens, students' agency was evident in conversation, in their production of knowledge through the game, and in their representations and interpretations thereof in PMM maps. The reflective conversations supported the research questions to be addressed through my exploration of the students' affective and moral engagement in these different types of game-based learning experiences, and my accessing of the moral dimension of their accounts through positioning theory. In the next section, both the opportunities to enact agency within school structures and the potential development of a student's agency in a school setting are considered.

3.1.2 Students and teachers as agentic beings

Recognition of students as agentive beings in school settings is central to the development of ideas in this thesis. A considerable amount of literature recognises student agency (Arnold, 2011; Deed et al., 2014; Doyle, 2015; McIntyre, Pedder, & Rudduck, 2005; Mercer, 2012; Scardamalia & Bereiter, 1991; Whitton, 2012; York & Kirshner, 2015) and the assumptions that underpin research into student agency in educational settings (Barton & Tan, 2010; Doyle, 2015; Goodman & Eren, 2013; Hằng, Meijer, Bulte, & Pilot, 2015; Martin, 2004; Mercer, 2012; Rappa & Tang, 2016; Rector-Aranda & Raider-Roth, 2015; Scardamalia & Bereiter, 1991). This research supports the definition of agency available to students during the game-based learning experiences put forward in this thesis, which serves to strengthen data analysis.

Schools are traditionally places where knowledge, skills, and social norms are nurtured and formed. School settings may be considered microcosms of the society they are serving (Levinson & Brantmeier, 2006) and described as a sociocultural construct. As school attendance is compulsory in Victoria, a difficulty here is to assume students have voluntary agency to act in ways that support their learning. Students are acknowledged to have rights and duties within the school setting and have choices in how they enact their agency within the setting. A student's willingness to become involved in an opportunity presented by the teacher can be seen as the student exercising their agency; equally, a student can refuse to participate, and this is also an expression of agency. The choices a student makes may reflect their own agency and understanding of the moral space of the classroom setting.

The short introductory summary above theorised agency as the way that humans may interact with the structures in the world around them. For adults, agency is theorised as an intentional action in relation to past behavioural patterns within social structures and settings. However, it may be difficult to apply the same autonomy to all students in schools, as attending the school setting is compulsory. Student ability to express their agency is dependent on the kinds of opportunities that the teacher and school provide. Martin (2004) called for an increase in a teacher's use of open-ended tasks for students to have clear opportunities to develop and express their agency. Such opportunities may be enabled by the school setting, school leadership, and the opportunities planned by teachers.

Martin (2004) conceptualised student agency as a form of self-regulating behaviour in relation to an educational context. Often, this conception of agency is not explicit in the literature, yet 'the self as agent is pervasively implicit in most writings on the topic of self-regulated learning' (p. 135). A student's agency includes their capability to make, and action, choices in a given context. This definition of agency assumes that the student has the cognitive tools, knowledge, and skills to make and enact their choices. In a school setting, making an assumption about students in a grade level having the same range of cognitive tools, knowledge, and skills is problematic; as such, individual students may develop qualities at different times. When focusing on the skills, knowledge, and cognitive domains, the moral domain in which the students are operating may not be attended to.

There are numerous influences on a student's ability to enact agency in a learning environment (Mercer, 2011, 2012). Mercer (2011, 2012) proposed a wide range of influences on student enactment of agency in a classroom environment. Such impacts include the student's belief systems, ability to control motivation, actual abilities, self-regulatory skills, and the effect of their teacher's classroom and pedagogies. Mercer (2011) recognised students as 'holistic beings nested within the bigger systems of their personal histories and the entirety of their lives and multiple contexts' (p. 435).

Such a consideration of the child as a whole being highlights the complexity of a student's ability to enact agency in a classroom. The classroom setting and local moral order of the site may also affect the student's ability to enact agency at a given time.

My study utilised a definition of the term *agency* supportive of the complexity of influences on students' learning perceptions during classroom activities. I believe this definition was necessary to explore the site ontology of game-based learning through the positioning of students as agentive learners in game-based learning experiences. Teacher and student reflections on their perceptions of learning were analysed to better understand the kinds of behaviours students and teachers describe as evidence of learning during game-based learning experiences.

3.1.3 Theorising student and teacher agency in this thesis

The main challenge faced by researchers is that agency is usually ascribed to participants through a retrospective analysis by a researcher (Doyle, 2015; New, 1994; Paul Sullivan & McCarthy, 2004). Such an analysis of agency may encompass cultural and situational influences; however, few studies have followed through with evidence of participants' knowledge of their own agency. It is again implied and assumed that the person will have realised their agency in the situation and enacted it in beneficial ways. Classroom researchers such as Doyle (2015), Martin (2004), and Mercer (2012) have acknowledged that both teacher and student agency are crucial factors for student learning progression and assume teachers and students are aware of their own agency.

In the last two decades, researchers have come to consider learner agency as more than a basic human right. This assertion of students' rights is where we begin to consider the moral domain of teaching to enable students' learning progress. The student's expression of learner agency through classroom actions may need to be considered as a form of legitimate participation in the community that is their authentic lived world, that of the school. It is necessary to take this conception of agency further to include learning about content and about self as a learner. Learner agency may be influenced by situational contexts of motivation, affect, and self-regulation (Mercer, 2011, 2012). The types of classroom experiences the teacher provides may also influence learner agency.

Teachers need to create pedagogical events that promote student agency. Classroom interactions have been developed towards supporting students to be cognisant of their agency (McIntyre et al., 2005; Noyes, 2005; Rudduck, 2007; Rudduck & Flutter, 2000).

In relation to an environmental action and climate change topic, Doyle (2015) explored the opportunities for student agency within and as a product of school participation. Doyle's conceptualisation of agency as an element of pedagogy is of particular note. The game-based learning experiences in this thesis would be classified as 'ambitious teaching' (p. 277) by Doyle as they shift the onus onto the student to act and collaborate with the game and peers through the game-based learning experience. Doyle (2015) ascertained that such approaches are 'rarely seen in practice' as they are 'often difficult to enact in a conventional classroom context' (p. 277). This thesis presents three case studies of such ambitious teaching happening in schools. The data generation focus was pedagogical events that utilised game-based learning experiences where students had the opportunity to act as agentive learners.

3.1.4 Learner agency as a socioconstructivist concept

Schools are places where students have agency to enact specific learning behaviours through interactions with curriculum (Ball & Forzani, 2007; Sandford, Duncombe, Mason, & Butler, 2015; Scardamalia & Bereiter, 1991; Paul Sullivan & McCarthy, 2004). This section clarifies the application of the term agency with reference to learner agency. It also acknowledges that the learner's perspective is often absent from educational policy (Kriewaldt, 2015) and frames the approaches taken, discussed in the Research Methods chapter (Chapter 4), to capture and analyse the learner's perspective through dialogue to support insights into meaning making as a learner.

Student learning in this thesis is defined as occurring in a socioconstructivist, discursive space (Boylan, 2010; Dewey, 1938; Kapucu, 2012; Laurillard, 2009). To be a socioconstructivist discursive space the classroom must provide opportunities for students to interact with the content and each other through discussion of ideas and experiences. This social construction of learning through dialogue and action is encompassed in the term socioconstructivist.

The game-based learning experiences framed students' interactions in the first instance and were possibly extended to include peers and teachers. The students' learning goals encompassed learning to interact with the game, developing both content knowledge in a domain (e.g., mathematics or coding) and a wider skillset, including collaboration and problem-solving. Acknowledging this range of interactions and outcomes may help to better understand the interactions of students with the game-based experience to construct new knowledge and identify skills. These interactions, with the game and with peers for the dynamic socioconstructivist site within the classroom.

Student agency in educational settings was defined by Doyle (2015) as the personal actions in response to a pedagogical event (p. 275). The pedagogical events that encourage learner agency are structures underpinning student-centred experiences of curriculum. Agency is operationalised in this thesis as an educational action in the sociocultural narrative of the classroom. The kinds of activities offered to students in classrooms will either encourage agentive behaviours by the students or stifle them. In Harré's (1996) terms, the student's agency is realised when they understand the options of what they can 'do', may 'do', and do 'do' during the event. These events provide the concrete moments referred to by Bandura (2001), Doyle (2015), Ratner (2000), Scott and Bhaskar (2015), and others, which may become a common experience that can be termed as a structure for later reflection.

To enable student agency, teachers have a role in offering pedagogical events that support active learner behaviours. The offering of certain tasks support teachers to build respect-based relationships with their students (Kriewaldt, 2015). Such relationships serve to enhance learning opportunities for students. In part, this respect-based relationship could be built upon the kinds of experiences that the teacher offers in the classroom. In this way, student agency is fostered through the pedagogical choices made by the teachers (Doyle, 2015). Teachers' use of games as a pedagogical tool could be interpreted as a structure that supports learners using a familiar cultural and semiotic tool. In implementing these experiences, teachers in this study were active in creating a common space for dialogue and meaning making.

The narrative data from the students also gave insights into their cognitive awareness of active learner behaviours that they identify as supportive of their learner agency in these game-based learning experiences. As the students worked through the game-based learning experience, they made meaning about how the knowledge or skills made sense. This form of learning can be understood as a form of discursive self-production. Such a recognition of self as agentive in response to the game is supported through positioning theory (Harré & van Langenhove, 1999; van Langenhove & Harré, 1999). This viewpoint assisted in locating the discursive productive relationship the student identified with the game. The exhibited agency included the student's understanding of the range of behaviours they can, may, and do enact in a school setting from asking questions to completing tasks to interacting with peers in collaborative ways.

Focusing on students' agency as a learner, my thesis seeks to illuminate students' agency as reflected in their dynamic exchange with the game. The development of agency as a learner is recognised as a continual process with many influences within and outside the classroom (Beaton, 2015; Coll & Falsafi, 2010). Claims about students' agency as a learner beyond this game-based learning experience were limited to the students' conceptions at the time of the learning experience and the interview process.

Students' reflective dialogue may also provide insight into their application of practical intelligence (Caldwell, 2012; Schatzki, 2010) to their interactions with the game-based learning experience. I used practice theory to interrogate the reflective dialogue to understand the actions students perform and recognise in constructing dynamic exchanges with the game. My study analysed students' and teachers' reflective conversations to understand the nature of the relationship between the student as a learner and the game as an ontological site.

The strength of defining agency as a sociocultural construct is that the choices students make in classrooms to engage with structures for their learning is recognised. These choices exhibit the moral rights of the student in response to the pedagogical event. Little empirical research has attended to this moral space of action, with many studies concerned with knowledge retention from game-based learning. Through defining agency as a student's response to a pedagogical event in a classroom setting, there was potential to apply positioning theory and practice theory to this empirical study.

3.1.5 Recognising the intertwined nature of teacher agency

Teachers in school settings are expected to enact their agency in two main ways, first in developing and enacting their own professional identity and second in supporting their students' agency as learners. These roles are intertwined within their professional position as constructors of classroom practice (Doyle, 2015; Laurillard, 2009; Roberts, 1996). This complex layering of teachers' agency and their daily work has rarely been acknowledged in research.

Their professionally recognised role imparts particular rights and duties (Harré & van Langenhove, 1999; Kriewaldt, 2015; Pinnegar, Mangelson, Reed, & Groves, 2011; Redman & Rodrigues, 2008; Redman & Trapani, 2012a). For Australian teachers, these rights and duties are articulated in the *Professional Standards for Teachers* (Education Services Australia, 2011) policy document. Part of teachers' professional commitment is to evidence each year that they have met these standards. The structures and setting of the school a teacher is working in may also enable their ability to enact their professional agency. The kinds of pedagogy and experiences a teacher can offer in a school space are bound by the structures and culture of the school.

Teachers had planned to support students' learner agency through the implementation of particular pedagogies (Kriewaldt, 2015; Reeves, 2009), in this case game-based learning experiences. Teachers developed structured pedagogical events, which were enacted through their classroom practice with students (Doyle, 2015; Laurillard, 2009). The teachers in my study sample were already agentive in the development of game-based learning experiences for their students.

The teacher interviews in my study presented an opportunity for professional reflective conversations, including about pedagogy and expectations when selecting and implementing game-based learning experiences. Their participation in this study served two purposes: a discursive space for professional conversation about their pedagogy and planning and an opportunity for them to reflect on their own agency and that of their students, structures of the school, and practice.

The next section presents the theoretical constructs that supported my research of the expression of student and teacher agency when using game-based pedagogies in the classroom.

3.2 Theorising Schools as Sociocultural Sites: Exploring Agency Opportunities in School Settings

Student agency as a learner is a response to specific pedagogical events. This means that research in a school setting needs to attend to the sociocultural nature of the individuals, the classroom, and the nature of learning. Agency literature supports our understandings of the moment-to-moment classroom interactions which may foster student agency as learners. Often, the focus on teacher practice assumes that students will be agentive in the classroom. Student retention of knowledge is assumed to reflect their agency in previous pedagogical events. These assumptions do not account for the moral dimensions of classroom learning experiences.

I acknowledged and researched students' moral and affective space. As an introduction to the positioning of this research, the concept of the local moral order is explained with reference to the impacts on an individual and their ability to be agentive (Harré, 1993). How do classroom and school settings provide a student with choices about what they can 'do', may 'do', and do 'do' within the discursive space of the classroom and wider school? The meaning making available to students includes content knowledge, skills, and self-development within this discursive space.

Teachers are agentive in developing pedagogical events that draw together these understandings and implement them in practical ways. The activities students experience can be thought of as concrete moments of site-based practices of learning. Practice theory (Schatzki, 2010) contends that sites consist of rules, understandings, and teleoaffective structures that support moments of learning. These sites are socially constructed and maintained through moral and affective practices in the school. This section presents how I made sense of practice theory through exploration of my own praxis and understandings of theories about teaching and learning.

The theoretical construct that supports classroom settings as a socioconstructivist space is the local moral order (Davies & Harré, 1982; Harré, 1993; Harré & van Langenhove, 1999). This section discusses the complex environmental impacts on agency, with the specific application of classroom settings upon student expression of agency as a learner.

3.2.1 Local moral order

The concept of local moral order (Harré & van Langenhove, 1999; Howie & Peters, 1996; James, 2012; Linehan & McCarthy, 2000; van Langenhove & Harré, 1999; Yamakawa, Forman, & Ansell, 2009; Zelle, 2009) recognises the range of cultural and social rules within a particular context or setting. The often unspoken rules of the local moral order will influence the interactions, conversations, and actions of individuals in various social situations and locations (Harré & van Langenhove, 1999). Regular participants in the setting will tacitly understand the local moral order of the setting (Harré & van Langenhove, 1999; van Langenhove & Harré, 1999). When using positioning theory as an analytic tool, the influence of the local moral order needs to be considered as part of the influences on the storyline and speech acts available to the individual in that setting.

Some specific settings and influences on local moral order that may be familiar to a general audience include one’s conduct at a wedding service contrasted with behaviours expected at a funeral service, audience behaviour at a tennis grand slam match as compared to a football game, or any number of ‘fish out of water’ scenarios in situation comedies like *Mr. Bean* and *Get Smart*. The tacit rules in school contexts are no different. There may be similar behaviours expected of students and teachers generally across schools; there will also be school-specific routines and expectations. For example, at School A in a whole-school assembly, students may be expected to sit in rows and quietly listen to teachers or guests; in School B, the students may run the whole-school assembly as a celebration of their learning, interacting with each other in dynamic ways.

Within school settings, the school philosophy is a key influence of the local moral order experienced by students and teachers. Such influence will be evident in the expectations and interactions of the principal, staff, students, and parents within the school. The school philosophy shapes the goals of the school and the types of experiences teachers may offer students in the classroom (Tait-McCutcheon & Loveridge, 2016). A teacher’s own efficacy and agency will determine their personal alignment with the school philosophy and goals (Lim & Chai, 2008; Saudelli & Ciampa, 2016; Stieler-Hunt & Jones, 2015). Student understanding of their place in the local moral order of the classroom, and school, will effect classroom interactions with teachers and peers (Rector-Aranda & Raider-Roth, 2015; Scardamalia & Bereiter, 1991). Such invisible influences of the local moral order may have varied impacts on the possible learning experiences and agency of teachers and students in each school setting.

The concept of local moral order supports the need to account for the physical and social worlds of individuals in any setting. This lens provides a view of influences on learner agency during game-based learning experiences by accounting for the sociocultural environment in which school-based learning occurs. Local moral order influenced the methods used in this study. Local moral order may influence pedagogical opportunities to enable learner agency in the school setting.

The following combination of theories and lenses were used as a critical realist framework, seeking to attend to the cognitive, moral, and affective space of the classroom. With so much social and psychological research to draw upon, I selected the four complementary models with which to attend to the student and teacher agency in my study:

- Teacher epistemic authority and knowledge: Roberts' (1996) trialogue;
- Student peer interactions for learning: Laurillard's (2009) conversational classroom framework;
- Local moral order and cultural rules in the classroom: positioning theory (Harré & van Langenhove, 1999);
- Games as a practice site for students: practice theory (Caldwell, 2012; Schatzki, 2010).

I explain each model as part of a practice theory (Schatzki, 2010) account of learning. This framework underpins the research methods developed in Chapter 4 and the analyses in Chapters 5 to 7. The combination of theories attend to the cognitive, teleoaffective, and moral dynamics of the site, giving rise to the concrete moments of learning students reflected upon with the game-based learning experiences. These four frameworks are offered as a cohesive whole, accounting for the range of influences on games as praxis in school classrooms. The frameworks align to expose 'games as practice' in the classroom, with practice theory at its core. The frameworks could also investigate classroom practice with other pedagogical structures.

The next sections provide a visual representation of how the frameworks fit together to account for the dynamic learning space offered in the classroom. The first of these is the teacher's professional knowledge that influences classroom pedagogy.

3.2.2 Teacher's epistemic authority and knowledge: Roberts' (1996) trialogue

To address the subquestion 'Why and how do teachers plan for their students' learning using game-based learning experiences?' I needed to account for the teachers' pedagogy and understandings of teaching and learning. I attended to this in two ways, first through Roberts' (1996) trialogue, explained below, and second by exploring the pedagogy of games as a practice site (Schatzki, 2010).

In his discussion of teacher knowledge discourses, Roberts (1996) recognised the epistemic nature of teachers' knowledge as part of a community of teachers. He extolled the virtues of researching the space of teaching to better understand the professional knowledge of teachers and their planned interactions for student learning. In Roberts' (1996) model, students learned about the knowledge domain as the result of various dialogical interactions (discursive acts) with the teacher. This model is Roberts' 'trialogue', where the relationship between the teacher, students, and the cognitive domain of knowledge is visualised.

Roberts' (1996) trialogue (see Figures 1 to 5) exemplifies the multiple dialogic interactions represented as a trialogue. Roberts offered the trialogue as a visual representation of the co-constructed conversations that need to take place for learning in a constructivist space. I discuss each model Roberts outlined and present my adapted version of Model 3 (see Figure 4 and **Error! Reference source not found.**) to acknowledge the semiotic space of the various game-based learning experiences.

Each of Roberts' (1996) models are presented and discussed with reference to how they support theorising the classroom interactions made available to students to support their learning. Each model presented by Roberts sought to depict the varied ways teachers may present learning experiences to their students. In all three models, the authority of the teacher's experience is central to which types of classroom experiences teachers offer to their students. In each model, the teacher and student are placed in different positions as they interact with the knowledge domain.

The first model considered is Roberts' (1996) imposition style (Figure 1). In this model, the teacher is the coach and justifier of the knowledge they share with the students. The teacher's role is to assist students to develop representations and explanations of the new knowledge domain. It is possible in this model for the knowledge domain to be effectively hidden from the student, as the teacher is the intermediary for delivery of content related to the knowledge domain. In a classroom based on the imposition style model, students may query the relevance of the knowledge domain they engage with in class.

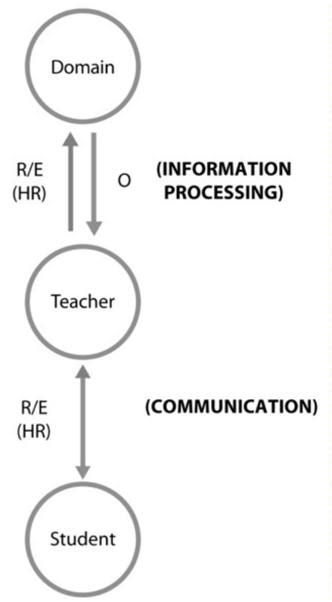

Figure 1: Roberts' (1996; Figure 2) presentation of the 'imposition' style teacher and student interactions within a knowledge domain. Code: O = observation/s; R/E = representation and/or explanation; S = by the student; HR = by others of the human race.

In Roberts' (1996) Figure 2 and Figure 3, by contrast, the student is aware of, and interacting with, information from the knowledge domain. The learning interactions may happen both within the classroom and independently of the teacher. In Figure 2, communication between the teacher and student leads to a co-construction of knowledge. This communication also recognises the student's prior knowledge of the domain and the 'justification of knowledge' that in contemporary classrooms could be considered the student's perception of authenticity of the reason for learning this knowledge domain. Today, the knowledge domain developed during formal schooling in Australia is broader, including 21c skills and higher order thinking (CEM, n.d.; Dede, 2009; DET, 2013).

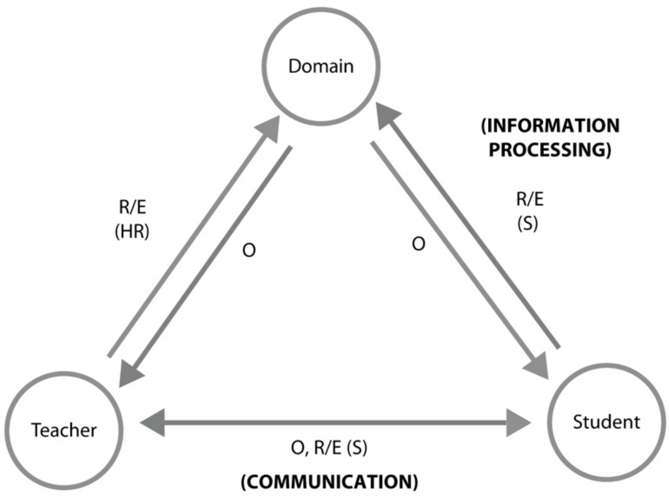

Figure 2: Roberts' (1996; Figure 3) presentation of the 'abandonment' style of teacher and student interactions with a knowledge domain. Code: O = observation/s; R/E = representation and/or explanation; S = by the student; HR = by others of the human race.

Figure 3 has the additional impact of the 'human race' in the classroom interactions and acknowledges the possible influence of bringing the community into the classroom. The goal of these models is to have students clearly interacting with the knowledge domain and making meaning about the world beyond their classroom.

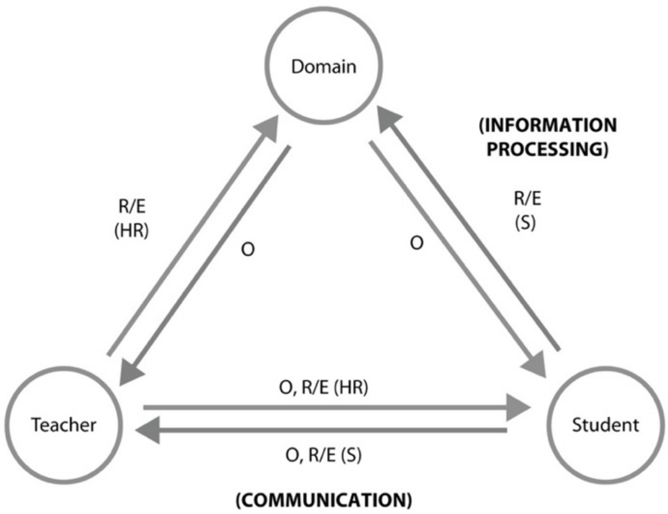

Figure 3: Roberts' (1996; Figure 1) presentation of the 'trialogue' teacher and student interactions with a knowledge domain. Code: O = observation/s; R/E = representation and/or explanation; S = by the student; HR = by others of the human race.

These models continue to have relevance as teachers seek to support student meaning making beyond the knowledge domain and to include the skills of agentive lifelong learners. The sociocultural interactions described by Roberts (1996) align with the paradigms of Dewey's (1938) constructivist learning (Clandinin, 2006; Kruckeberg, 2006). Roberts (1996) validated the student as having agency in their learning while endorsing the role of the teacher as a pedagogue.

Within educational research, there is a focus on teacher choice and why they select, or do not select, certain pedagogies (Phillips, 2016; Stieler-Hunt & Jones, 2015). A gap in the research pertains to student perception of their particular learning experiences as learners, with existing studies of game-based learning focused on leveraging student enthusiasm for leisure games into educational settings (Chen, Teo, & Zhou, 2016; Eow, Ali, Mahmud, & Baki, 2009; Oztok, 2013). My study sought to better understand the relationship between students' agency and game-based learning experiences. By adapting Roberts' trialogue I can display the interactions in the classroom clearly for this research.

3.2.2.1 My revision of Roberts' trialogue

The use of game-based learning experiences may encompass more than a single knowledge domain. To reflect this, I now present my reasoning for the revision of Roberts' (1996) model for use in this thesis.

In developing the methods for this research, I updated the language used in the Roberts' (1996) trialogue, revising it to document interactions with game-based learning experiences as the context for interacting with the knowledge domain. The game-based learning experiences are now represented on the revised trialogue. These interactions with the game may support students to access wider skills than a single content knowledge domain. The game-based learning experiences in this research reflected the curriculum in Victoria during the 2012 to 2015 data generation period. The revision of the trialogue acknowledges students' agency through dynamic transactions with the game-based learning experience.

Roberts' (1996) trialogue Model 3 was selected to help visualise the complex nature of the learning interactions available in the schools in my research. Roberts' (1996) trialogue supported the methodological design for this research, with the knowledge domain of the model revised to reflect the specific game-based learning experience in each classroom (Figure 4 and **Error! Reference source not found.**).

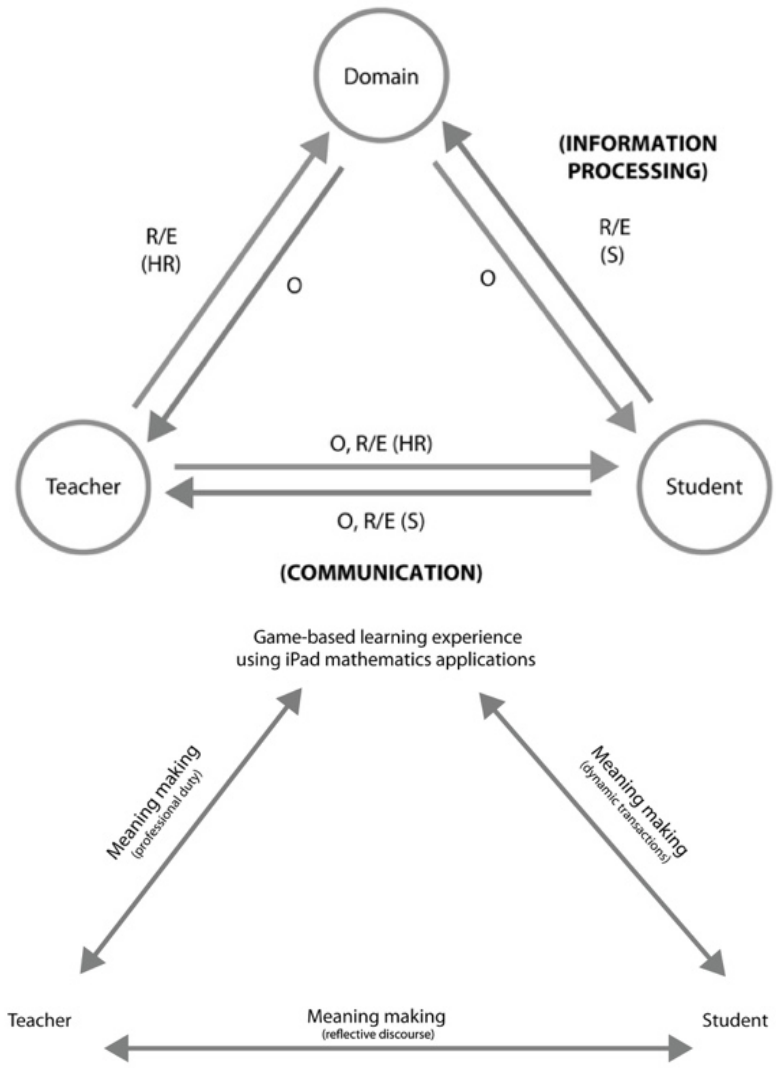

Figure 4: Roberts' (1996) trialogue (top) and the revised trialogue (bottom) for the classroom interactions in this research.

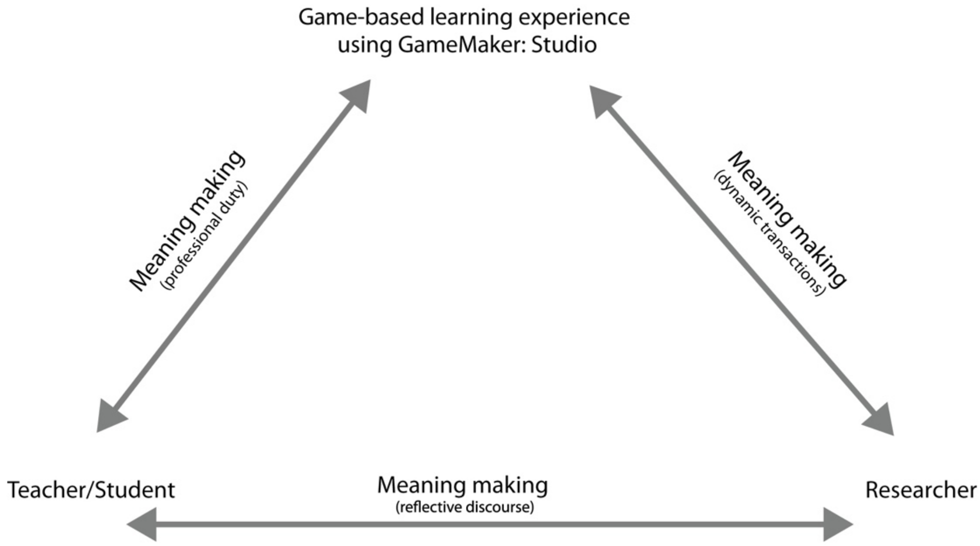

Figure 5: Roberts' (1996) trialogue, outlining the relationship of teachers, students, and researcher to the spaces and tools, with the example of the GameMaker: Studio as a learning experience.

The double-headed arrow along the bottom of the trialogue indicates a two-way interaction of teachers and students as co-constructors of learning (Figure 4). Arrows on the left and right vertices are double headed. These double-headed arrows indicate where the students and teachers may have asynchronous interactions with the game-based learning experience in the classroom setting. In figure 5 this trialogue is adjusted to show the place of the researcher in the site under investigation.

There may be multiple knowledge domains involved in the game-based learning experiences. The data chapters (Chapters 5 to 7) present and explore the student interactions with the knowledge domains. The teachers' epistemic authority directed the learning experiences offered; in this case, teachers selected game-based pedagogy. Teacher planning and pedagogy were important parts of the interaction; how and why teachers planned for this to enact their professional duty was of interest in this research.

The revisions I made to Roberts' (1996) trialogue reflect the possible classroom interactions available to students. Both teachers and students were agentive in these learning experiences. The ways meaning making and agency developed are visualised here as happening in the discursive classroom space between the teacher and the student in response to the game-based learning experience at a curriculum level.

3.2.2.2 Teachers enacting their epistemic authority: Game-based learning as practice

To begin, I discuss why the teachers planned and implemented game-based learning experiences. The teachers did not express an expectation that the game would teach the students. Instead, they saw the pedagogy of activity-based learning as assisting the students to make personal connections to content and skills. The game-based learning experiences were not the only learning experiences offered to the students, and the use of these games did not replace the explicit teaching model, also proposed by Roberts (1996). Direct teacher instruction still occurred in the school environment for these students; however, it was not the focus of my study (Figure 6). The focus was the student's relationship with, and perceived learning through, the use of games to experience a knowledge domain (Figure 7).

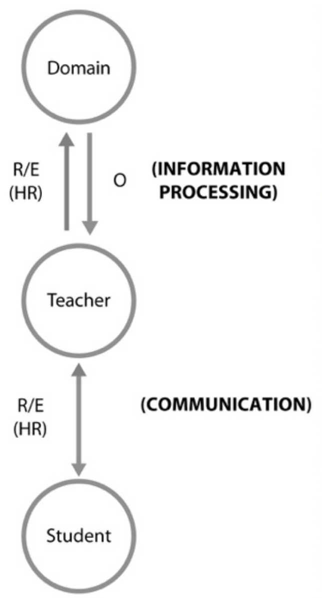

Figure 6: Roberts' (1996) information-processing representation of teaching and learning, showing the direct instruction model where the teacher is the sole deliverer of domain knowledge.

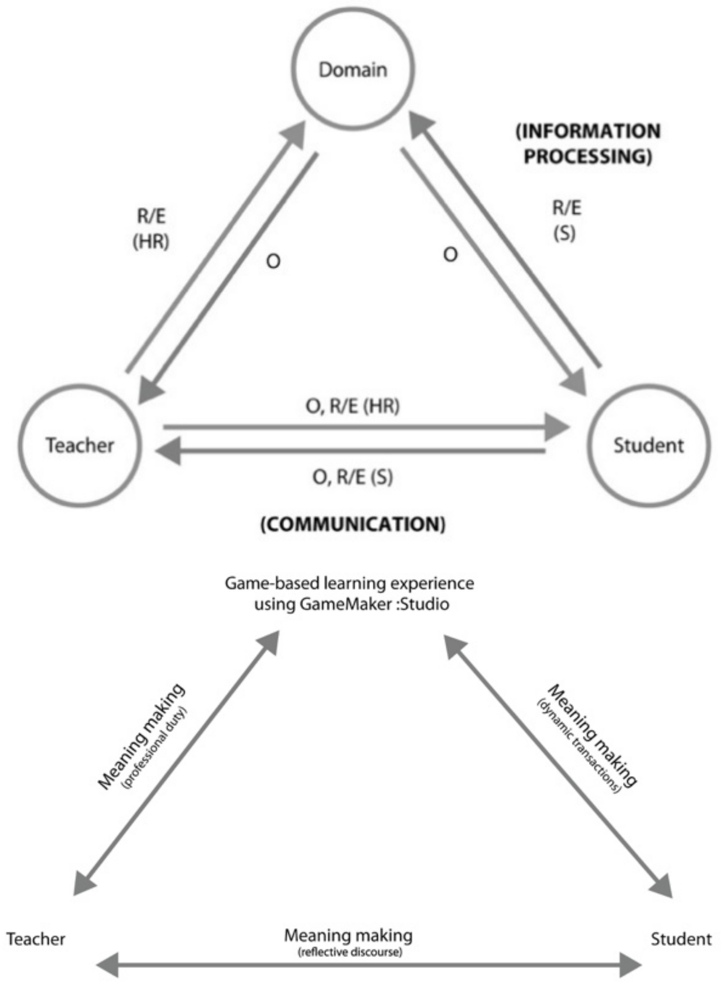

Figure 7: Roberts' (1996) representation of the trialogue (top) where the domain knowledge is visible to the student. Image on the bottom is my adaptation to show the relationships in my study.

Roberts' (1996) trialogue provided a starting point from which to understand the professional knowledge of teachers and how this influenced interactions in the classroom. Without the teacher offering activity-based, student-centred learning opportunities, there would be little sociocultural interaction. The technologies available in the school setting and the support from the school leadership to implement these technologies were also important factors in teacher implementation of student-centred learning experiences. This is the most crucial step in the success of any activity-based learning; the teacher needs to offer this to the students. If it is not made available to the students, they are unlikely to experience it. If we consider games as practice (Figure 8), the 'understanding' frame that leads to games being implemented at all, the games need to be compliant with the teacher's understanding of what is acceptable in their classroom and what is believed to support students as learners.

Figure 8: One frame of practice theory, depicting the general and practical understandings of the teacher and students, linked to Roberts' (1996) trialogue.

3.2.2.3 Strengths and limitations of Roberts' trialogue

To strengthen the analysis of the co-constructed narrative data, my adaptation of Roberts' (1996) trialogue assisted in visualising the asynchronous interactions between the participants and the game. The game is a knowledge domain and contributor to the dynamic learning experience, giving insight into the participants' agency in their daily interactions. This supports the analysis of how the participants may position the game in the learning experience.

A limitation of Roberts' (1996) trialogue may be that it is a simplified representation of the known interactions in these classroom settings. As outlined in Section 2.2, the relationships within the classroom setting are also affected by the cultural and social life within, and beyond, the school (Burkitt, 2002; Clandinin, 2006; Harré & van Langenhove, 1999; Ratner, 2000, 2009; Shakurova, 2012). To partially overcome this limitation within the methods for data analysis, Roberts' (1996) trialogue is complemented by positioning theory (Harré & van Langenhove, 1999) to further illuminate the complex interactions occurring in the classroom as a sociocultural space.

A further limitation may be that Roberts' (1996) trialogue is interpreted as a hierarchy. The position of the teachers and students appear as equal stakeholders in this research, each having an important role and privileged information to share. I observed and interviewed the students and teachers at different times. The game-based learning experience was placed at the top of the revised Roberts trialogue as this was the knowledge domain reflected upon.

The trialogue presents a clear view of the participants in the one aspect of educational experience under investigation. But how the impact of different teacher pedagogy and student-to-student interactions that may take place in the classroom be accounted for? Laurillard's (2009) conversational framework for classrooms provided a visual representation of the different types of interactions common in teacher pedagogy today.

Building upon Roberts' (1996) conceptualisation, the epistemic authority of the teacher extends beyond the domain knowledge of the traditional content and now encompasses specific tools and pedagogy. When planning for a game-based learning tool, the teacher's understanding of the general and practical nature of teaching and learning is put into action. When these pedagogies are implemented, the wider interactions of the student in the classroom need to be accounted for, beyond just the discursive relationship with the teacher. This is exemplified by Laurillard's (2009) conversational framework of classroom interactions.

3.2.3 Laurillard's conversational frameworks for the classroom

To address the following research subquestions,

- How do students identify and describe experiences of learning through games?
- Are there aspects of games which students identify that support them as learners?

I now consider teachers' understanding of teaching and learning and build upon this to acknowledge how this is lived out in the classroom space through Laurillard's (2009) conversational framework of classroom action.

The pedagogy of experienced teachers is often tacit, as has been noted when analysing successful integration of digital technologies into classrooms (Fullan & Langworthy, 2013; Langan et al., 2016). Experienced teachers sometimes find it difficult to explain why they select certain successful pedagogies (Fullan & Langworthy, 2013). In Victorian schools, the teacher's role includes being a designer of knowledge-based products, using their 'decisional capital' (Fullan & Langworthy, 2013, p. 13) and epistemic authority to plan and implement these products in ways that respond to student need. The teachers in my study used their decisional capital to provide opportunities for students to engage in game-based learning experiences as part of their everyday classroom work.

One way of understanding the complexities of delivering such pedagogies in the classroom may be through closer analysis of the interactions that occur in classrooms as a constructivist space. Laurillard (2009) developed several models, presented as conversational frameworks, to help visualise the multiple, layered, and dynamic interactions within classrooms. Of Laurillard's five models, two were chosen to represent the interactions of students and teachers when using game-based learning in the classroom. These interactions may support students to recognise, and enact, their own agency within the classroom experience.

Laurillard (2009) studied classroom interactions to better understand teachers' pedagogy when integrating computer-supported learning. She found that teachers implement a range of activities that promote student conversation and collaboration. By mapping the interactions during learning experiences, Laurillard developed a series of five conversational frameworks that encourage the integration of computer-supported learning. The importance of her work is two-fold. First, it provides a view of the interactions between teachers and students that computer-supported learning, or indeed any learning tool, such as a game, may enhance. This builds on Roberts' (1996) trialogue to better show the dynamics of a contemporary classroom. Second, the conversational frameworks give insight into the learner-centred practice environment developed by teachers in the classrooms I studied.

In Figure 9, Laurillard's (2009) conversational framework exemplifies the interactions between the teacher and the student through the teacher-designed task practice environment. There are opportunities for the student to interact with the teacher and times where the student works independently before returning to the teacher. In my study, the teacher and learner conceptions were accessed through reflective dialogue about the task.

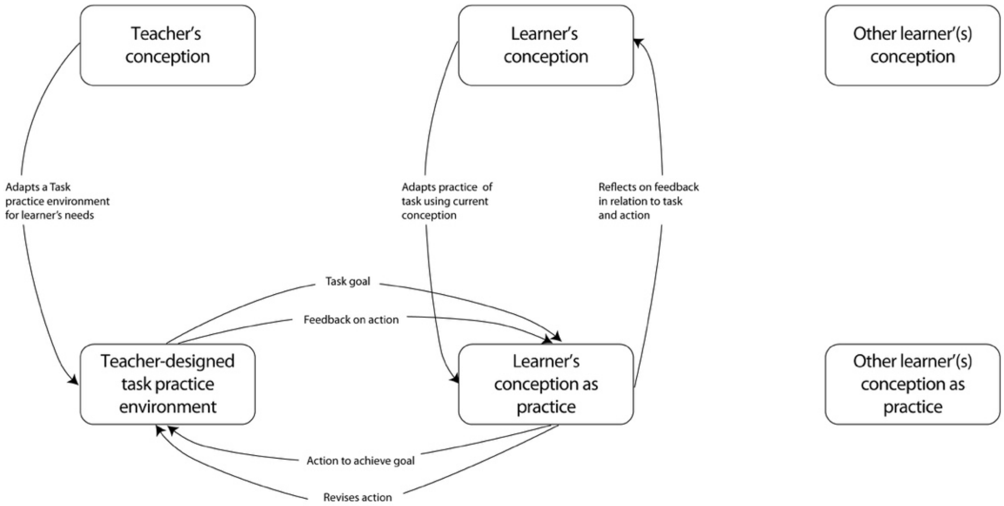

Figure 9: Laurillard (2009, p. 9, Figure 2): Learner's activity in a practice environment adapted by the teacher to their needs, where it provides intrinsic feedback on their action in relation to the task goal, enabling them to reflect on that internal relation in light of their action adapted by their current understanding.

The second of Laurillard's (2009) conversational frameworks (Figure 10) shows that the inclusion of collaborative peers in this learning experience increases each student's access to alternative ideas. The students still return to the teacher for feedback on goal attainment; however, it is evident that the additional peer interactions could support students in developing a wider range of agentive learner behaviours and skills and so increase student opportunities to experience success in goal attainment.

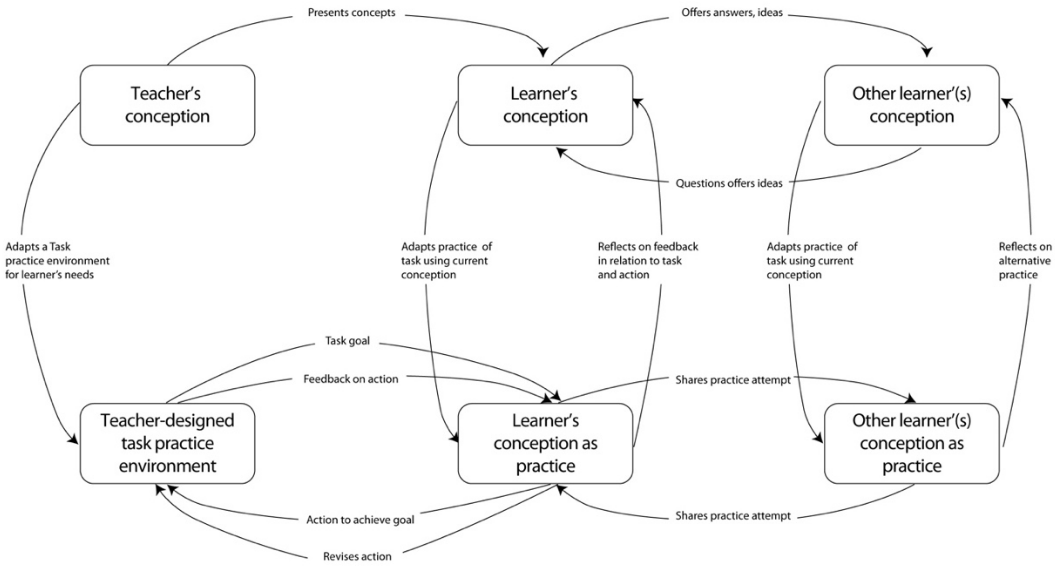

Figure 10: Laurillard (2009, p. 11, Figure 4): Collaborative learning combined the pedagogies of constructionism and social learning to provide richer interactions between learners and their concepts of practice.

By considering Laurillard's two conversational frameworks, this study sought to document the teacher's reasoning for pedagogy when planning to implement game-based learning. This framework may assist to understand students' agency and actions within classroom pedagogies.

Laurillard's depiction of classroom interactions (Figure 11) gives insight into the complex interactions that happen in the classroom employing any learning activity. The role of the teacher as the only source of knowledge shifts, and the teacher implements a pedagogy that supports the students to engage individually and with peers to explore the domain knowledge. This creates a variety of social interactions where the students are in conversation with each other and with the activity itself. Laurillard drew particular attention to the 'learner's conception as practice'. This practice is seen through the moment-to-moment interactions within the activity where the student enacts behaviours they may interpret as learning.

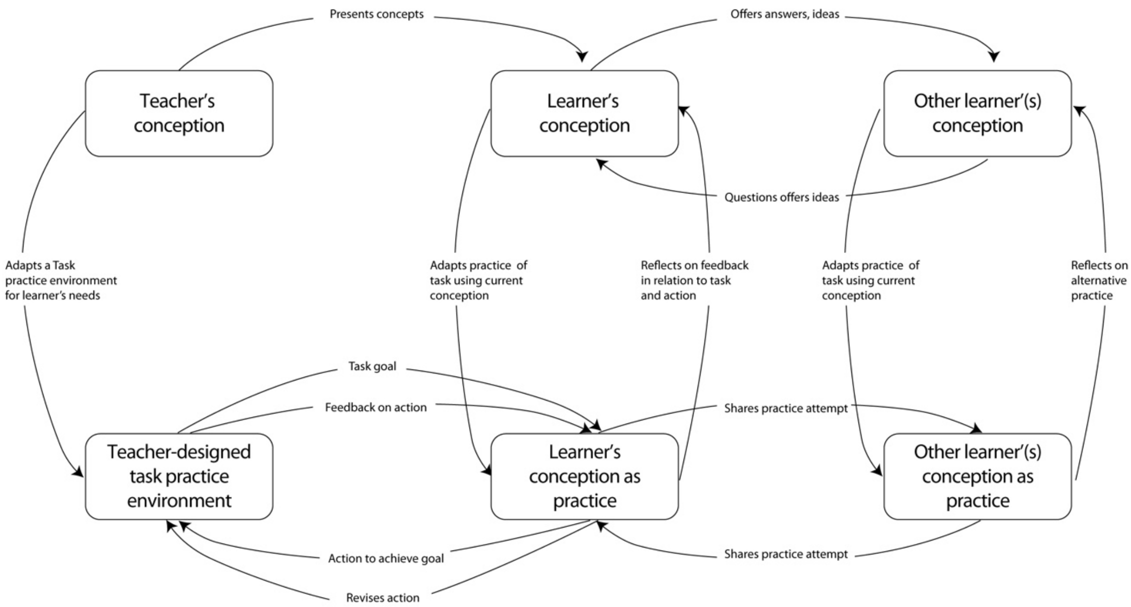

Figure 11: Laurillard's (2009) conversational framework of classroom interactions.

A strength of Laurillard's models is that they put the student's agency as a classroom co-constructor at the centre of the interactions. It acknowledges that their peers are also agentive in the classroom setting, and the social and affective space that is part of the socioconstructivist classroom becomes visible. In this way, the student's' rights and duties as learners were brought into focus in my study as the key interest.

A further strength of Laurillard's models is that they acknowledge the contribution of the participants' conceptions (thoughts) to their practice (do) in the task environment (Figure 12). This aligns with practice theory (Schatzki, 2010), providing a view of the cognitive and social interactions that contribute to students' affective experiences. Building teleoaffective structures in the classroom relies on a combination of the tasks set by the teacher and the student's discursive interactions with the teacher and peers. How students conceptualise their actions in the game-based learning experience is analysed to better understand the ontological nature of this dynamic learning experience.

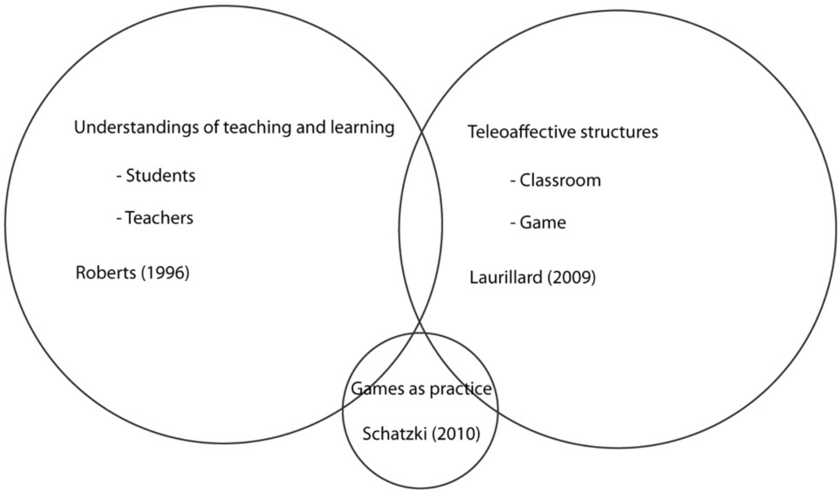

Figure 12: Two frames of practice theory understandings of the teacher and students and the teleoaffective classroom and game structures that influence the practice site.

Roberts' (1996) trialogue and Laurillard's (2009) conversational framework provide two theoretical models to represent the kinds of relationships that existed in the classrooms studied. They give insights into the relationships teachers and students experience in normal classroom interactions, with or without game-based learning experiences. The learning outcomes when implementing game-based learning experiences may encompass both content and wider skills. The implementation and success of such experiences may be impacted by the local moral order of the school.

The pedagogies used in the classrooms I studied required students to be active participants in their learning. The ways teachers implement game-based learning experiences may support students to be agentive in their learning. Additionally, understandings of the local moral order and positioning theory (Harré & van Langenhove, 1999; van Langenhove & Harré, 1999) may give insights into student agency and their perception of the game-based learning experience; this is presented next.

3.2.4 Positioning theory as a way of understanding the moral space of meaning making

So far in this chapter, I have presented the supporting theory needed to apply two aspects of practice theory to a classroom environment, that of understanding the general and practical approaches to teaching and the recognition of the contributors to the teleoaffective structures in a sociocultural classroom. Now I will account for the wider school influences on games as a practice by attending to the moral space that is intertwined with the rules of the school and the game to influence the local moral order of the classroom.

Roberts' (1996) and Laurillard's (2009) models represent dynamic classroom interactions that are often discursive in nature. The concrete moments where discussions are carried out between students, peers, and teachers are the windows through which meaning making may be viewed. The rules that impact the game as practice were defined in this study as the discursive interactions that expose the students' actions of following game and school rules, uncovering the local moral order recognised by the student. I follow Harré's (1992) reasoning that the student's meaning making in the classroom is produced in the conversation: 'All psychological phenomena and the beings in which they are realised are produced discursively' (p. 154).

Harré (1992) maintained that these discursive acts are contingent in the moral positioning of the students and may form a basis to better understand the self in relation to the social reality: 'The social realm can be pictured as composed of three basic processes: conversations, institutional practices and the uses of societal rhetorics; all forms of discursive practice. Conversations are the most basic substance of the social realm' (p. 394).

I analysed the co-constructed discursive data generated in the research to show students' and teachers' agency in the classroom experience and the relationship between the game-based learning experience and their own perceptions of learning. The research methodology was designed to position the students to share their perceptions of action, points of view, and the common biographical event of the game-based learning experience:

> Deliberate self-positioning occurs in every conversation where one wants to express his/her personal identity. This can be done in at least three different ways: by stressing one's agency (that is presenting one's course of action as one from among various possibilities), by referring to one's unique points of view, or by referring to events in one's biography. (Harré & van Langenhove, 1991, p. 400)

Harré and van Langenhove (1999) and van Langenhove and Harré (1999)[1] referred to positioning theory as a 'grammar', or set of rules, that assists insight into complex social interactions. Positioning theory attends to the social and cultural influences on an individual's agency through their actions (do) and conversations (say). Each conversation may give insight into the individual's perceptions of their actions in a social space at a particular moment in time.

Positioning theory (Harré & van Langenhove, 1999) was applied to the socioconstructivist space in the classroom (Redman & Fawns, 2010; Tait-McCutcheon & Loveridge, 2016; Yamakawa et al., 2009), offering an enriched analysis of the relationships between the teachers and their pedagogy. It provided an approach to better understand participants' meaning making in everyday classroom settings.

[1] Positioning theory is attributed to both Harré and van Langenhove (1999) and van Langenhove and Harré (1999). From here on, the publication with Harré as first author is referenced.

Harré and van Langenhove's (1999) positioning theory is presented as a simplified triad (Figure 13), which shows the position of the self and others, the storyline implicit in the positioning, and the illocutionary force (the speech act) impact on the conversation. This triad has been widely applied to a number of fields across the social sciences, including Pinnegar et al.'s (2011) study exploring preservice teachers' perceptions of rights and duties, Reeves' (2009) study investigating teacher pedagogy with English language learners, and Yamakawa et al.'s (2009) study of teacher-directed classroom interactions with mathematics learners. The triad has not often been applied to student dialogical classroom interactions.

The positioning theory triad (Harré & van Langenhove, 1999) displays the possible position and storyline of the participant through analysis of their speech acts (Figure 13). In the context of the school classroom, available student and teacher positions were influenced by the local moral order within the school. The ways the students and teachers discussed their actions in the game-based learning experiences gave insight into their perceptions of the opportunities for their own agency and meaning making, through their identification of what they can 'do', may 'do', and do 'do' within the game interaction. These dialogical moments also gave insight into the moral positioning of the student, teacher, and the game itself.

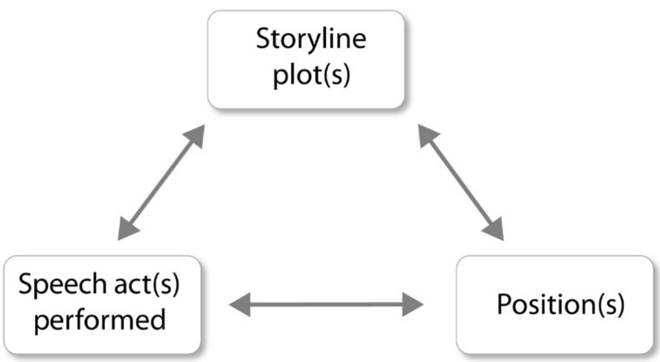

Figure 13: Positioning theory triad (Harré & van Langenhove, 1999).

Positioning theory may support a deeper analysis of not only what is being said by teachers and students, but also the social forces and local moral order that may influence how the game-based learning is experienced by participants. The research conversation is an opportunity for a person to enact agency. Positioning theory supports analysis of narratives beyond a simplified account of a person's position (Harré & Moghaddam, 2012; Harré & van Langenhove, 1999; Paul Sullivan & McCarthy, 2004; van Langenhove & Harré, 1999). The person's perceptions of their role may include rights and duties (Pinnegar et al., 2011; van Langenhove & Harré, 1999) in response to a specific social context.

A key strength of positioning theory is that it provides a fine-grained analysis of the participants' conversations, giving insights into their actions (do) through their dialogical interaction (say). The positioning of the speaker can be reflected upon using pronoun grammar analysis (van Langenhove & Harré, 1999), while acknowledging the local moral order of the social situation the event took place in. Such analysis is steeped in philosophical understandings of Wittgenstein's language games, where dialogical interactions follow particular orders, rules, and conventions to organise a representation of an experience for a participant.

Positioning theory provides a lens through which to analyse students' conversational reflections on their lived world, with reference to their own experiences to expose the local moral order of the classroom. When we consider practice theory, the rules of the classroom that affect the practice itself need to be accounted for (Figure 14). The inclusion of psychological discourse analysis (Harré, 2012) in the final diagram of this chapter signifies that a person's own understanding of the rules and social order of the setting influences their experience of the practice at hand. How they transact with the game and discuss this in the conversations gives insight into their discursive self-production as a learner in this space. This diagram aligns all frameworks in my study to identify the layers of sociocultural experiences I recognised in the sociocultural classroom. These sociocultural experiences were pivotal in my analysis of the praxis of students' game-based classroom experiences.

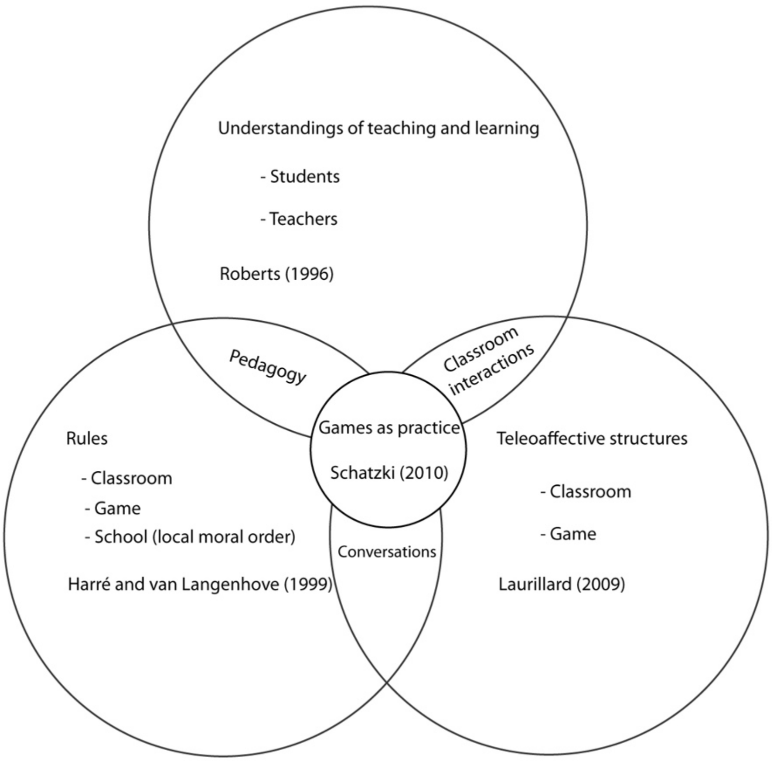

Figure 14: Practice theory diagram, with the rules of the setting and game attended to through positioning theory.

By combining practice theory (Schatzki, 2010) and positioning theory (Harré & van Langenhove, 1991), students' discursive production of meaning with reference to these concrete moments may provide a unique insight into the site-based ontology of game-based learning experiences. The final section of this chapter details how the game as a site of practice was attended to.

3.2.5 Bringing the frameworks together with practice theory

The preceding sections outlined how Roberts (1996), Laurillard (1999), and Harré and van Langenhove's (1999) theories combine lenses to better understand the discursive psychological sites classrooms provide when using game-based learning experiences.

Through the visualisation of practice theory, each lens supports the analysis of the game as a site of practice. To answer the research question 'How do game-based learning experiences contribute to student perception of self as a learner?', the ontological site offered by the game-based learning experience needs to be understood from students' perspectives: how they make meaning about the content knowledge, skills, and themselves as learners.

Practice theory (Schatzki, 2010) allows a variety of semiotic forms in the meaning-making process with a site to be attended to. When considering the complexity of the classroom and variety of student interactions with digital game-based learning experiences, practice theory may assist in better understanding the nature of the interactions that lead to students' meaning making.

The concept of practical intelligibility (Schatzki, 2010) also supports the acknowledgement of the student as agent in this interaction. The student's agentive actions provide the opportunity to enact site-specific knowledge and skills. These actions are part of a dynamic exchange with the game, enabling the expansion of meaning-making opportunities within the classroom setting. The use of practical intelligibility (Schatzki, 2010) provides a lens for the actions of students to be interrogated and understood as building on their prior skills and knowledge through the ontology of the game as a site.

The ontology of what learning can look like shifts with the use of digital games in classrooms. There is a pressure from outside schools to engage with blended practices and pressure inside schools to use existing equipment in valuable ways. I believe that as teachers and educators, we need to think about games differently in school settings. The use of digital games may provide a more dynamic opportunity for students to be agentive in their learning than has previously been acknowledged in the literature.

My study attended to the game as an ontological space. Through the lens of practice theory (Schatzki, 2010), the ontology of games experienced in the classroom as a learning tool was interrogated. Considering the game as a practice becomes an example of an embodied experience in this space, as student understanding of their potential action is understood before classroom action in the game takes place. This may be due to students' existing habits of action, interpretation, and beliefs about games as a learning tool and themselves as learners.

Practice theory (Schatzki, 2010) supports prising apart the layers of student conversation to expose the do and say to understand what the game provides for them to identify their learning. Students' meaning making may be inclusive of habits of action in response to game feedback, habits of interpretation in recognition of prior skills and knowledge being implemented, and habits of belief about new knowledge and skills they have articulated.

Students' reflections on their game-based learning interactions were interpreted with reference to their habits of interpretation, habits of action, and habits of belief. It may be possible, when supported by the cognitive, teleoaffective, and moral lenses, to understand students' true beliefs about their learning with game-based experiences.

These theoretical frameworks supported my research methods to identify the participant as agentive in both their classroom interactions and this research space. The research methods presented in Chapter 4 were designed to support discussion of the students' meaning making when engaged in a game-based learning experience, through their own do and say. The protocols in the next chapter were carefully designed to scaffold students to share their perceptions of learning when using digital games. The analysis of student and teacher perceptions was embedded in these same theoretical frameworks to interrogate the findings and answer the research questions.

3.3 Summary

Through this theoretical framework chapter, I have detailed my own practical classroom teacher and researcher intelligence. By defining agency for both students and teachers, the different rights and duties of participants in classroom experiences were recognised. The learning environment within the classroom is influenced by the types of learning experiences the teacher is able to provide, and these experiences may encourage the students to be agentive in different ways.

Practice theory (Schatzki, 2010) was explained and supported using specific educational theory, with cognitive (Roberts, 1996), teleoaffective (Laurillard, 1999), and moral dimensions (Harré and van Langenhove, 1999) that influence classroom learning and agency of students identified. These lenses supported the development of a dialogical research method and subsequent analysis of the ontology of game-based learning experiences.

Chapter 4: Research Methods

Chapter 3 gave insights into the conceptualisation of schools as sociocultural settings for learning. The sociocultural nature of the setting, including the moral and affective space, supports students to be active in their learning. When a student participates in a game-based learning experience, they exhibit agency as a learner. The aim of my research was to analyse students' reflections on their game-based learning experiences and investigate how their relationship with the game contributed to a perception of agency and learning. The research findings could illuminate the aspects of games which students value, and may also lead to a better understanding of how games may be utilised in classrooms to improve student awareness of agency.

This chapter outlines the instruments and protocols used with the students and teachers to gather data informing this research, defines the school contexts, and introduces the student participants.

4.1 Development of Research Methods to Investigate Perceptions of Game-Based Learning Experiences

This section outlines the methods used to record student and teacher reflections on game-based learning experiences. The research methods employed in this study were grounded in the sociocultural theoretical frameworks presented in Chapter 3.

As a sociocultural experience, a game-based learning experience changes the actions available to students in the classroom; this phenomenon has been documented across the research literature. There is speculation about why this might be the case, and I determined to investigate this from the student's viewpoint through their own words and actions (do and say; Harré, 1993). Guided by my research questions: How do students identify and describe experiences of learning through games? and, why and how do teachers plan for their students' learning using game-based learning experiences?, the following methodology was developed to attend to the sociocultural settings in each school and to promote agential actions of the participants in this study. By generating reflective accounts of the students' experiences, I sought to account for the cognitive, affective, and moral spaces offered in the school environment.

4.1.1 Ethics

This research was conducted in accordance with the ethics guidelines set by the University of Melbourne Human Ethics Advisory Group (HEAG; ID 1136124.1) and was additionally approved to be conducted in school settings by both CEM (ID GE12/0009-1843) and DET, formerly the Department of Education and Early Childhood Development (DEECD; ID 2012_001760). To ensure anonymity, all students, teachers, and schools in this thesis are identified by pseudonyms. References to school websites have been redacted to protect the anonymity of the schools involved in this research. Data was recorded in both hard copy and electronic form and was stored in line with the University of Melbourne HEAG guidelines.

4.1.2 Data generation overview

The term *data generation* was a deliberate word choice over the term data collection. Data collection implies that the 'data' was already available in the setting, which was not the case in my study. The data from the students and teachers in this study was developed through a co-generative dialogical process, involving the use of reflective tools to support dialogue about the game-based learning experience. As both students and teachers were active agents in the creation of the data in this study, the term data generation is used throughout this thesis.

Through my methodology, I hope to change the storyline of research in schools. I want to go beyond acknowledging the agency of participants, to co-generate data that supports student and teacher agency. There is something compelling about using game-based learning in classrooms, for both teachers and students. My data co-generation approach sought to implement a methodology to build relationships that would generate insights into a student's perception of the learning relationship they developed with the game. By beginning with a theory of games/play as learning (Bruner, 1983), I sought to blend sociocultural theory (Schatzki, 2010) with understandings of schools as sociocultural transactions (Dewey, 1938; Roberts, 1996; Laurillard, 2009) and discursive psychology (Harré, 1992) provide an account of the site based practices in classrooms through the storylines of the students. I offer this methodology as a way of attending to, and analysing, participant agency as a valued co-generator of data.

Data was generated with teachers and students from two different schools in Melbourne's northern suburbs. The teachers had already planned the game-based learning experiences as part of the schools' regular teaching and learning programs. Included in this thesis is data from teachers and students at two of the schools, Red River Primary School (Red River) and Forest Springs Secondary College (Forest Springs). Two different classes at Red River were part of the sample, with the composite Prep/1/2 use of iPad mathematics applications and Grade 3/4/5 use of Lego Robotics as the game-based learning experiences the focus of my study. At Forest Springs, students in the Year 9 Information Technology (IT) elective class were designing their own digital games using GameMaker: Studio software, and this provided the third context for my study.

Table 1 summarises the school context, students, and teachers in the sample and the game-based learning experiences of focus. Students and teachers selected their own pseudonyms.

Table 1: Schools and contexts presented in this thesis.

School	Learning Experience Using Artefact	Participant Pseudonyms (Agents)
Red River Primary School in Melbourne northern suburbs, Grade 1	Repetitive-learning tool for mathematics iPad mathematics applications (existing activity in-class use)	Students: Kate, Charlotte, Jacob, and Samuel Teacher: Monique
Red River Primary School in Melbourne northern suburbs, Grade 3	Play-based construction and programming experience Lego Robotics programming (new activity)	Students: Lily, Rosie, Brian, and Jackson Teacher: Judy
Forest Springs Secondary College in Melbourne inner suburbs, Year 9	Games as learning: students learning coding and design skills while creating their own games to meet a brief Digital game design with GameMaker: Studio in a semester-long elective class (existing class project)	Students: George, Obi-wan, Phoebe Teacher: Rey

4.1.3 Order of data co-generation

This research attended to students' perceptions of their learning during game-based experiences and the sites in which those experiences were located. The interview protocols were designed to support ongoing student agency through a shared reflective dialogue with the researcher. The data generation instruments were selected and adapted to align with the sociocultural frameworks outlined in Chapter 3 and the research questions. Figure 15 shows the order of experiences during the data generation.

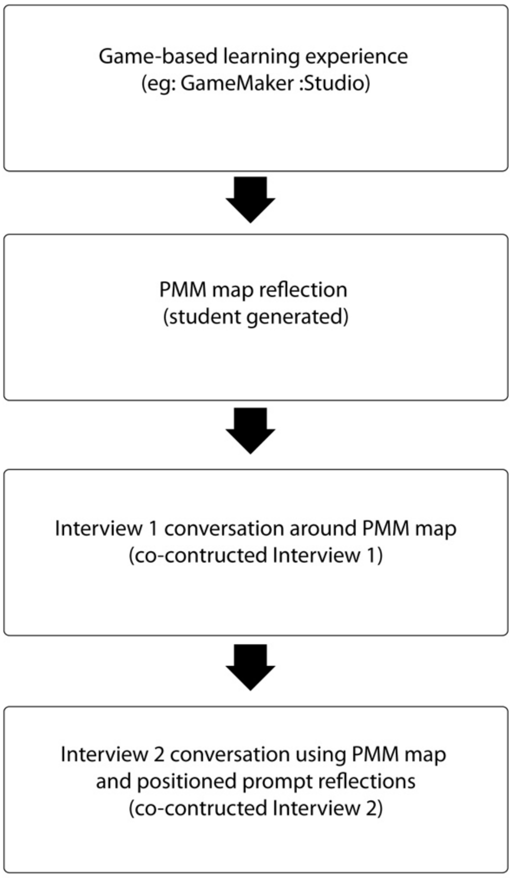

Figure 15: Flowchart of data generation sequence.

The order of data generation was carefully considered to support participants (students and teachers) to feel comfortable in sharing with me their reflections on learning. Being invited into the classrooms during the specific game-based learning experiences assisted in the development of the sustained dialogical encounters, which provided opportunities to capture the complexities of the site. The data generated was then analysed and illuminated through the positioning, site practices, and local moral order of the game-based learning experiences and with reference to the research questions.

The concept and enactment of agency is central to my thesis. Using the PMM map as the first step of data generation placed the participant as having an indisputable agency in this research relationship. Their reflective voice gave rise to the Interview 1 agenda and was revisited in Interview 2. This methodology aimed to provide authentic student voice as a basis for meaning making.

Interview 2 used question stems to support students to develop their meaning making to understand how they may respond to themes from the literature like challenge, 21c skills, and so on. The meaning of students' actions may be explored through a knowledge of language games (Harré & Slocum, 2003), that is, what the students could say, may say, and do say when reflecting on their use of game-based learning experiences.

The following sections explain the development of each data generation tool in order of their use in the research and give insight into the reasons for the sequence of tools implemented in my study. I present the instruments in the order they were used with the students and attend to the strengths and limitations of each instrument. After the game-based learning experience, a PMM map gathered the first dataset.

4.1.4 Data generation tools: Personal meaning making map

The PMM map (Falk, Moussouri, & Coulson, 1997; Falk et al., 2007; Falk & Storksdieck, 2005) was used as a data generation instrument and to support student and teacher agency. The PMM map is similar to a concept map, generated by the student and teacher participants after their game-based learning experiences. It served as a way for the participants to actively record and reflect upon aspects of the game-based learning experience important to them. An example of one student's PMM map is provided in Figure 16.

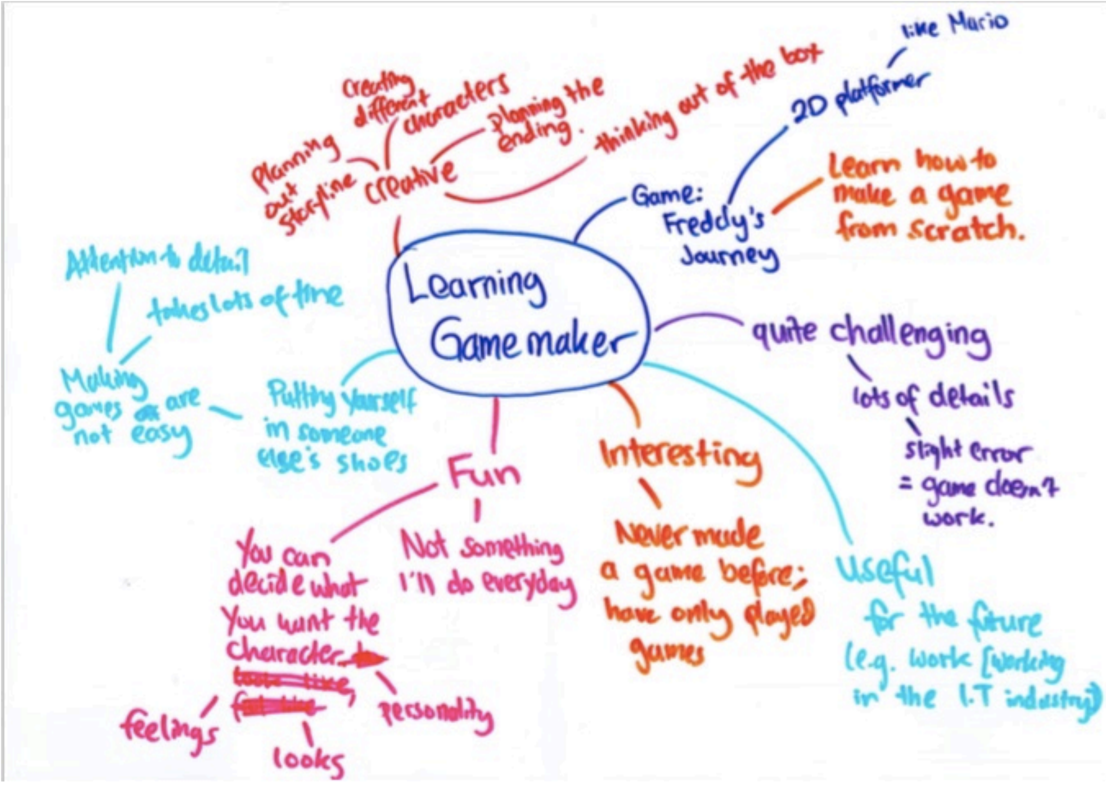

Figure 16: PMM map example from George, Year 9, Forest Springs.

I adapted the PMM map from Falk (Dierking & Falk, 2016; Falk, 2005; Falk et al., 1997). Falk applied PMM maps as an instrument to better understand the perceptions of adults towards learning in the informal learning context of a museum visit. The PMM map has also been used successfully within formal education settings to position participants as active agents in the data generation process (Hamari et al., 2016; Redman & James, 2016). Students and teachers were invited to enact their agency through reflections on their game-based learning experiences by developing their own PMM map. In this way, the PMM map became a curation experience, offering students and teachers an opportunity to self-code the experiential data in nonlinear ways to aid our dialogue. Giving the students the opportunity to share their own language and constructs in this experience assisted me to tailor the language used in our dialogue.

To draw the PMM map, students and teachers were supplied with a sheet of white A3 paper and felt-tipped pens. Felt-tipped pens were a deliberate choice as they were quick to use, photocopied clearly, and gave the participant the opportunity to colour code key ideas or use coloured elements in different ways for their own expression.

Students and teachers used the PMM map to record reflections on the specific activity; for example, GameMaker: Studio (Figure 16) was used to develop the narrative shared in the conversational interviews about their learning. Interview 1 was a discussion of the points participants had made on their PMM map. The second interview utilised the PMM map as a visual recall prompt for the participant. In this way, teachers' and students' thoughts and experiences of game-based learning were central to co-construction of Interviews 1 and 2.

The PMM map was used to position the students and teachers as agentive co-generators of the dataset. I believe this was a strength of the data generation protocols. Students took pride in explaining what they had written, suggesting that they felt their reflections were valued, and they were agentive in this research. This curated reflection provided insight into the cognitive and affective space the students were aware of during and immediately after their game-based learning experiences.

The PMM map helped to answer the research questions by providing an opportunity for students to curate their own reflections and use their own language to construct their narrative of learning. When used by itself, the PMM map and its development gave insights into the key reflective points a student wished to share. As it is a text-based construct, it could be analysed using positioning theory and practice theory. I chose this as the first interaction to ensure that the student had a chance to rehearse their thinking before further developing their voice in Interviews 1 and 2.

Strengths and limitations of PMM mapping

A key strength of the PMM map was that it positioned the student or teacher to set the agenda for discussion in the research. The student or teacher offered their 'personal constructions of knowledge and experiences' (Falk et al., 2007, p. 19), and their unique individual responses could be compared across a single educational experience. It could also be utilised to give insight into the student and teacher meaning making in this context (Falk et al., 2007, p. 19). The PMM map supported answering the research questions as it recorded the participants' direct reflective experiences in their own words.

Two possible limitations to the students' successful completion of the PMM map include student literacy level and their familiarity with reflecting on their own learning. This may have hindered the quality of the data for very young students.

Students with low literacy may experience an inability or anxiety when expressing their thoughts on paper. This was anticipated as a possible barrier for younger students in the sample. During the data generation phase of this research, literacy issues were not encountered as a problem as students in the sample could draw their answers. Many also felt comfortable enough to ask how to spell particular words when they were unsure, and this was perhaps due to the students perceiving me as an interested and helpful adult. This served to enhance our developing relationship.

Student ability to reflect on their own learning may also have inhibited the depth of reflection documented on the PMM map. Younger students may have been unable to make multiple statements about their learning. The interview component of the protocol served to reduce this limitation as the students were able to verbally expand upon the ideas they offered in their PMM map.

One aspect of the PMM map development process that could be improved in future studies is for the researcher to note the order in which the participant writes their reflections on the PMM map. Such data may give insight into the progression of thoughts and relative importance of the ideas to the participant. The transcript data indicated the teachers' and students' ordering of ideas as they discussed their PMM maps.

Should this tool be used in future studies, the following aspects of student ability may affect the completion of PMM maps. Such considerations include

- the confidence and ability of the students to spell and draw;
- noting the order of development of the map (does this form a hierarchy of importance for the student?);
- the choice of prompt for central ideas to be shared; and
- the commitment of the researcher to use this in a way that is supportive of the student; i.e., the shared ideas need to come from the student.

4.1.5 Data generation tools: Conversational Interview 1

Interview 1 was a discussion of the participant-generated PMM map. The participant was invited to discuss their map, co-constructing the conversation that explored their perceptions of learning in relation to the game-based learning experience. This process is outlined in Figure 17.

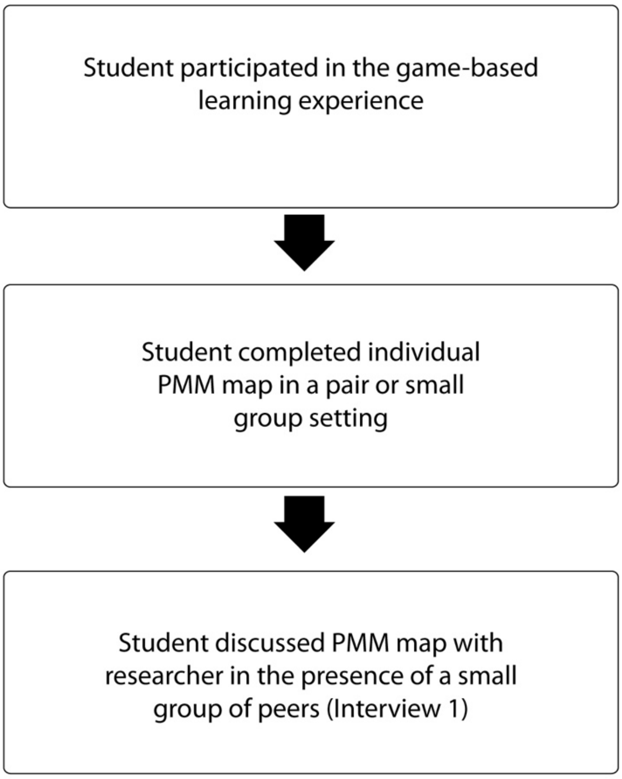

Figure 17: PMM map and experience timing.

At Red River, both the teachers and students completed the two interviews. The teacher at Forest Springs only completed one interview. In both schools, the students participated in both interviews.

One of the aims of my research was to contribute an analysis of student voice to the game-based learning literature. The participants' PMM maps acted as a rehearsal space to order their thinking, with our conversations in Interview 1 elaborating the students' ideas, which began the recorded dialogical exchange with the participants. Using this data generation method alongside the PMM map was planned to gain insight into the participants' understanding of what the game was and how the game was performing as part of a classroom learning experience, supporting an ontological study (i.e., what the game 'is') of games in classroom pedagogy.

Interview 1 immediately followed the PMM map; this timing was important in capturing the participants' immediate reflections on their learning. It also supported my understanding, and subsequent analysis, of the sociocultural setting of the learning experience. As a teacher, I brought an ability to identify the subtleties of classroom interactions, and as a researcher, I attended to these in addition to the recorded data. Together, the sequence of these first two protocols served to record the richness of the transactions experienced, using the participants' own words and voice.

Strengths and limitations of Interview 1 format

The aim of this first conversational interview was to generate data from the participants' viewpoint. As participants explained their PMM maps immediately after they had drawn them, it was hoped that the participants would enact their agency as they were authoring this aspect of their involvement.

As my research attended to students' perceptions of their game-based learning experiences, a further strength of Interview 1 was that the students were very much in control of the kinds of information they shared on the topic. Aside from the heading on their page (learning with 'game title'), I gave no prompting about the content of their PMM map, which supported Interview 1 to be guided by the participant's ideas.

A limitation was noticed with younger students. They tended to read what they had written and rarely embellished their written points with further explanation. Older students had more experience in explaining their thinking with further examples, reducing this limitation for the older student samples. This could indicate that the younger students saw their PMM maps as iconic representations that did not need further elaboration. The analysis of the data generated was designed to support further insights into the iconic, symbolic, and indexical use of the PMM maps.

4.1.6 Data generation tools: Conversational interview 2 with two dice

After Interview 1, there was a break of at least two weeks before I returned to the school for Interview 2. This gap in time helped to determine the reliability of the data already generated, as comparing what student participants recalled and developed in Interview 2 could give insight into the long-term stability of their reflections and ideas. Students furnishing similar responses in Interview 2 suggested durability of the narrative as potentially aligning with a longer term learner identity (Buckingham, 2008b; Hung, 2010; Schwartz et al., 2011).

Interview 2 was developed to support a deeper reflection about the students' learning in the context. It was conducted in a game-like manner, with students rolling paper dice then completing sentence stems as they were rolled. The game-like element supported students to feel in control of the interview. The use of dice randomised the sentence prompts and added an element of luck to the order of the sentence stems. As the students were interviewed in pairs or small groups, the randomisation also reduced the copying of answers among students.

The sentence stems were developed to position agentive reflection for students. Interview 2 was designed to clarify and augment Interview 1. In writing the stems, careful attention to the use of pronouns in the stems and to the themes in the existing game-based learning literature were required. This helped to hone and reduce the number of stems in Interview 2 so as not to be exhaustive or onerous for the students. I consulted with primary and early childhood educators to better understand the language for the stems to ensure that the students felt they had an authentic voice in this interview.

Table 2 and Table 3 outline the sentence stems used in Interview 2. Particular attention to specific pronouns was given to position the student to share their individual thinking. Analysis of the responses with reference to the type and order of positioning as performative or accountative (van Langenhove & Harré, 1999) would give further insight into their perceptions and positioning of the game-based learning experience.

Table 2: Conversational Interview 2, Stage 1 prompts.

Dice 1 Sentence Prompts	As a Prompt to Position Students to Share Their:
I was surprised about/when . . .	Meaning making and past agency
I found GameMaker interesting because . . .	Meaning making and past agency
I found GameMaker challenging so I . . .	21st century skills and past agency
I show I am a learner when I . . .	21st century skills and present agency
I show my understanding best when I can . . .	Meaning making and present agency
The best thing about GameMaker was when I . . .	Meaning making and past agency

Table 3: Conversational Interview 2, Stage 2 prompts.

Dice 2 Sentence Prompts	As a Prompt to Position Students to Share Their . . .
The skills I used from GameMaker will come in handy when . . .	21st century skills and future use of skills
The knowledge I used in this topic will come in handy when . . .	21st century skills and future use of knowledge
When I grow up I want to be . . .	Future possible self
My favourite activity at school is . . .	Meaning making and present agency—school context
My favourite activity at home is . . .	Meaning making and present agency—outside of school context
My friends would describe me as . . .	Present agency positioned from 'outsider' viewpoint

Students began Interview 2 by re-engaging with their PMM map and the Interview 1 transcript. Students were invited to read and comment on the transcript. This step ensured that the students had a right of reply if they felt they had been misrepresented in any way. The process of reading the transcript served as a reminder of our previous meeting and learning experience. It also positioned the student as having already shared aspects of their learning and prefaced the sharing to continue in this second conversation.

Common participant queries included certain aspects of the transcript, like 'pauses' and 'ums', which I explained to them as helpful for me to see when they were thinking hard about their ideas. One student withdrew part of their transcript as he diverged to discuss his recess lunch and found this embarrassing when reading over it. Aside from these two queries, the remaining transcripts were unchanged, and Appendix 1 shows a sample.

After students had read the transcript, I showed them the dice and explained the format as a game-like conversation. These stems and their presentation method required a game-based learning action by the students (dice rolling) and encouraged them to be agentive in this part of the data co-generation. With respect to the research questions, the positioning pronouns I used in the sentence stems referred to the game-based learning experience and to other learning and home life, with the intention of giving a wider range of conversation points that the students may not have thought of in their PMM map and Interview 1.

After this introduction, the student rolled the dice, read the uppermost stem, and completed it in their own words. The prompts were presented across two dice templates shown in Figure 18 (sourced from Classroom Copilot, 2012). The dice were made of paper and easily updated in a Word document to reflect the learning experience at each school. Dice 1 had six sentence stems to prompt further reflection on the PMM map and Interview 1. Dice 2 had six different prompts to generate conversation around agency, learner actions, meaning making, and anticipated future use of learning.

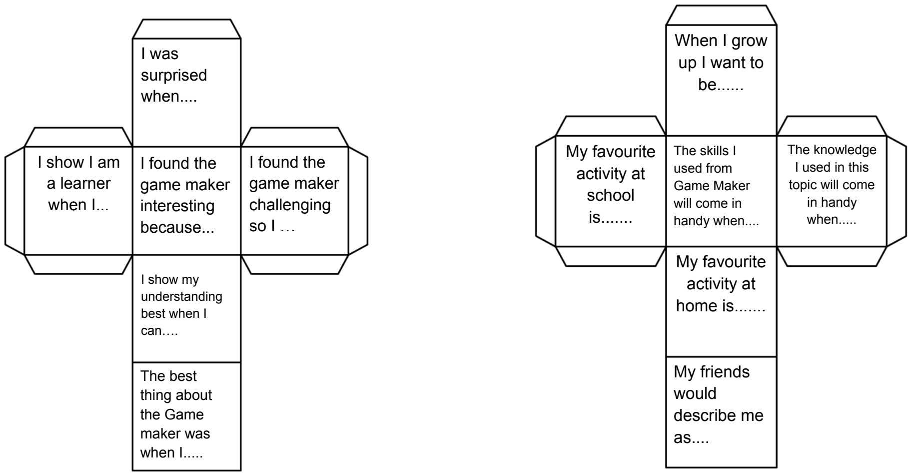

Figure 18: Example of adapted Dice 1 and Dice 2 templates used for GameMaker: Studio, Interview 2.

Interview 2 therefore served to ensure that the dataset extended the students' initial affective responses to their game-based learning experiences and helped them to make links to learning beyond the classroom. Note that some students made these affective and wider links in their initial reflective PMM map without the prompting from sentence stems in this later interview.

Strengths and limitations of Interview 2 format

The key strength of using sentence stems in this part of the interview was that I had designed them to use ***I*** and ***my*** to position students using pronoun grammar. The pronouns are presented in **bold** font to reflect the analysis of the pronoun grammar, as part of the positioning theory analysis. In reference to the research questions, the reflective voice prompting the students using these stems would allow analysis of their positioning and agency in relation to the game-based learning experience.

A notable limitation of the dice protocol was that words like 'knowledge' and 'skills' were taken to have the same meaning by many students in the sample. The sentence stems using the terms 'learner' and 'understanding' were similar enough that students believed they had already answered and did not respond differently to the second stem when it appeared. The students' interpretation of these specific words in the stem suggests that they perceived these as interchangeable words; the nuances in the words' meanings may not have been part of the student's everyday language. In terms of data generation, this limitation may have been overcome using the PMM map and Interview 1.

In Interview 1 with the students from Forest Springs, a bingo card format was trialled (Figure 19). This served two purposes, first to keep track of which questions had already been discussed and second as a prompt for students to read ahead and anticipate their possible answers. Should the game-based interviews be implemented again, I suggest that this bingo card be used alongside the dice protocol. It seemed to support students to see across the kinds of prompts they would respond to in addition to keeping track of the prompts already answered.

'Bingo' card interview Question Tracker

Dice 1

I was surprised about/when.....	I found Game Maker interesting because....	I found Game Maker challenging so I ....
I show I am a learner when I....	I show my understanding best when I can....	The best thing about this topic was when I....

Dice 2

The skills I used from Game Maker will come in handy when....	The knowledge I used in this topic will come in handy when.....	When I grow up I want to be......
My favourite activity at school is.......	My favourite activity at home is.......	My friends would describe me as....

Figure 19: Bingo card question tracker for Interview 2.

The last few subsections outlined the data generation instruments and interview protocols, with attention to how these instruments were designed to enable the agency of students and teachers within the research. The next section summarises the technical notes for the recordings, transcription of the interviews, and the generation of pseudonyms for participants and schools.

4.1.7 Technical notes for data generation

This section documents the practical aspects of recording and transcribing the interviews, and generating pseudonyms for participants and schools. The software used for recording, transcription, and analysis was selected as it aligned with the requirements of the ethics protocols for generating and storing digital data.

4.1.7.1 Recording, transcription, and storage of data

The researcher recorded all interviews using the voice-recording function on a smartphone. Voice recordings were immediately saved in password-protected Evernote and Google Drive accounts. The researcher transcribed the voice recordings and saved them in password-protected Dropbox files. Student and teacher PMM maps were scanned and saved in password-protected Dropbox and Google Drive files.

4.1.7.2 Data treatment, coding, and analysis

Data generation was shaped by the concepts of agency, practice theory, and positioning theory; the data analysis encompassed these frameworks and was supported by the themes from the literature review. Using a combination of these approaches served to ensure that the data analysis was a rigorous process and that the storylines that emerged were substantiated by the co-generated dataset.

In line with ethics, the teachers and students were invited to nominate their own pseudonyms; these pseudonyms are used throughout the transcripts and data chapters in this thesis. The schools were also given pseudonyms, and potentially identifying references to the schools in this thesis have been redacted.

Initial and narrative theme coding phases were used for the data treatment process. The initial codes used in this process stemmed from the literature review and were analysed using the theoretical frameworks presented in Chapter 3.

The narrative themes were further interrogated during thematic coding using MAXQDA12 software (Kuckartz, 2015). This allowed the comparison of transcripts and emergent themes both within and across each school's dataset. The MAXQDA12 software provided graphic representations of the coded themes, validating the analysis already undertaken on paper.

4.1.7.3 Initial coding

As a first step in analysis, a process of initial coding was undertaken. The PMM maps and interview transcripts, were read together, seeking any patterns or themes in the data itself. This step supported insights into the storylines and positioning put forward by the students.

Student and teacher interview transcripts were reviewed alongside their PMM maps and examined with reference to their discursive practices: what they 'say and do' (Benoist, 2012; Burkitt, 2002; Harré & van Langenhove, 1999; Putnam & Borko, 2000; Redman & Fawns, 2010) with emphasis on exploring the relationships participants perceived. Key words and phrases were coded in line with the literature review themes and analysed for any further themes and patterns that may have arisen within the school datasets (Corbin & Strauss, 1990, 2008; Lincoln & Guba, 2013).

Pronoun grammar was used as an analysis tool. ***I***, ***we***, and ***you*** (Harré, 2012; Harré & van Langenhove, 1999; Redman & Fawns, 2010; van Langenhove & Harré, 1999) were used in the PMM maps and interviews as the first level of pronoun grammar in this initial-coding phase. Exploration of the use of *you*, *they,* and *they're* may have exposed another level of references to people, processes, or artefacts in the setting. The use of qualifiers, for example, *perhaps* and *maybe*, can be indicators of either a strengthening or distancing of the speaker to the artefact or idea. In my research, the pronoun use could also have positioned the game-based learning experience as an entity. Pronoun grammar supported the analysis of the PMM maps and interview transcripts, highlighting patterns in the teacher and student rights and duties (Pinnegar et al., 2011; Redman & Rodrigues, 2008) through their 'say and do'.

In addition to pronoun grammar, positioning theory (Harré & van Langenhove, 1999; van Langenhove & Harré, 1999) was used in this analysis. Transcripts were analysed to indicate instances when performative or accountative intentionality were put forward. When reflecting on interactions during the learning experience, student use of phrases such as '**We** tried to add a motor' may indicate shifts in the student's perception of their agency as part of the group. Due to the socioconstructivist nature of all the learning experiences across this dataset, it may be that student reflections present a richer view of learning than that attained through testing and observation alone (Scardamalia & Bereiter, 2006; Zhang et al., 2007). Such approaches have been used across educational research, with success in showing agency and positioning of participants in educational settings.

Pronoun grammar analysis and positioning theory can be used in combination to provide a fine-grained analysis beyond what is said, how it is said, and by whom it is said. As a dialogical interaction unfolds, the positioning of the participants can change, giving insights into the rights and duties of the participants and the local moral order of the setting. The positioning theory triad is used to present the summary of this psychological discursive analysis, with examples of participant speech acts that supported the storylines and positioning presented. Figure 20 is an example of a positioning triad as presented in the analysis chapters.

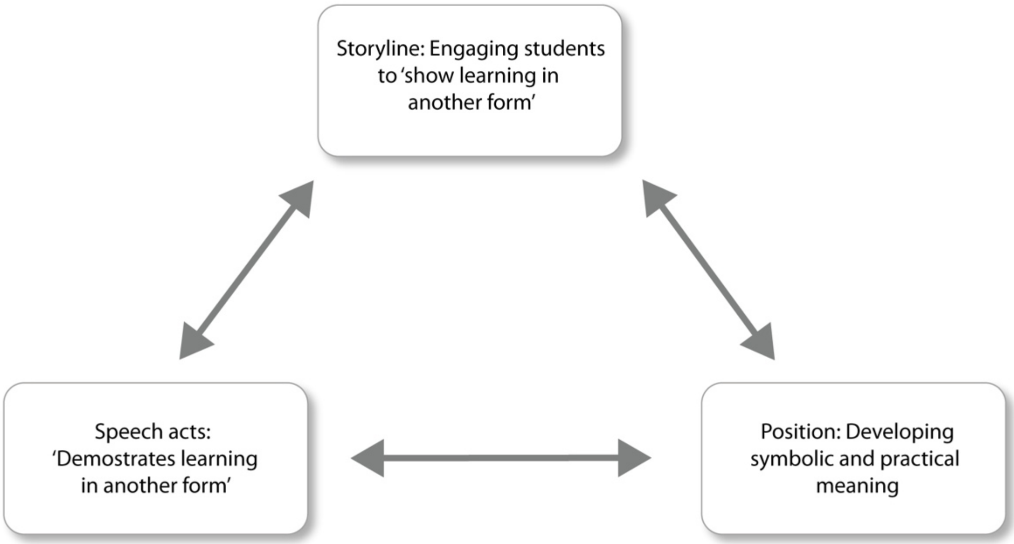

Figure 20: Mutually determinant positioning triad used to explore the Grade 1 teacher's self and other positioning in the research conversation.

After the initial-coding phase outlined above, coding of the narrative themes was undertaken in line with the patterns recognised.

4.1.7.4 Narrative theme coding

In an effort to understand the relationships between the students and their game-based learning experiences, a second step in data analysis was the process of coding using the narrative themes. Thematic coding built the initial-coding phase by seeking connections between the narrative themes, and exposing deeper relationships within the data analysis. These relationships supported an understanding of the 'systematic study of the creation and management of meanings' (Harré & Slocum, 2003, p. 100) to further support the positioning theory analysis and development of storylines from the narratives.

As explored in the literature review, teachers and academics justify the use of games as a learning tool because they are perceived to bring elements of engagement, motivation, challenge, and fun to the classroom experience. In the first level of coding—the student and teacher transcripts—engagement, motivation, challenge, and fun developed as themes. Twenty-first century skills (Dede, 2007; Scardamalia et al., 2012) were used as another level of thematic coding. These constructs sought to align the patterns in the transcripts to identify and validate narrative themes (France, 2010) and narrative types (Clandinin & Connelly, 1996).

The literature reviewed in Chapter 2 influenced the themes anticipated in the data, while others arose from the student and teacher narratives in the initial coding stage. The wide range of narratives collected in Sools, Tromp, and Morren's (2015) research gave rise to thematic categories such as personal orientation and values, goal setting, monitoring goal-directed behaviours, and exploring options. The data generated in the student and teacher reflections in my study gave rise to themes of personal value of learning through game-based experiences, specific goal-directed learning behaviours, and storied future selves in relation to knowledge and skill use beyond the game-based learning experience. I anticipated the students would describe their game-based learning experiences by discussing examples of their communication, collaboration, critical thinking, problem-solving, and cognitive engagement in the activity.

Insights into specific learning behaviours that students discussed include actions of themselves and others and feedback from the game or others. These themes emerged from the literature and included students' perceptions of the following in their reflections on their game-based learning experiences:

- Learner behaviours;
- New knowledge and skills;
- 21c skills;
- Anticipated future use of knowledge and skills from the game; and
- Challenges during game play.

These themes were further supported by the findings of Rowan, Townend, Beavis, Kelly, and Fletcher (2016), where the coding of open responses about the use of digital games at school, by Australian school students in similar age groups to those in my study (6 to 14 years), revealed themes of discovery, collaboration, social connection, and problem-solving. In a separate study by Bereiter and Scardamalia (2010), students used phrases that identified new knowledge and skills and could contrast these with their prior knowledge and skills. Students who anticipated future use of the knowledge and skills highlighted through the game were likely to value the game space as a novel learning experience, as supported by the findings of Hakverdi-Can and Sönmez (2012) and Yang (2012). How students discuss the anticipated and unexpected challenges in the games may also give insights into attitudes to games as learning experiences, including motivation and ludic (playful/fun) mindsets (Dubbels, 2013a; Echeverría et al., 2011; Joo, Joung, & Son, 2014; Pink, 2009). Together, these themes reflect some of the complexity of a student's learning experience in the classroom context.

The recognition of teacher professional agency to support learner agency within this pedagogical event may be important. The teacher's' reflections were anticipated to give insights into their professional and moral agency (Boylan, 2010; Russell, 2002; Stieler-Hunt & Jones, 2015; Paul Sullivan & McCarthy, 2004). Teacher transcripts were examined for their perceptions of rights and duties (Pinnegar et al., 2011; van Langenhove & Harré, 1999) in planning learning experiences for their students. The game-based learning experience was the object for the teachers' PMM maps. Within and across settings, teachers' explanations of their reasoning and actions were analysed. In this sociocultural frame, the teachers' curriculum-making narrative (Huber, Murphy, & Clandinin, 2011) gave insight into their enactment of professional moral agency, with emerging themes aligned to the *Australian Professional Standards for Teachers* (Education Services Australia, 2011).

My study provided an opportunity to analyse students' reflections in a new way. In addition to the students positioning themselves and the game within the local moral order of the school, my analysis considered the ontological nature of the game as a site or context for learning. The text record of dialogue was analysed through positioning theory, while the site of the transaction was attended to through a contextual analysis using practice theory. In this analysis, the game may be attributed to have its own local moral order, which may be discerned through the dialogue about the game as a site of practice.

When woven together, these approaches provided an analysis of the moral agency that students and teachers perceived when engaged with game-based learning experiences in a classroom setting. By using these sociocultural theoretical frameworks to consider students' interactions with game-based learning experiences, I provide empirical evidence to consider the moral space that influenced the perceived success of the game-based learning experiences.

4.2 Sample Schools, Contexts, and Methods

4.2.1 Selection of schools for participation

The focus of my research was to observe and co-generate student-centred accounts of game-based learning experiences in schools in Victoria between 2012 and 2015. I did not design or impose these experiences. I hoped to gain insights into the existing practices of game-based learning in schools as a point of difference to the research literature, which has many examples of specially developed digital games being implemented in classrooms with their effect measured through testing.

Between 2012 and 2015, I invited the principals of six primary and secondary schools through email and phone to take part in this research. Of these, four agreed to participate as they used game-based learning experiences as a part of their classroom programs. I visited the four schools to meet with each principal to discuss my research project and gain consent to work with the school community. After this, I met with the teachers of each class the principals had nominated and gained consent from the teachers for their involvement in the study. I spoke to each class group about my research and gave out plain language statements and consent forms to students and their parents. The classroom teacher then collected the consent forms from the students so that in my next visit, I could begin to observe their game-based learning experiences and start the interview process.

As an advocate of agential participation in research, the use of parent and student plain language statements and co-signed parent and student consent forms aligned with my moral obligation as a teacher and as a researcher. The students were aware that the purpose of this research was to investigate their perceptions of learning when using games. There was no hidden agenda in my study, which strengthened the dataset generated.

Note that four schools generated data for this research. During coding and analysis, the student data from two of the schools supported the data already analysed. No new themes were discovered, and so the three case studies that consistently displayed the data themes were chosen for this thesis.

4.2.2 Students and game-based learning experiences in the sample

This section introduces each of the schools and the game-based learning experience offered to the students. Each school is outlined for the reader to gain a sense of the school as a sociocultural space, details of the game-based learning experience, and the interactions available to the students in the classroom situation and research context. I have used the term ‘sample’ in the ordinary sense, not in a quantitative sense. It is a convenient way of describing the grouping for a layperson/reader.

The games used within the schools were commercial games so I explain the legal owners and trademarking conventions used to refer to the game or digital technologies. As the author of this thesis, I refer to these games in my writing as required by the legal owners (e.g., iPad mathematics applications). When quoting student or teacher voice, I refer to the artefacts using participant words (e.g., iPad math app).

The revised Roberts (1996) trialogue detailed in Chapter 3 was further tailored (Figures 23 and 24, 33 and 34, 39 and 40) to depict the two different relationships that existed in the setting. The first trialogue shows the meaning-making process in the normal classroom, where teachers and students were engaged in the game-based learning experience. The second triangle for each site depicts the relationship during the research process, and it includes me as a researcher in the site, co-generating data with the students and teachers at different times but in response to the same game-based learning experience.

First, I introduce the Grade 1 students at Red River used the iPad mathematics applications as a repetitive-learning tool, then I present the Grade 3 students, also from Red River, who used Lego Robotics, followed by the GameMaker: Studio project at Forest Springs where Year 9 students designed their own digital games.

4.2.2.1 Grade 1: iPad mathematics applications: Classroom context at Red River

Red River was established in 2009. The school was envisioned to support a culture of learning through inquiry. Teachers at Red River sought to support a culture of learning using contemporary learning approaches. The school charter and annual report ((Name Redacted), 2014) emphasised that the environment at Red River was supportive of personalised learning. Teachers supported students' personalisation of learning in flexible classroom learning spaces. The professional learning community at this school sought to develop student confidence as lifelong learners:

> The learning environment of Red River Primary School has a variety of flexible learning spaces that inspire creative, productive and efficient learning. These include our both [*sic*] indoor and outdoor learning and play spaces providing an environment conducive to personalised and cooperative learning preparing children for a future of lifelong learning. ((Name Redacted), 2014, p. 4)

The attention to students as experts evidenced the collaborative nature of the learning environment at Red River. The school supported students to develop learning behaviours beyond solely relying on the teacher for assistance. Students were encouraged to enact their agency as learners.

Students used digital technology to progress in their mathematics learning. The CEM (n.d.) guidelines recommend regular use of digital technologies within school activities. At Red River, iPads[2] were a shared digital resource across the composite Prep/1/2 classes. The three streams of Prep/1/2 shared 30 iPads. Teachers coordinated the days and times their classes accessed the iPads.

The teachers at Red River had selected specific mathematics applications that students could play independently. The device did not store any student metrics. Students showed progress to peers and teachers before putting their iPad away. The Grade 1 students in this research used iPad mathematics applications as part of their everyday learning activities.

[2] iPad® is a trademark of Apple Inc., registered in the United States and other countries. The mathematics applications Math Bingo© and Dominoes Addition© were used in accordance with the school's licensing agreement. Math Bingo© was developed by ABCya.com (2010), while Dominoes Addition© was developed by Kondys (2011). These games are referred to in the main text without their © symbol to stay true to students' voice and to enhance the readability of this thesis.

This activity was set as independent learning time, and the games chosen had been designed to be played individually by students. Students engaged in the repetitive nature of the game to practise and build their knowledge of mathematical operations. The setting of this activity reflects a ‘knowledge building environment’ as described by Scardamalia, Bransford, Kozma, and Quellmalz (2012). The students engaged as independent learners, using the technology to improve their accuracy in using mathematical operations.

While students often worked independently with iPads, this did not mean they were isolated from their peers. The iPads were most often used while sitting with a small group of students, giving options for parallel play (Child Development Institute, n.d.) while supporting collaborative sharing as students felt the need. While playing different games alongside each other, the students shared moments of success in the game with those sitting close to them.

The students used the iPads in their mathematics independent learning time. The Grade 1 students discussed their favourite iPad mathematics application in this research. The learning focus for the Grade 1 students was practising mathematical operations: addition, subtraction, multiplication, and division. Each time students used an iPad for their independent learning time, they could choose which game they played, the level of difficulty, and the mathematical operation. The Grade 1 students at Red River were using iPad mathematics applications to practise and apply their mathematical knowledge and skills.

iPad mathematics application 1: Math Bingo at Red River

The first iPad mathematics application to be presented is Math Bingo (ABCya.com, 2010). Figure 21 shows the game interface. The students begin by selecting a mathematical operation, such as addition, subtraction, multiplication, or division, and a play level, such as easy, medium, or hard. The repetition in this game supports student development of speed and accuracy in the operation chosen.

Math Bingo presents its game interface as a bingo-style card (left-hand panel, Figure 21). At the top is the mathematics problem, and students match an answer from the bingo-style card below. When students select a correct answer, an animated bug covers one of the squares on the bingo card, accompanied by a sound effect. Students continue to answer questions until they have filled a whole row with animated bugs. When the row is filled, further music and animations play (middle panel, Figure 21), signalling the student's successful achievement of the 'bingo' goal. The bugs are then released to play in a mini-game (right-hand panel, Figure 21). At the completion of the mini-game, coins are awarded and the student is returned to the main screen to select another mathematical operation and level.

Figure 21: Math Bingo iPad mathematics application: Images from playing interface.

Students are supported as learners through multiple features of the Math Bingo game design. First, the repetitious presentation of mathematical problems aligns this game as a rehearsal space for students to practise their mathematical skills. Students' actions within the game attain immediate feedback on their success. The animated bugs and sounds act as an in-game reward. The collection of multiple bugs lead to a further level achievement goal by unlocking a mini-game. Levels in game rewards are acknowledged as extrinsic motivators within this style of educational game (McGonigal, 2011; Whitton, 2010). In terms of game attributes, these in-game rewards act as self-assessment of student success (Bedwell et al., 2012; Michael & Chen, 2005; Owen, 2004).

Math Bingo presents a variety of mathematical operations and levels of challenge. Students have choice within the game to select a level of difficulty (Bedwell et al., 2012; Michael & Chen, 2005; Owen, 2004). When they begin to play the level chosen, the game has programmed adaptive features (Bedwell et al., 2012). Should a student be repeatedly unsuccessful in answering the questions, the difficulty of the questions presented by the game are reduced (Bedwell et al., 2012; Michael & Chen, 2005; Owen, 2004). The game design focuses on supporting students to meet the goals of the game. Student choice and in-game adaptive difficulty are key game attributes that may be supportive to learners playing Math Bingo (Bedwell et al., 2012; Michael & Chen, 2005; Owen, 2004).

Kate, Charlotte, and Jacob chose Math Bingo as their favourite application. Their narratives are analysed with a focus on their identification of learning behaviours and anticipated future use of the mathematical knowledge and skills. The fourth student in this sample was Samuel; he used Dominoes Addition, and this application is described next.

iPad mathematics application 2: Dominoes Addition at Red River

Dominoes Addition (Kondys, 2011) has varied levels of play. All the levels use images of dominoes as a digital representation of the counting resource (Figure 22). The numerical and visual materials on the game screen provide tools for the student to think and act in the virtual space. The game designer Kondys (2011) suggests that the students' use of dominoes in the virtual space may be similar to using dominoes in the physical classroom. The support website for the Dominoes Addition application has free printable domino tasks to use with students in the classroom (Kondys, 2011).

Dominoes Addition includes six different game modes to choose from: sorting dominoes, equal the dominoes, add the dominoes, complete the dominoes, pick the dominoes, and a teacher tool. The teacher tool is designed to support the teacher to work with individual students. Samuel, who chose this application as his favourite, played 'equal the dominoes' and 'add the dominoes' modes independently of the teacher.

Students choose how to answer the mathematics problems presented within Dominoes Addition. The screen shots in Figure 22 show these choices. Students can drag the matching numbers to the dominoes, they can drag dots onto dominoes, or they can select a domino to represent answers to mathematical problems. In higher levels of game play, a question mark represents a mystery number. This format encourages the student to work backwards from the answer to solve the problem in a pre-algebra format (A. Kondys, personal communication, 30 March 2017).

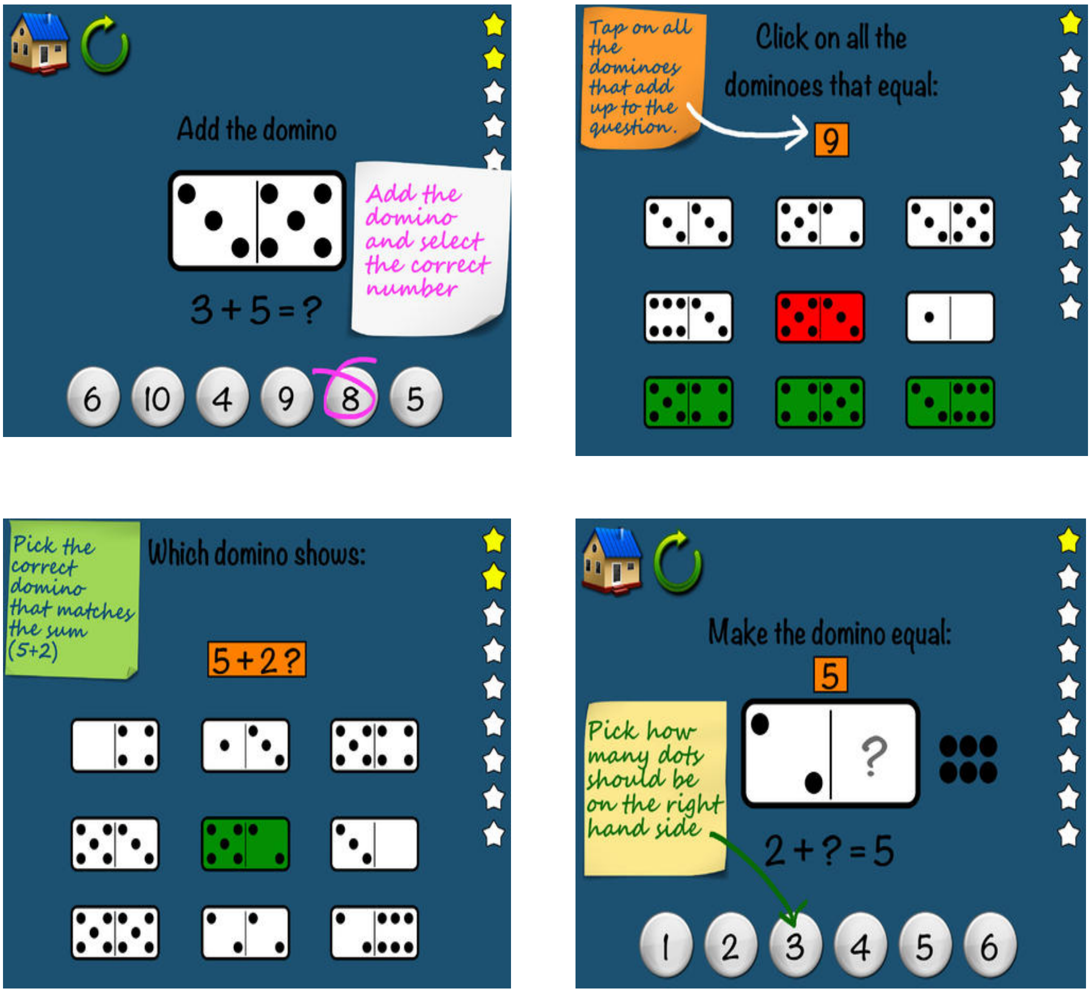

Figure 22: Screenshots of Dominoes Addition, showing varied levels of game play.

The in-game rewards in this application are minimal. When an answer is correct, the domino changes colour from white to green, while an incorrect answer changes to red. If a student chooses an incorrect answer, they continue to select dominoes until they obtain the correct answer. The stars on the right-hand side of the screen accrue as mathematical problems are completed. If a student chooses an incorrect answer, no star is awarded for that problem. After completing the series of nine problems, the student then has a choice to replay the level or to go back to the home screen to select a different game mode. The feedback is immediate, supporting students to self-assess their progress (Bedwell et al., 2012; Michael & Chen, 2005; Owen, 2004).

Dominoes Addition is designed for students to use alongside a teacher. It does not have an adaptive game mode (A. Kondys, personal communication, 30 March 2017). The opportunity for the student to have multiple attempts within each question is a feature to support student persistence. In the game modes chosen by Samuel, the interface screen presented multiple correct and incorrect answers. This design feature supported the student participants to consider the multiple possible solutions, expanding their skills in solving these problems.

Summary of game design features

Common game attributes (Bedwell et al., 2012) designed to be conducive to learning in both Math Bingo and Dominoes Addition are as follows:

1. The student has a choice of mathematical operation and game level (Bedwell et al., 2012; Michael & Chen, 2005; Owen, 2004).
2. The game interface has visual feedback to track progress (Bedwell et al., 2012; Michael & Chen, 2005; Owen, 2004).
3. Repetition of mathematical problems in the game targets repetitive-learning methods for the students (DET, n.d., 2013).
4. Math Bingo includes the use of adaptive programming to support students' incremental development of skills (Bedwell et al., 2012; Michael & Chen, 2005; Owen, 2004). This provides challenge within their zone of proximal development (ZPD) (Samaras & Gismondi, 1998; Vygotsky, 1966).

These four game design attributes (Bedwell et al., 2012) may support students in their successful completion of independent learning activities (DET, n.d., 2013).

The trialogue below (Figure 23) provides a diagrammatic representation of the interactions between the teachers and the game as a knowledge domain, at different times to the students interactions with the game. These asynchronous interactions occur for the teacher during the her preparation time and the students during their numeracy time in the classroom.

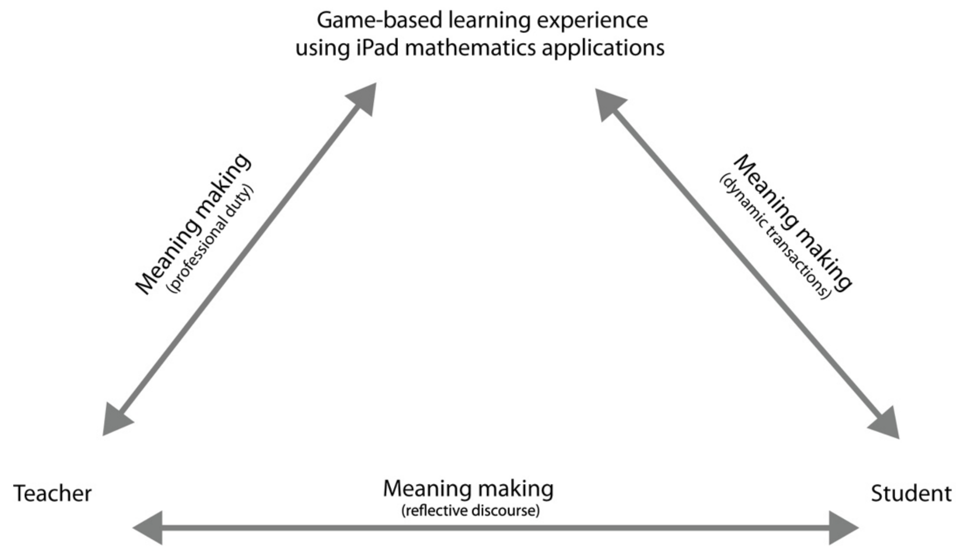

Figure 23: Roberts' (1996) trialogue depicting the normal classroom relationship of the teachers and students (agents) with the game-based learning experience using iPad mathematics applications (artefact) at Red River.

4.2.2.2 Red River Grade 1: iPad mathematics applications: Research context

The PMM map drawing and interviews took place after the above classroom experience took place with the Grade 1 students. The adapted Roberts (1996) trialogue in Figure 24 outlines the relationships between the teachers, students, and me as the researcher. As researcher I designed the protocols, including the interview 1 and 2 questions to guide reflection on the game based learning experience for the students and teachers. An explanation of the specific steps that occurred to co-generate the data with the Grade 1 students follows.

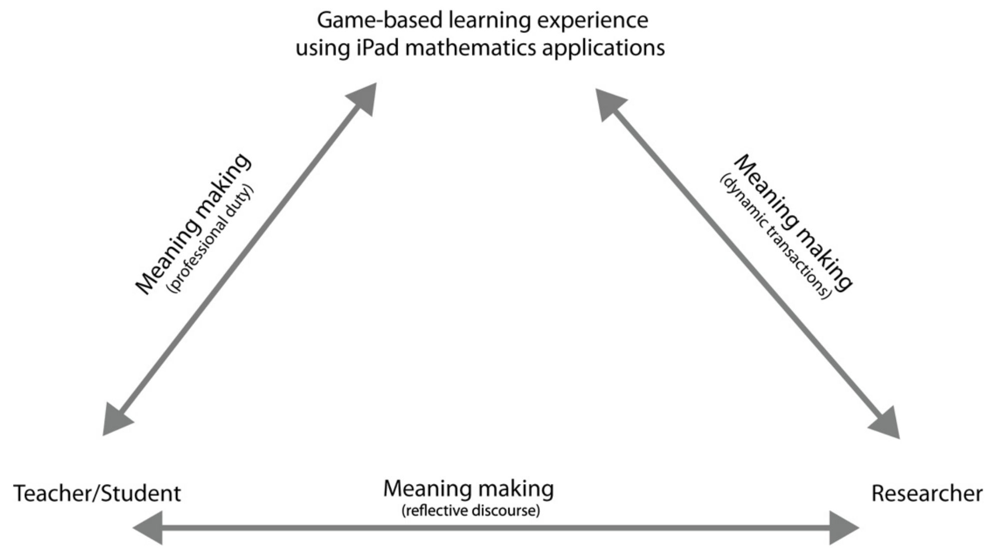

Figure 24: Roberts' (1996) trialogue depicting the relationship between the teachers' and students' interactions during the research and their game-based learning experiences using iPad mathematics applications (artefact) at Red River.

Selection of sample: The principal and teachers selected students who might be involved in this program, and I gave interested students plain language statements and consent forms to obtain parental consent; those that returned them were included.

Eight Grade 1 students returned their notes and participated in the data generation phase in their school. One of the Grade 1 students withdrew through the data generation process; he was present for Session 1 and chose not to join the group in Session 2. The data was generated with the students across the sessions: an observation of their time using the game-based learning tool, a PMM map drawing session, and the first of the two interviews followed two weeks later by the second interview. The interactions for each school context are summarised below.

Student Session 1: Eight students were seated in a conference room, each with an iPad. The observation stage involved the researcher moving around the students and audio recording their explanations of the iPad mathematics application they had chosen. Each student then drew their own PMM map and took turns to talk through their map, further describing their learning when playing the game. This took up to 15 minutes in total for each student.

Student Session 2: Three weeks later, students returned in groups of four to discuss their PMM map and extend the previous conversational interview. In this discussion, students were invited to read their Interview 1 transcript and annotate their PMM map to show their learning and reflected experience. Two students added words and symbolic embellishment to their PMM maps. All students responded to 12 set prompts in the follow-up Interview 2 presented as a dice game. This took place during 20 minutes for each group of four students.

Introduction to Red River Grade 1 students

Each student is now introduced through their PMM map and short vignettes, followed by a brief introduction to their teacher.

Introduction to Kate

Kate presented as a quiet and shy 6-year-old student. At home, she liked playing mathematics games on her iPod, while at school she enjoyed mathematics on the iPad. Kate was unsure what she would like to be when she grew up.

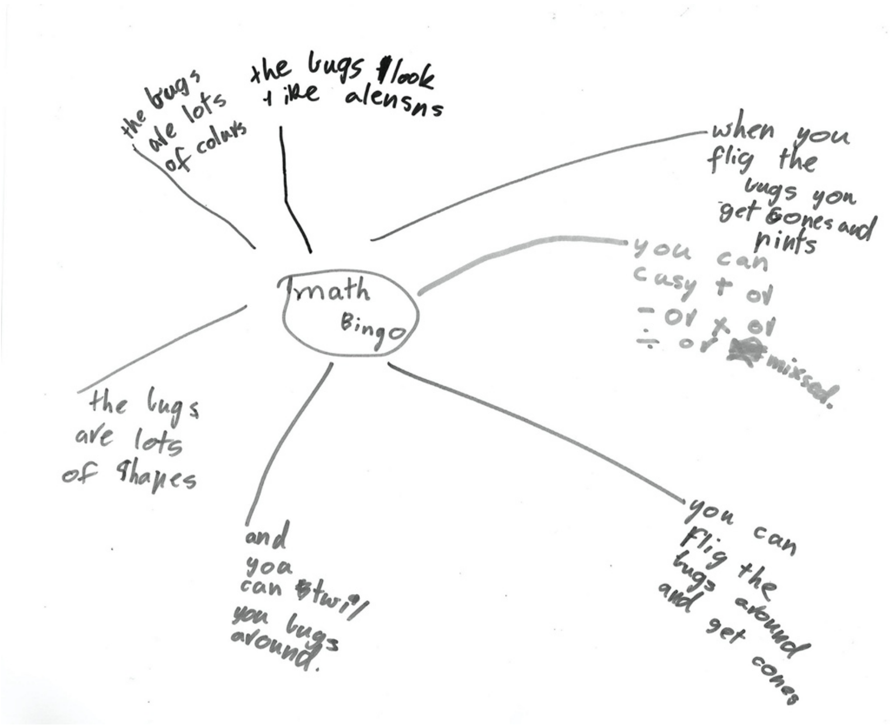

Figure 25: Kate's PMM map.

Kate's PMM map (Figure 25) included descriptive detail of aspects of game play, choice of task, and feedback mechanics. She repeated the in-game reward system of bugs and coins through her PMM map. Kate focused on the in-game actions of 'flinging' and 'twirling' the bugs to access the coin reward. The use of active verbs indicates she considered these actions exciting aspects of game play. She also referenced the choices of addition, subtraction, multiplication, and division operations in the game. Kate selected addition when she demonstrated the game to me. In using the pronoun ***you*** in her PMM map, Kate positioned herself performatively (Harré & van Langenhove, 1999) as she explained her learning within the application.

Introduction to Charlotte

Charlotte was a confident and friendly 6-year-old student who wanted to be a teacher when she grew up. At school, she enjoyed sport, and at home, she liked to play on the iPad. Before I began observations, Charlotte approached me and demonstrated other applications she used on her iPad to practise her written characters in an additional language. Her confidence to approach a new adult in the school setting and share her learning unprompted was notable. Charlotte appeared passionate about sharing her learning with others.

Figure 26: Charlotte's PMM map.

Charlotte's PMM map (Figure 26) used the pronouns ***I*** and ***you,*** exhibiting a shift between explaining the application and asserting her thoughts about her learning within the game. She shared her perceived position as a learner through the statements evidenced with her direct experiences. Charlotte placed herself in a performative first order position (Harré & van Langenhove, 1999) through her PMM map. When using Math Bingo, her perceptions of her rights and duties (Pinnegar et al., 2011) centred on learning and anticipating challenges within the game. Charlotte did not note the bug reward in her PMM map.

In Interview 2, Charlotte was one of two students who further developed her PMM map. Her new statements are indicated on her PMM map (Figure 26) with the numeral 2.

She repeated points already made on the PMM map in the first sitting: ‘I think Maths Bingo helps you learn maths questions’; ‘I think you have to answer so you can get better at learning the harder maths questions’; ‘When you get to harder levels it gives you harder questions and it got a bit challenging’. Charlotte’s repetition of these main points supported the reliability of the ideas she shared. There seemed to be a stability in her perception of her agency as a learner using this application over the period of data generation.

Introduction to Jacob

Jacob was a chatty and friendly 6-year-old boy. Jacob enjoyed learning mathematics at school and practising his times tables at home. When Jacob grew up, he wanted to be a ‘maths teacher’. His narrative gave insight into his love of learning and confidence in mathematics.

Like Charlotte, Jacob was one of only two participants to add to the PMM map during Interview 2. He added pictures of the bugs being flung to collect coins. Jacob was the only student in this Grade 1 sample to share an application of mathematics skills and knowledge beyond his current classroom setting.

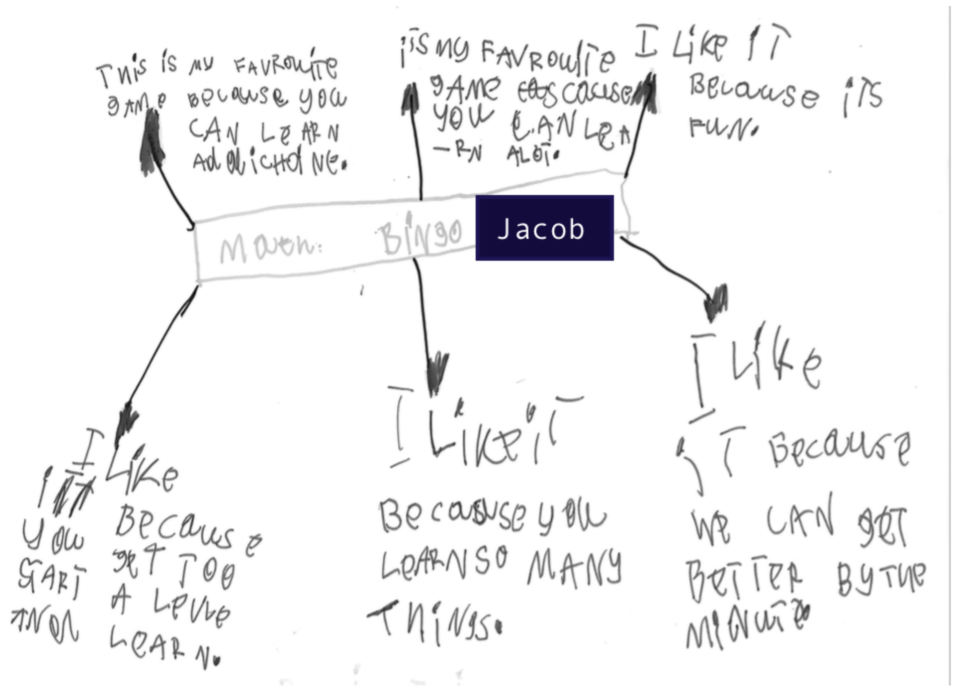

Figure 27: Jacob's PMM map.

Jacob positioned his PMM map (Figure 27) with the use of the pronouns ***I*** and ***my*** in each of his statements. Jacob conveyed his excitement about the use of Math Bingo by starting each of his six statements with 'This is **my** favourite . . . and **I** like it because . . .'. Jacob considered this application to be helpful in progressing his knowledge and skills in mathematics. This is conveyed through the repetition of the word 'learn' in four of his six statements.

Jacob's PMM map stated, 'I like it because it is fun'. His other statements focused on further reasons he liked Math Bingo: 'You can learn addition'; 'You can learn a lot'; 'You get to start a level and learn'. The written statement, 'I like it because we can get better by the minute', used a shift in pronoun from ***I*** to ***we***. This extended his perception to include his peers as equally successful in the game-based learning experience. In the interview, Jacob broadened his idea, using the pronoun ***I*** to position his personal future learning of mathematics: 'The skills **I** used in this topic will come in handy when **I** learn more mathematics and **I** get more better by the minute' (Transcript 1c; Lines 258–259).

Introduction to Samuel

Samuel was a bright and talkative 6-year-old student who described himself as a mathematician. His favourite activities at school were watching TV and playing tiggy at recess. His favourite activity at home was playing light sabre battles with his Lego Star Wars. Samuel aspired to be a Lego master builder when he grew up. Samuel chose Dominoes Addition as his favourite iPad mathematics application.

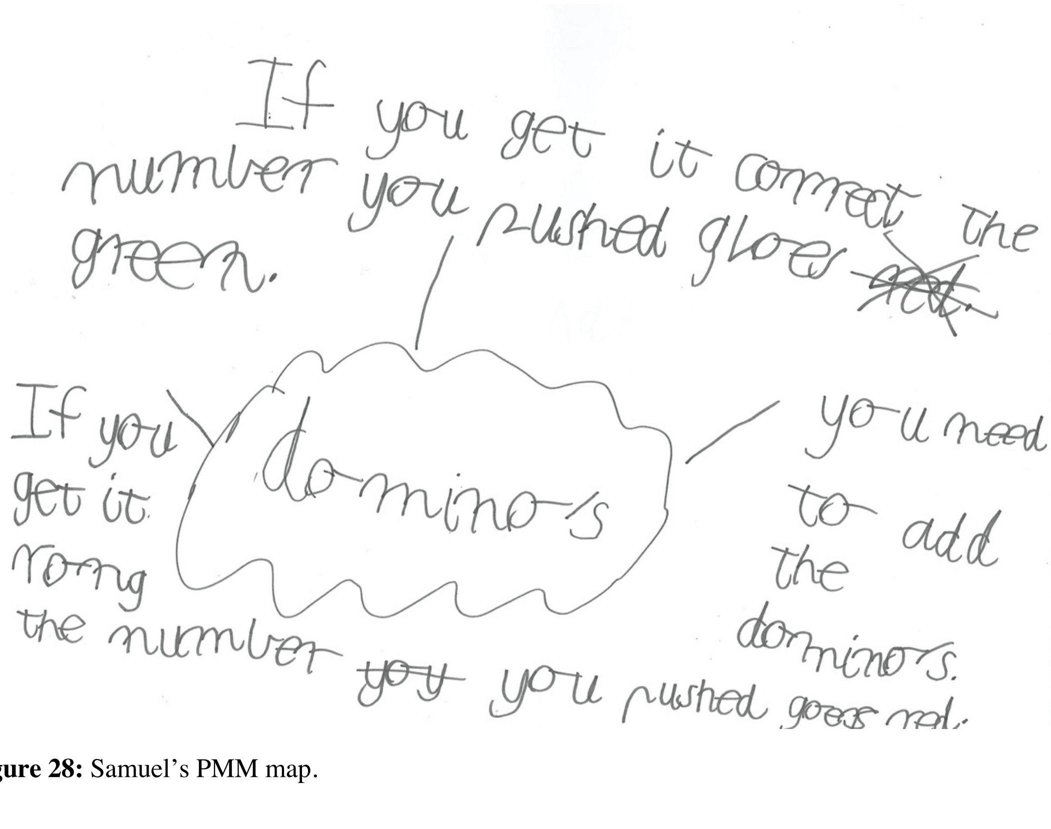

Figure 28: Samuel's PMM map.

Samuel's PMM map (Figure 28) described the three ways that the application helped him learn mathematics. The aim of Dominoes Addition was to 'add the dominoes'. The two key features of the feedback mechanism were highlighted; if an answer was correct it 'gloes [*sic: glows*] green', and 'if you get it rong [*sic: wrong*] the number you pushed goes red'. Like Kate, Samuel positioned himself performatively (Harré & van

Langenhove, 1999); the use of the pronoun ***you*** indicated a step away from ownership of the explanation of this game. This suggested a familiarity with the basic user experience within the game.

Introduction to the Teacher: Monique

Monique was a first-year graduate teacher, beginning her teaching career at Red River. As a beginning teacher, she taught a multi-aged class of Prep/1/2 students. Monique was using the iPad mathematics applications for the first time in a structured classroom environment. She was supported by her year level teaching team to plan and implement these games as part of her emerging professional practice.

4.2.2.3 Red River Grade 3: Lego Robotics

This is the second student sample from Red River. The Grade 3 students were part of a multi-aged Grade 3/4/5 class. The use of digital technology progressed from the use of applications for mathematics in Chapter 3. The use of the Lego Robotics kits[3] in the classroom supported the Grade 3 students to direct their own learning, while learning to build and code robots.

The next section gives insight into the cultural history of Lego as a form of play-based learning followed by an outline of the Grade 3 learning experiences observed.

Lego Robotics as a play-based learning tool

Lego has built a reputation as a creative toy (Mortensen, n.d.) over the last eight decades, with the now familiar plastic blocks patented in 1958. Lego Technics and Lego Robotics are more recent additions to the wide Lego range, marketed as educational tools that introduce students to programming and robotics. Red River had four Lego Robotics

[3] Lego is a registered trademark. It is used in accordance with the school's licensing agreement. It is referred to as a registered trademark (Lego Robotics® software) in the first instance of use in the main text and thereafter as Lego Robotics or Lego, as this is how the students and teachers in the sample referred to it and to enhance the readability of this thesis.

kits for their Grades 3 to 6 students to use as part of their regular class programs. Lego rebranded these kits as WeDo 2.0 in 2014, using an iPad interface. Red River's kits were in the older style, which required a desktop or laptop computer as the programming interface. The contents of the kit consisted of physical blocks and electronic components, like motors, with a USB cable to attach to a computer loaded with the Lego programming software (Figure 29).

Figure 29: Lego WeDo 2.0 kit, similar to the Lego Robotics kit used at Red River. (Image credit: Lego, 2016)

This software uses a format familiar to children from the commercial Lego toy instructions, with simple graphics presented as iconic flow charts for students to follow. This graphic format uses minimal language, providing an opportunity for differentiated access for students to the learning experience. The programming interface on the computer uses icons that students can drag and drop to follow the set tutorial or adapt to create their own program (Figure 30).

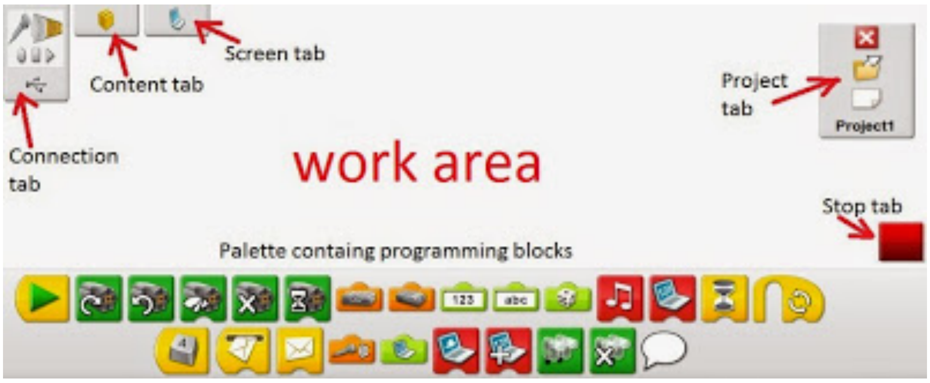

Figure 30: Screenshot of the programming interface for Lego Robotics. Note the icons and symbols used to program. (Image credit: Robotics for Children, 2015b)

By plugging the robot into the USB cable and clicking on a play icon, students can test their program on the robot (Figure 31).

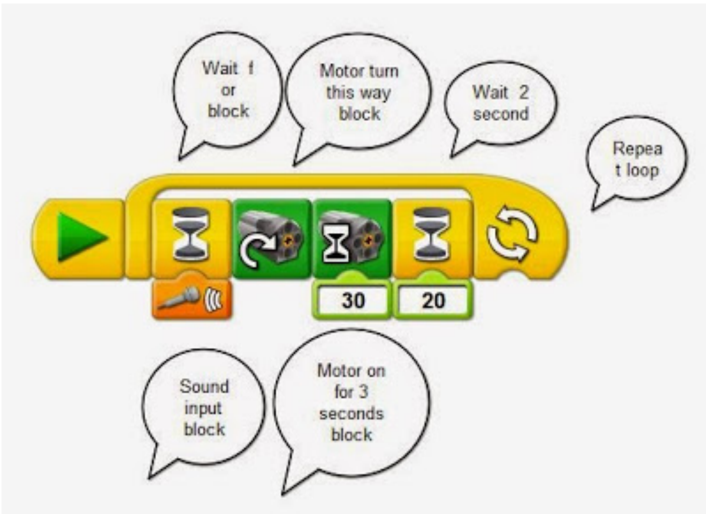

Figure 31: A screenshot of a completed Lego Robotics program. Note the green play icon on the far left. (Image credit: Robotics for Children, 2015a)

The feedback from testing the robot is immediate; on the screen, the program lights up the steps in order, and the robot either moves as programmed, or not. Students may then change the program on the screen or adapt the design of the physical robot. The real-time feedback through this interface provides a safe place for students to explore this tool and make visible their progress in learning in both construction and robotic programming.

Hromek and Roffey (2009) and Zhang, Scardamalia, Lamon, Messina, and Reeve (2007) noted the potential of technology to support varied collaboration of students in classrooms, specifically towards building both knowledge and 21c skills (Dede, 2007; Ingram, 2016). The game-based learning experience using Lego Robotics offered students the opportunity of collaborative and cooperative problem-solving. The teacher, Judith, highlighted these skills as important in her planning for the students' learning and supported her pedagogical choice to implement Lego Robotics as a small-group task. These skills formed part of the knowledge domain depicted in the trialogue in Figure 32.

Lego Robotics formed a normal part of technology use within the school. This technology was available for Grade 3 to 6. The principal suggested the Lego Robotics session as students' contemporary use of technology. While Lego Robotics is not strictly defined as a game, this activity utilised the familiar cultural tool for students in a play-based building and programming activity. It is also a relevant play-based cultural tool (Bruner, 1983) for this age group.

Students worked with a Lego Robotics kit in groups of four. The school had three Lego Robotics kits and three computers (two laptops in the classroom and a desktop computer in the conference room), which were loaded with the Lego Robotics software. I observed the four students Brian, Lily, Rosie, and Jackson selecting, building, and programming two robots. These interactions between the students and the game are shown on the right hand side of the trialogue in Figure 32. We were situated in the conference room as this was a familiar environment for the students undertaking this activity.

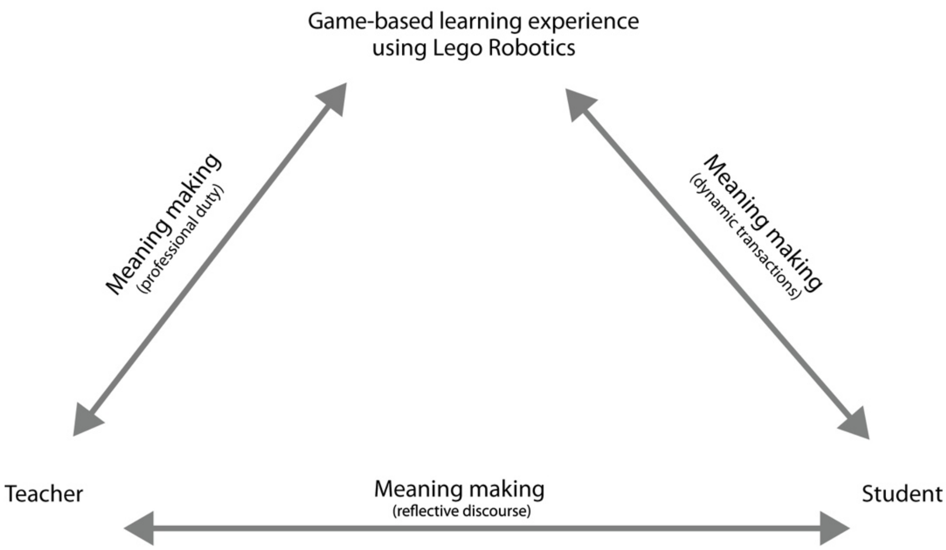

Figure 32: Roberts' (1996) trialogue depicting the normal classroom relationship of the teachers and students (agents) with the game-based learning experience using Lego Robotics (artefact), Red River.

The Lego Robotics was part of the planned program at Red River. Students interacted with it in small groups during their classtime. The next section explains how the research was conducted to capture the student's learning experience.

4.2.2.4 Red River Grade 3: Lego Robotics: Research context

In the session, I observed that the small group of students had free choice to build two robots. They were excited to be involved in this session. Lily and Rosie did not have Lego at home, and it was the first time they had used Lego Robotics at school. Brian and Jackson were familiar with Lego and had used this set at least once before with a multi-aged small group. We were situated in the conference room, which had an interactive whiteboard and computer to display the programming software.

In the 50-minute session, the students completed two robots. First, they chose to make a plane, and second, they made a bird. The plane instructions were straightforward, and students successfully completed both the building and programming. The second robot was more complex. The initial diagram for the program of the bird promised a bird that would flap its wings. However, the building and program instructions led to a bird that would move its head and chirp. The students successfully built the bird, but they believed it was not a successful execution of the program as the wings did not flap as had been advertised.

Brian stopped the others from dismantling the bird and attached the motor from the previously made plane to the wings of the bird. This did make the wings flap as expected; what was not expected was the powerful motor coiling the USB cable and the bird flipping over. These students had exhibited many skills in this session, including problem-solving a bugged (nonworking) program. The students' description of the cognitive conflict and their learning in this situation became the storyline of this chapter. The findings section introduces each student and explores their reflections on their experiences, including the problem-solving that eventuated from the interaction with the bird robot as an artefact.

The adapted Roberts (1996) trialogue in Figure 33 gives an overview of the researcher relationship in conversation with the teachers and students about the Lego Robotics learning. My role as the constructor of this study has impacted on the level of reflection the students and teachers have taken after these experiences. The specific data generation process is outlined next.

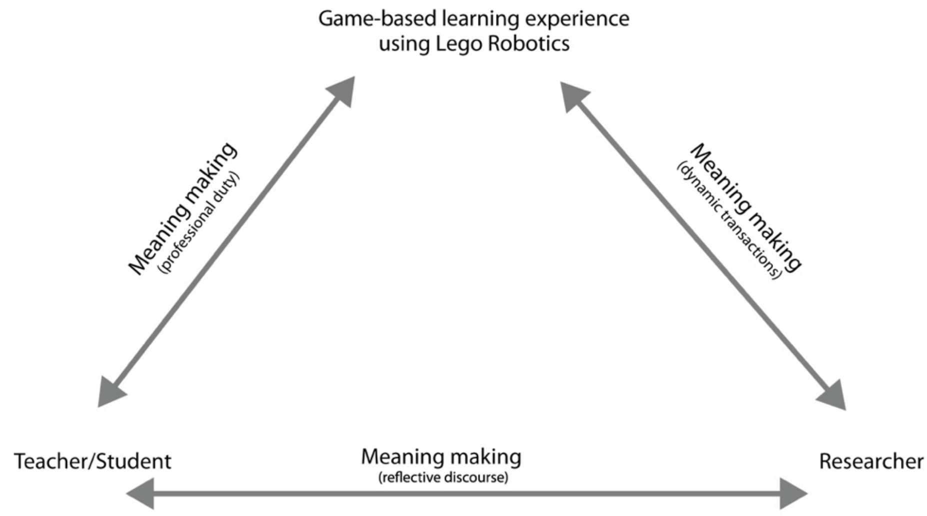

Figure 33: Roberts' (1996) trialogue depicting the relationship of the teachers' and students' interactions during the research with their game-based learning experiences using Lego Robotics (artefact), Red River.

Selection of sample: The principal and teachers selected students who could be involved in this program, and I gave interested students plain language statements and consent forms to obtain parental consent; those that returned the forms were included. Four grade three students returned their consent forms and participated in the following sessions.

Student Session 1: Four students were seated in the conference room with the researcher. The conference room was a familiar room for the students as it was often used for small-group tasks like the Lego Robotics. The software for the Lego Robotics was loaded on the computer in the conference room, and students used the interactive whiteboard to navigate the program. Students chose two robots to make in this game-based learning experience and discussed their building with me during the 50-minute class session. After recess, the four students returned to the conference room to work on their PMM map and participate in Interview 1 which took 10 minutes per student.

Student Session 2: Three weeks later, Interview 2 took place. The students were invited to read their first transcript and annotate their PMM map. Students then responded to 12 set prompts in the 20 minute follow-up interview presented as a dice game.

Teacher Session 1: These took place with two teachers, separately though on the same day as the student interviews. Teachers developed a PMM map reflecting on the pedagogy and choices they had made to support the students' learning with either the iPad mathematics applications or the Lego Robotics.

Teacher Session 2: The follow-up interviews took place three weeks after Interview 1. Teachers read over their interview transcript. The questions used in this interview built upon the themes and ideas explored in the teachers' PMM maps. The teachers were invited to add to their PMM map; however, this option was not taken up.

Introduction to Red River Grade 3 students

Each student is now introduced with their PMM maps. Followed by a brief introduction to their teacher.

Introduction to Lily

Lily was a chatty and friendly 9-year-old girl who enjoyed mathematics and problem-solving activities at school. She liked to investigate new things and thought her friends would describe her as an explorer. When she grew up, Lily aspired to be a doctor, a vet, or a scientist.

Lily had not used the Lego Robotics kits before. Despite this, she displayed a confidence to be involved in leading the group as they built and programmed the robots. Lily positioned herself as one of the leaders in this small group, taking on roles including reading instructions, locating pieces, and being involved in programming decisions. This positioning extended to her PMM map, where she used ***I*** at the beginning of all eight statements about her learning with Lego Robotics. Lily's consistent use of this pronoun indicates a first order performative position (Harré & van Langenhove, 1999), showing ownership of her role in the learning process.

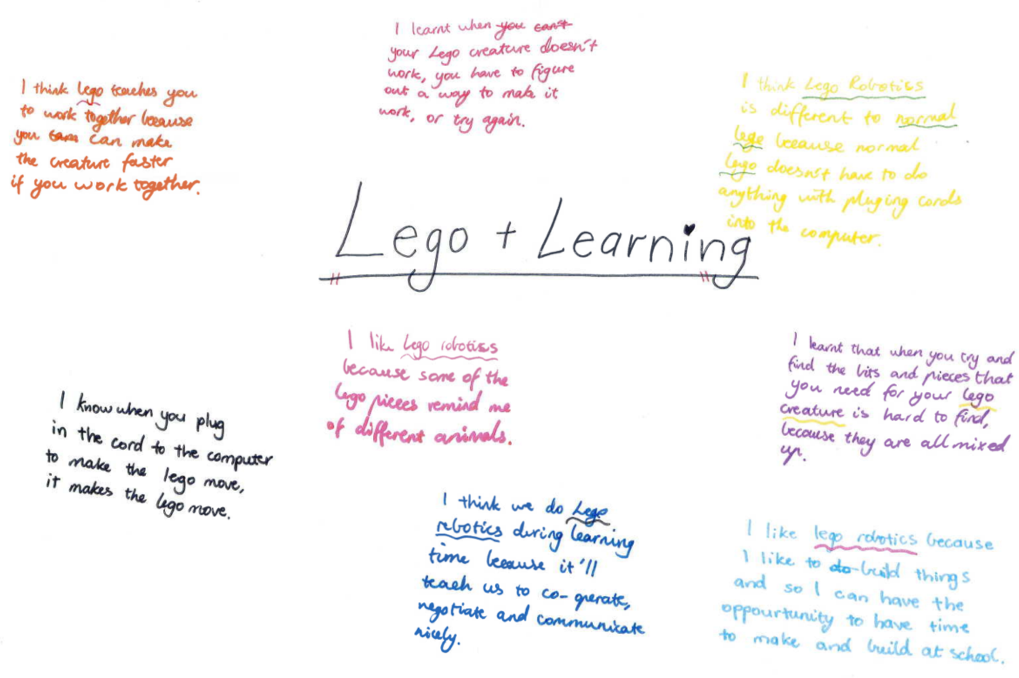

Figure 34: Lily's PMM map.

Her reflective statements on her PMM map (Figure 34) included aspects of the Lego Robotics that were novel for her: 'plugging cords into the computer to make the Lego move' and 'I learnt when your Lego creature doesn't work you have to figure out a way to make it work or try again'. Lily liked the Lego Robotics because she 'likes to build things' and enjoyed 'the oppourtunity [*sic*] to build things at school'. Lily thought the Lego Robotics was used 'during learning time because it teaches you to work together' and 'it'll teach us to cooperate, negotiate and communicate nicely'. Another positive aspect of the Lego Robotics was that 'some of the pieces remind me of different animals', an example of a personal semiotic connection for Lily and evidence of her learner agency when connecting to this new experience.

Introduction to Rosie

Rosie was a quiet and shy 8-year-old student. She liked having friends over to her house, and she enjoyed writing stories at school. She was unsure what she wanted to be when she grew up.

Within the group for the Lego Robotics activity, Rosie often waited to have her turn in using the Lego. This was the first time Rosie had used the Lego Robotics in school, and she reported not having any Lego at home. In this way, Rosie was a novice in the use of Lego and Lego Robotics. Lily, Brian, and Jackson invited Rosie into the group space to help locate and attach specific pieces. By the end of the session, she had used the computer to help to program the bird.

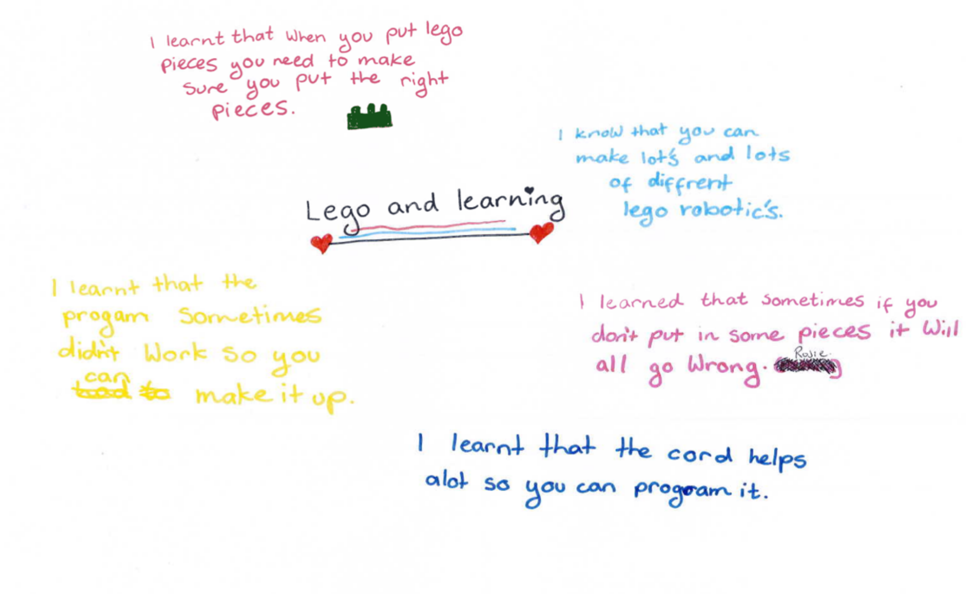

Figure 35: Rosie’s PMM map.

Rosie used the pronoun ***I*** to begin each of her five statements on her PMM map (Figure 35). Four of her five statements included the word ‘learnt’ and focused on the specific skills and knowledge Rosie felt she had accessed while building and programming the Lego Robotics. As this was the first time she had used the Lego

Robotics, she had paid most attention to the novel aspects of this experience in similar ways to Lily.

Her statements included ‘I learnt that when you put the Lego pieces you need to make sure you put the right Lego pieces’; ‘I learnt that sometimes the program didn’t work and so you can make it up’; ‘I learned that sometimes if you don’t put in some pieces it will go wrong’; ‘I learnt that the cord helps a lot so you can program it’. Things like choosing the right pieces and plugging in the USB cord to program the robots were recognised by Rosie as novel and important to make a working robot. Her fifth statement, ‘I know that you can make lots of different Lego Robotics’, gives a sense of the possibilities this endeavour might offer in the future for Rosie.

Introduction to Brian

Brian was 9 years old at the time of this activity. He was a friendly boy who had used the Lego Robotics at school at least once before in a small, multi-age group. At school, Brian’s favourite activity was ‘mathematics’ and ‘problem solving’. At home, he liked ‘playing on the computer’, especially ‘poptropica and minecraft’. He thought his friends would describe him as ‘helpful’. Brian hoped to be an ‘architect’ when he grew up. Brian exhibited confidence in setting up the computer and the Lego pieces for this activity. He was one of the first students to work with the Lego Robotics kits and was working towards being an expert. Brian shared the leadership role with Jackson and Lily at varied times through the session.

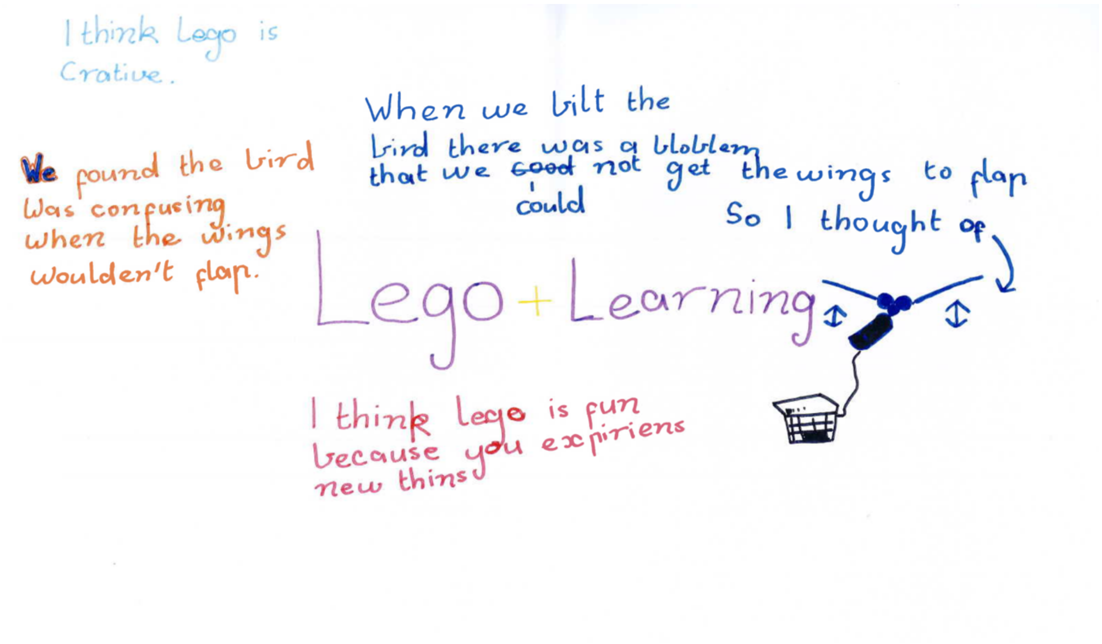

Figure 36: Brian's PMM map.

Brian recorded four key points on his PMM map (Figure 36). These gave insight into the relationship Brian had with the Lego as a learning tool. He noted that learning with Lego was 'crative [*sic: creative*]' and 'fun because you get to experience new things'. Two of his statements highlighted the problem-solving aspect of this session: '**We** found the bird was confusing when the wings woulden't [*sic: wouldn't*] flap'; 'When **we** bilt [*sic: built*] the bird there was a boblem [*sic: problem*] that **we** could not get the wings to flap so **I** thought of [drew picture of solution]'. Brian used the words 'confusing' and 'broblem [*sic: problem*]' when the robot bird did not work as expected. All four students echoed the problem with the robot bird as an example of unexpected cognitive dissonance leading to a problem-solving 'concrete moment'.

Introduction to Jackson

Jackson was 9 years old at the time of this activity. He was a very friendly and chatty boy who was quick to engage me in conversation about Minecraft and how it was like Lego for him. Jackson had used the Lego Robotics kits before and was confident in leading the group, alongside Brian and Lily. Jackson's favourite activity at school was mathematics and Lego, while at home he enjoyed Minecraft and basketball. When he grew up, he wanted to be a video-game developer, engineer, or a player in the NBA (National Basketball Association, United States).

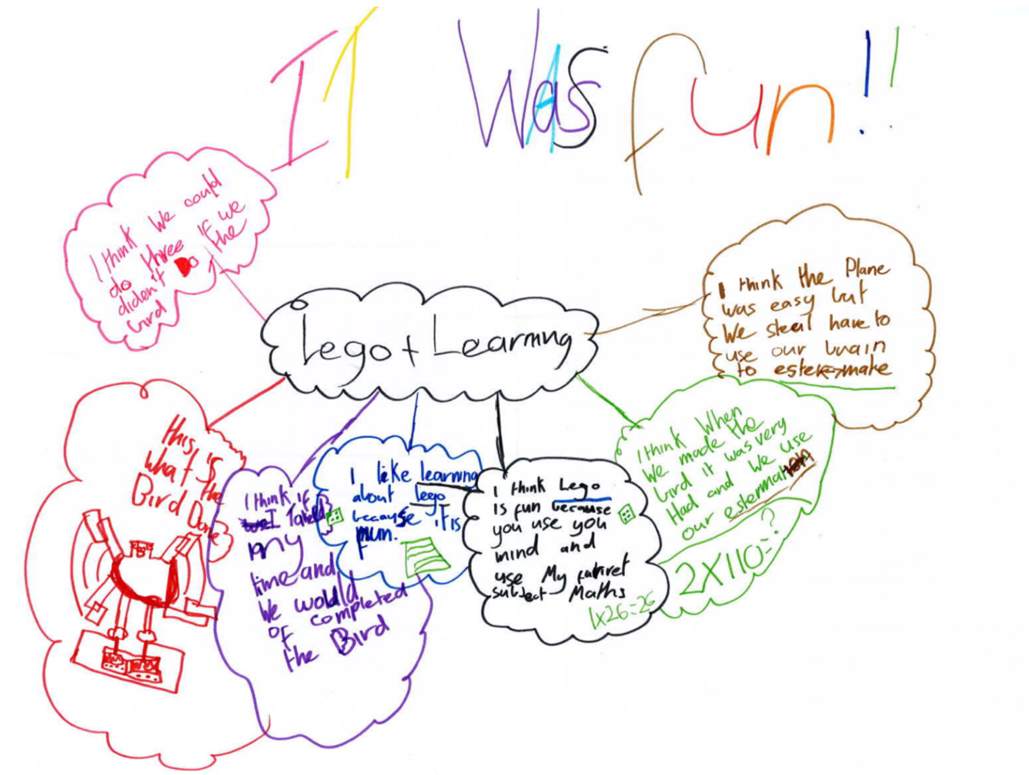

Figure 37: Jackson's PMM map.

He placed 'Lego and Learning' as the prompt on his PMM map (Figure 37) under the eye-catching title 'It was fun!!'. Jackson's consistent use of the pronoun '**I** think' and '**I** like' across six of his seven statements positioned his PMM map as an account of his personal perceptions of his learning. His seven statements on his PMM map were as follows:

> I think Lego is fun because you use you [*sic: your*] mind and use my faviret [*sic: favourite*] subject maths.
>
> I think we would do three if we didn't do the bird.
>
> I think the plane was easy but we steal [*sic: still*] have to use our brain to estermate [*sic: estimate*].

> I think when we made the bird it was very hard we had to use estermation [*sic: estimation*].
>
> I think Lego is fun because you use you [*sic: your*] mind and use my faviret [*sic: favourite*] subject maths.
>
> I like learning about Lego because it is fun.
>
> I think if I taked [*sic: took*] my time we would of [*sic: have*] completed the bird,
>
> This is what the bird done [picture of the bird flapping].

Jackson found varying difficulty for this activity, stating the first model of the 'plane was easy', and that the 'bird was very hard'. He identified that he used the mathematical skill of estimation to build these robots. He liked using his mathematics knowledge and skills in this activity. Jackson also focused three statements on the problems experienced when building and programming the bird. Jackson's PMM map included a variety of knowledge and skills he identified he had applied in this activity.

Introduction to the Teacher: Judith

Judith was the teacher of the multi-aged Grade 3/4//5 class. She was an experienced teacher of more than 20 years. Judith had been at Red River since its foundation year, 2009. As a foundation staff member, Judith had been involved in planning the student-centred, Prep–6 curriculum for the school.

4.2.2.5 Forest Springs Year 9: GameMaker: Studio: Classroom context

The principal and teacher offered the 2015 elective Information Technology Systems (ITS) class to become the focus for this study. The students in this class used the software package GameMaker: Studio[4] to design and code their own digital game for the first time.

[4] GameMaker: Studio is a registered trademark of YoYo Games. It is used in accordance with the licensing agreement held by the school. The students referred to the GameMaker: Studio software as 'Game maker'; however, to meet the requirements for referencing this software in a publication, this has been formalised within the text.

The students at this Year 9 secondary level were 14 or 15 years of age. The three participating students were George, Obi-wan, and Phoebe. The teacher Rey had been teaching ITS and Business Studies for 15 years, with the last six years at Forest Springs. I had worked with her at a previous school.

The GameMaker: Studio project is a four-week epistemic experience designed by the Year 9 ITS elective teacher. The aim is for the students to experience coding through an immersive game design experience. Students work through a series of activities to critique, plan, and code their own digital games. This series of experiences moves them from thinking as a consumer of games towards being a creator of games.

Over the four-week project, the students are introduced to various genres of digital games, through viewing and analysing game reviews from the TV program *Good Game* (Carr, 2015). The teacher then introduces the GameMaker: Studio software and starting points of digital game design including character, storyline, and visual concepts.

The students are given direction to plan for a platformer-style game—one in which a character moves across a screen landscape in a 2D way (usually left/right and up/down) to collect items and reach a goal or finish line.

Students then begin working through the investigate, design, produce and evaluate (IDPE) process, which is checked by the teacher, before coding can begin. Students have four 45-minute sessions each week over the four weeks (two single periods and one double period) to work on developing their game in class. Students have access to the teacher, each other, and online support documents through the GameMaker: Studio community.

The adapted Roberts (1996) trialogue in Figure 38 outlines the meaning-making opportunities open to the students within this classroom project.

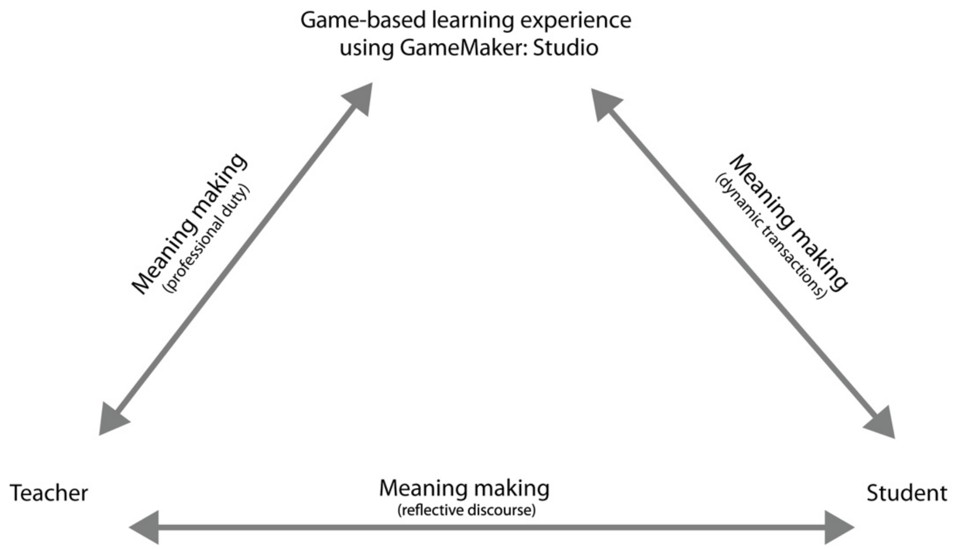

Figure 38: Roberts' (1996) trialogue depicting the normal classroom relationship of the teachers and students (agents) with the game-based learning experience using GameMaker: Studio (artefact) at Forest Springs.

4.2.2.6 Forest Springs Year 9 GameMaker: Studio: Research context

Selection of sample: The teacher gave students the option to participate in the research. Students who volunteered to participate were given the plain language statement and consent form to take home to parents. Classes were observed during the Year 9 elective class focusing on GameMaker: Studio. Three students from Year 9 returned consent forms to be involved in the interviews. Three sessions included an observation phase, a PMM map drawing session, and two interviews. The specific interactions for data generation are summarised below.

Year 9 students: The students had both their PMM map drawing and Interview 1, then Interview 2 in a group of three. The time taken for the PMM and interview 1 was 10 minutes per student. Interview 2 also took 10 minutes per student. Note that Phoebe was present for only the first part of Interview 1 as she had a school responsibility to attend. The PMM map drawing and interviews at Forest Springs took place in a breakout room attached to the school library during class time.

Teacher: The teacher who had developed and administered this program completed a PMM map and interview. The adapted interview protocol of the combined PMM map drawing session and interview, which took place two weeks after the second set of student interviews, was completed. Both the PMM map and the interview took place in one 30-minute block as this time best accommodated the teacher's timetable.

Introduction to Forest Springs Year 9 students

The year 9 students are now introduced with their PMM maps, followed by a brief introduction to their teacher.

Introduction to George

At the time of this data generation, George was 14 years old. He presented as a bright and friendly young man, eager to share his project with me. George had chosen to work in a pair to develop this game. George's partner was not part of this data sample.

George placed the words 'Learning Game maker' as his prompt in his PMM map (Figure 39). He completed his PMM map halfway through the four-week topic, and it revealed his thinking about the design phases, programming, learning, and potential career links.

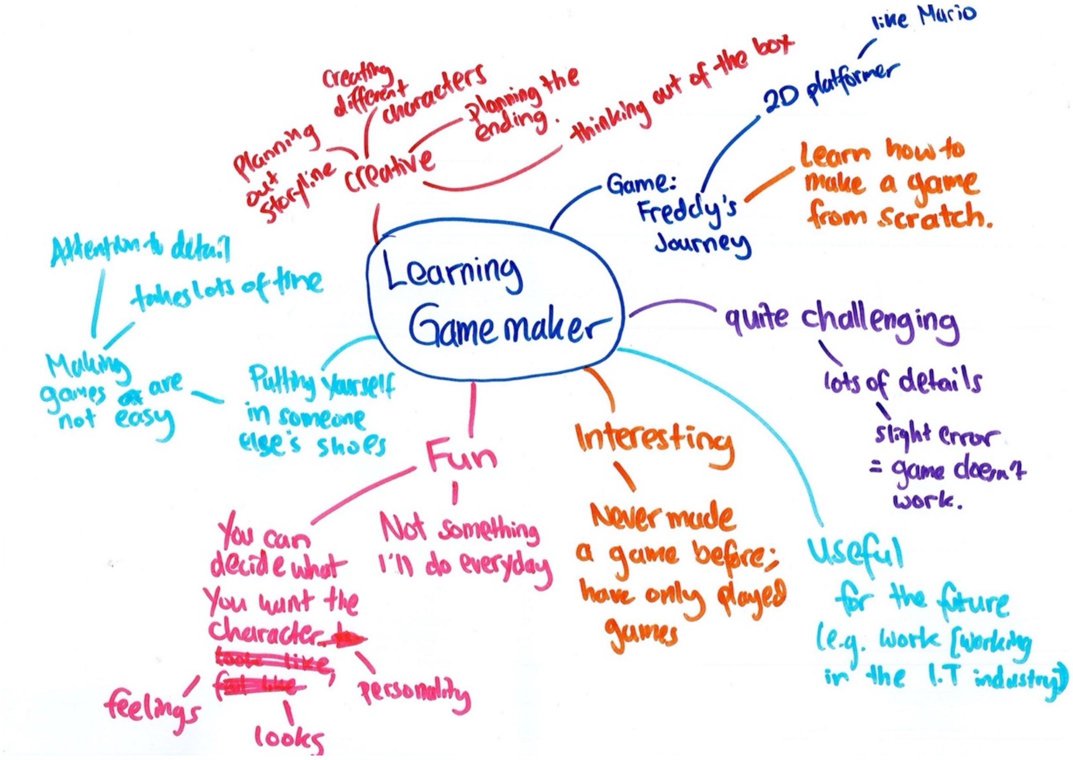

Figure 39: George's PMM map.

George arranged his PMM map (Figure 39) with seven headings. In addition to the name and design of his game, George developed six of these prompts to give his thoughts on how the GameMaker: Studio program was 'challenging, interesting, useful, fun, and creative'. His thoughts gave insight into his anticipated cognitive engagement with this project. As an example of his thinking about cognitive engagement, he framed the anticipated challenge as learning to use code within GameMaker: Studio to complete a working game. George was also perhaps giving an insight into his perception of his duty as a learner. George described the project as challenging, showing his awareness of his anticipated new knowledge. This gave insight into his understanding of his personal ZPD (Vygotsky, 1978) in relation to this project: '**I** also find it interesting, cause, **I've** never made a game before and **I've** played games before, but never made one' (Transcript 5a; Lines 94–95).

George was excited to design his game, called Freddy's Journey. He gave particular attention to developing the storyline and character in the PMM map and described the process as fun.

Introduction to Obi-wan

Obi-wan was also 14 years old at the time of the interviews. He presented as a friendly and talkative young man. As he knew I was there to talk with them about their games, he let me know before we left the classroom just how much he enjoyed playing games, including a new Star Wars digital game.

Obi-wan's PMM map (Figure 40) began with the name of his 'spin off' Halo game in the centre. Halo is a popular first-person shooter genre game with a strong presence in the commercial games franchise market. In selecting this as his PMM map focus, Obi-wan identified himself as an avid gamer. The project offered an opportunity for him to learn about coding with GameMaker: Studio and to explore his own creative story and extend his favourite digital game.

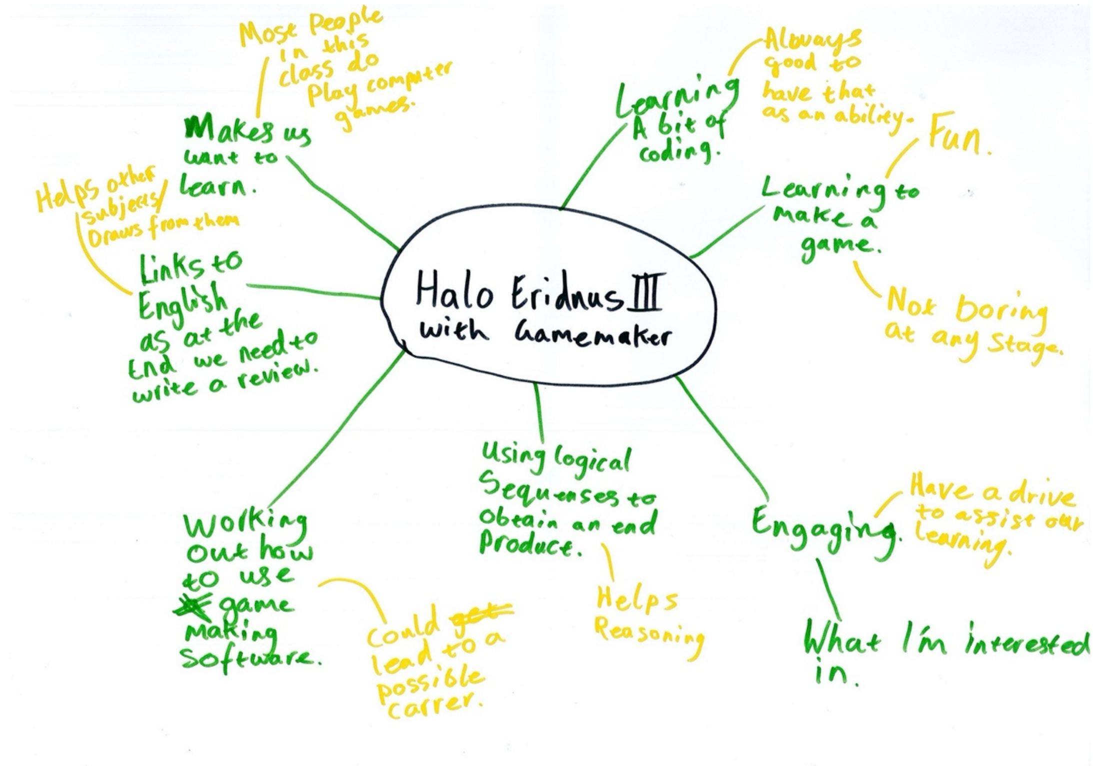

Figure 40: Obi-wan's PMM map.

Obi-wan's PMM Map (Figure 40) repeated the word 'learning', referencing himself and his peers. He used 'interesting', 'fun', and 'not boring' to describe his learning during this project. He also saw the project as drawing upon other subjects at school such as English. He valued the skill of coding through proposing it as a possible future career. Obi-wan identified the range of learning experiences available through this project, suggesting he valued the open-ended nature of this opportunity. His identification as a gamer supported his self-perception of success in this project.

Introduction to Phoebe

At the time of the interview, Phoebe was also 14 years old. Phoebe presented as a bubbly and friendly student. Phoebe was the first to complete her PMM map and interview as she had to leave for bin duty (an example of a school-based responsibility) part way through the scheduled class time. In Phoebe's PMM map (Figure 41) she placed 'GameMaker' as her prompt.

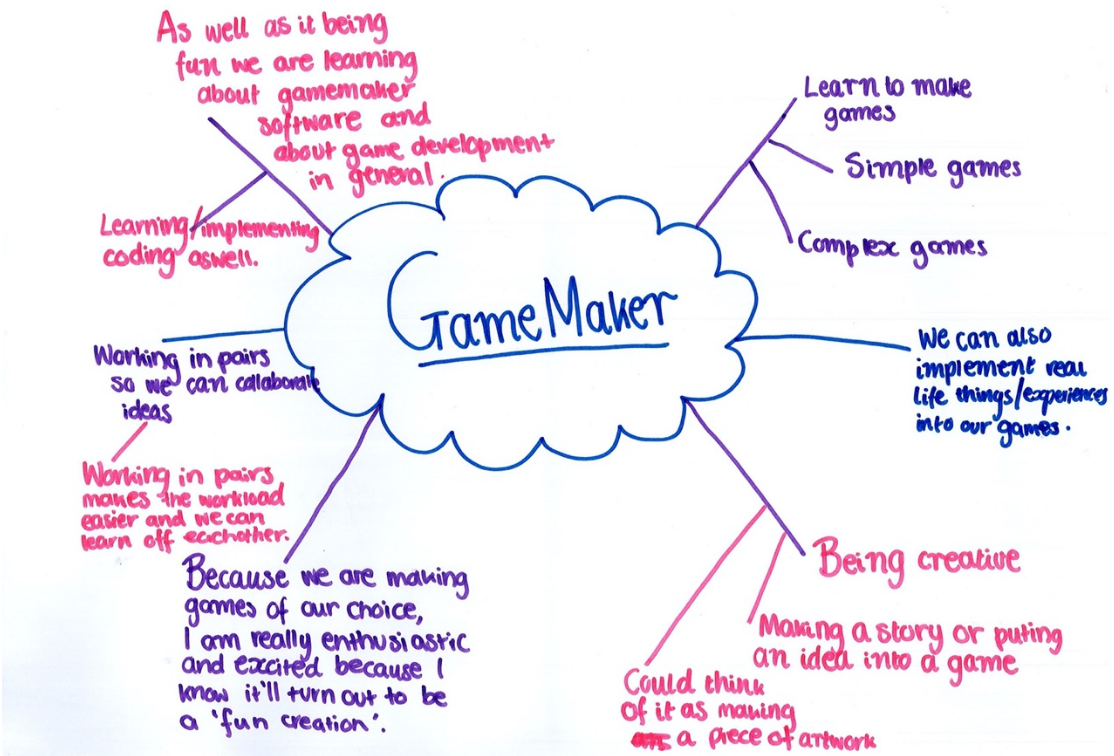

Figure 41: Phoebe’s PMM map.

The central ideas that Phoebe developed in her PMM map (Figure 41) included ‘making games’, ‘learning coding’, ‘being creative’, and ‘having personal choice’.

Phoebe highlighted the opportunity to implement real-life aspects into her game and work in a collaborative pair. She suggested that the game could become an artistic expression and ‘a piece of artwork’ for her. Her description of the anticipated learning experience focused on developing a storyline and graphics, with coding being developed to apply to this creative pursuit.

Introduction to the Teacher: Rey

Rey was an experienced teacher who had been teaching for more than 12 years at the time of the interview. She had trained as a secondary Business Studies and IT teacher and had taught these subjects at three secondary colleges, including Forest Springs, for the preceding six years. Rey was active in reflecting, resourcing, and refining her praxis to ensure this task better supported the learning needs of the Year 9 elective students.

4.2.3 Strengths and limitations of the specific school samples

This section showed that the data generation phase was adapted, in line with ethics consent, for each school. The core process and focus were the students' reflections through PMM maps and interviews, with insights into planning from the teachers' PMM maps and interviews.

The teachers' selection of students for the primary school sample was based on availability. This may have been biased, with teachers selecting students who were most likely to be given permission to participate or who had confidence in articulating their learning. This is a strength and a limitation, as the enthusiastic students may have given a skewed view of the value of the game-based learning experience. A further limitation could be the small sample size, with data collected from a total of 19 students and four teachers across four schools. The findings of this research may not, therefore, be representative of the wider population in each school or generalisable to other educational settings, which is typical of this kind of ethnographic study.

Targeting schools that were implementing game-based learning experiences is a key strength of this sampling procedure. I did not instigate these activities; I sought to research the classroom practices already established in schools. This dataset supported me to investigate how students perceived their own experiences through a learning lens and why teachers continued to implement these experiences. The school already recognised these experiences as productive classroom experiences, and the dataset presented here is quite different to that in the existing literature.

4.3 Summary of Research Methods Chapter

This chapter outlined the research methods used to co-generate data in line with the theoretical frameworks and to answer the research questions. The specific data generation instruments and protocols were explained and the school contexts presented. The meaning-making relationships within each classroom and the research space were presented through adapted trialogues. An overview of the game-based learning experiences observed was provided with a description of the games as artefacts.

Each student in the sample was introduced through their PMM map and short vignette. The purpose of this is to help the reader understand the students as agentive beings, with their own personalities and biographies. Part 2 of this thesis presents the positioning of the game-based learning experience from the perspective of the students through the findings and analysis chapters (Chapters 5 to 7).

The research methods presented in this chapter were designed to support participants as agentive co-generators of the dataset. Chapters 5 to 7 present the findings and analysis of the co-generated datasets. These three chapters are arranged in similar ways, using the narrative storylines of the students and teachers to better understand their perceptions of the game-based learning experiences.

Each of Chapters 5 to 7 begins by providing the reader with insights into the teachers' planning of the learning experiences. This background information aims to assist the reader to better understand the rights and duties of the students and teachers in these contexts, with their actions during the experiences explored through the analysis of the narratives. The chapters are structured to present the analysis of data against the narrative themes and research questions.

Chapters 8 and 9 draw upon the findings to present new understandings of the students' perceptions of meaning making during game-based learning experiences as a practice site.

Part 2 Findings, Analysis, Discussion, and Conclusions

Part 2 of the thesis contains the findings, analysis, discussion, and conclusions of my study. This section describes the organisation of Part 2 and the road map for reading the sections.

Chapters 5 to 7 present the findings and analysis of the co-constructed interviews with the students and the teachers for each of the game-based learning experiences. Each chapter is divided into the following sections:

- A short introduction to the teachers and their planning narratives for game-based learning
- Positioning theory and practice theory used to analyse the data generated to reveal the teachers' and students' self-positioning
    - Teachers' planning of the game-based learning experiences
    - Students' reflective experiences presented against the themes disclosed in the literature review and research methodology, namely,
        - learning behaviours
        - 21c skills
        - identification of new knowledge
        - anticipated future use
        - challenges
- Analysis through storylines and positioning theory
    - Storyline 1: Student self-positioning
    - Storyline 2: Student self-positioning
    - Storyline 3: Student game positioning
    - Storyline 4: Teacher self-positioning
- Summary of chapter

The discussion chapter (Chapter 8) provides a response to the research questions through the data. Practice theory (Schatzki, 2010) is developed with reference to the cognitive, affective, and moral dimensions of the students' experiences.

The conclusion chapter (Chapter 9) presents a summary of new knowledge and implications for teacher praxis and research.

Technical Notes for Reading Part 2

The data analysis combines the discursive psychology of positioning theory (Harré & van Langenhove, 1999; van Langenhove & Harré, 1999) and practice theory (Schatzki, 2010) to interrogate the student and teacher reflections (Roberts, 1996) within the sociocultural space of the classroom (Laurillard, 2009). Combining these four lenses gives insight into the ontological site offered by game-based learning experiences. I have used a narrative format to explore the findings and analysis for three different game types in three different classrooms because this is an accessible format.

Within the narratives is a combination of small quotations and full quotations. To keep the flow of the narratives, I have woven student voice into small sections of the main text using 'quotation marks' within the text. I have shown full quotations as indented text accompanied by references to transcripts or PMM maps:

> This format of text shows full quotations. These are generally longer sections of conversation with students or teachers. **Pronoun grammar** will be made clear to the reader using **bold text**. **I** ensure that other occasional formatting is clear for **you**, the reader, by explaining this in the text itself. (Transcript X; Lines yx–yz)

I have made the pronoun grammar clear in the quotations by bolding the significant pronouns and references that position the student, teacher, or game as an entity. Other formatting, like an underline in a quotation, I have explained in the text for the reader.

Within quotations, an ellipsis denotes a pause in the participant's transcript. The general convention is to use an ellipsis '…' to denote up to three seconds and repeat ellipses for pauses longer than three seconds. There is one instance where the ellipsis highlights the change in word choice uttered by a student. Again, I explain this break with convention in the text preceding that particular quotation.

Chapter 5: Narratives of iPad Mathematics Applications

5.1 Introduction to Red River Grade 1 Narratives: iPad Mathematics Applications

As the first of the three data chapters, this chapter analyses the discursive reflections of four students—Kate, Charlotte, Jacob, and Samuel—who used the iPad mathematics applications in their numeracy classroom. Monique, the teacher of this class, is introduced through her narrative about the contribution she saw game-based experiences made to her students' learning. This teacher's intentions contributed to the analysis of the students' positioning of the game and the emergent storylines. The second part of the chapter presents my analysis of the sociocultural positioning of the game in each classroom setting and the students' semiotic experiences with game-based learning.

The findings present the student voice, their do and say, through their reflective writing and utterances. The introductions to the students in chapter 4 serve to help the reader to see these students as holistic human beings, with their own legitimate life stories partly shared through our dialogical interactions. The analysis of these discursive acts revealed the students' perceptions of transactions in relationship to the game. This relationship is explored through themes including moments when the students identified new knowledge in association with the game, the use of 21c skills in the game, when the students thought the knowledge from the game would be used in the future, and any specific challenges they faced, and overcame, in the game.

These educational transactions with the game positioned the students as psychologically located agents within the two social orders identified by Harré (1992). The first of these social orders is practice: the student getting the job done and doing mathematics. The second social order is honour: the student's reputation as a successful mathematics learner. This chapter analyses the students' reflective dialogue about transacting with the iPad mathematics applications with attention to these two social orders. The participants' habits of belief and interpretation (Heiskala, 2014) were exposed through our conversation and are analysed in this chapter from a perspective of better understanding the semiotic space available to the participants during game-based learning experiences.

My study attended to students' personal accounts of playing the game, their positioning of the game as an interlocutor, and their accounts of their learning. Such accounts signalled a reciprocal positioning as the students transacted with the game. The students interpreted this reciprocal positioning as mathematics learning, through their dialogue about in-game feedback mechanisms, giving insights into their developing understanding (meaning making) of themselves as agentive mathematics learners using this cultural tool. In this chapter, students' data is grouped by the themes arrived at through analysis of the conversational interviews; learning behaviours, 21c skills*,* identification of new knowledge, anticipated future use*,* challenges. These themes were limited by the type of game being used. The games relevant to the data in this chapter were rote-learning games, which offered a range of levels and choices for students to repetitively practise basic mathematical operations. These games did not offer problem-solving or collaborative opportunities for the students. Students' perceptions of problem-solving and collaborative opportunities are explored in later data chapters, which focus on different game-based learning experiences.

The game-based learning experiences of Grade 1 students using iPad mathematics applications were situated in the school community of Red River. Small groups of students worked on the iPads as a regular part of their numeracy rotation, with students completing different activities over the week. Some activities involved technology, either iPads or desktop computers; others involved the use of physical manipulatives like tens frames, blocks, dice, card, or board games. During this time, the teacher would work with small groups to implement targeted mathematics interventions and assessments. These interactions would not be possible without the teachers planning for learning and implementing the use of games. The teachers intentions and agency as a professional will now be presented.

5.2 Teacher Professional Knowledge of Learning: Monique’s Narrative

Monique’s narrative about planning attends to her using game-based learning to meet her students’ diverse learning needs.

5.2.1 Choosing games as pedagogy: Demonstrating learning in another form

Math Bingo and Dominoes Addition are promoted through iTunes as educational applications (ABCya.com, 2010; Kondys, 2011). These applications aim to assist students to engage in repetitive-learning activities as rote-learning tools. The methodology chapter (Chapter 4) highlighted the game attributes (Bedwell et al., 2012) of Math Bingo and Dominoes Addition to support mathematics learning. These two applications were part of a suite of teacher-selected mathematics applications on Red River’s iPads. Monique’s planning considerations when implementing iPad mathematics applications are outlined in her PMM map (Figure 42).

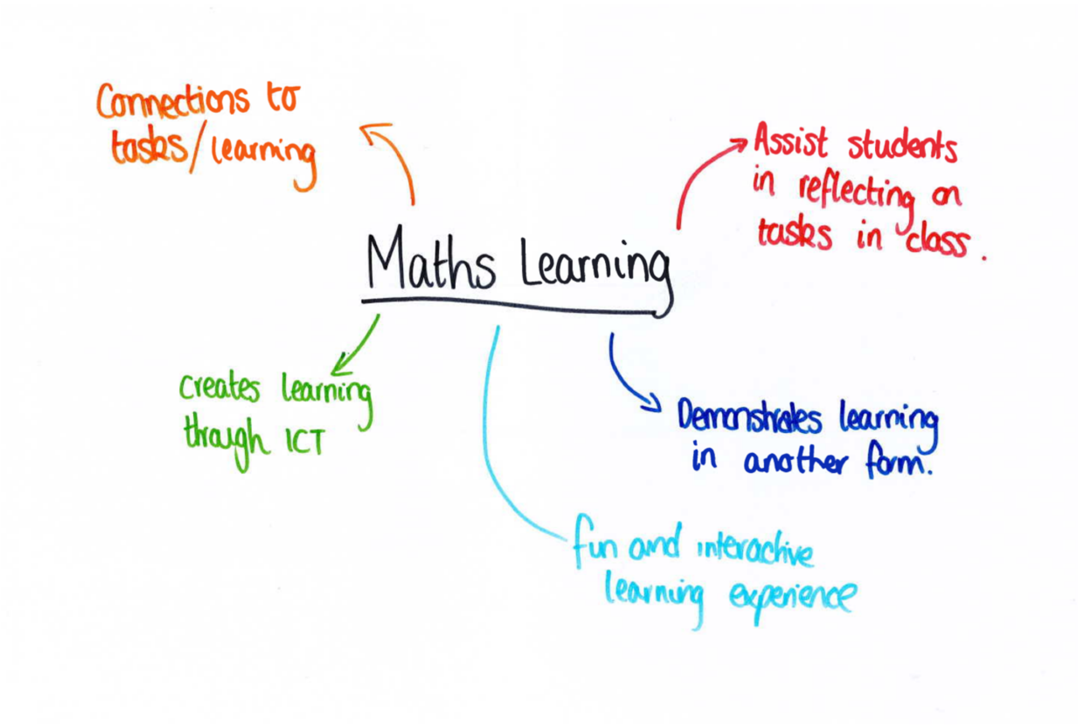

Figure 42: Monique's PMM map.

Monique outlined the use of iPad mathematics applications as part of mathematics learning on her PMM map (Figure 42). Monique considered the iPad to be a tool that provided tasks for her students in Grade 1 to 'demonstrate(s) learning in another form'. Monique expected that students would use the iPad to 'reflect' and 'connect to their learning' in class. She also identified that this was a 'fun and interactive learning experience', supporting students to 'create[s] learning through ICT'. Monique discussed her planning, expanding on aspects of her PMM map in the following ways.

To exemplify the way Monique integrated iPads into mathematics learning, she spoke about the time topic in the interview. First, she described the process of making paper analogue clocks with the students. The students made and used the paper clock in class and then took it home for their home learning time. They used the iPad clock application after making the paper clock as an example of demonstrating 'learning in another form'. The iPad application had some similar features to the analogue paper clock. It also had additional capabilities enabling the students to work with digital numerical displays. In this way, the iPad became part of the differentiated experiences for students to 'connect tasks' to their 'learning' and 'create learning through ICT'.

Monique explained how a different iPad application reinforced class tasks. With the topic of number patterns, tens frames with plastic counters were implemented as a hands-on activity. Monique felt the tens frame iPad application offered an opportunity for the students to enact their 'learning in another form'. In describing the iPad applications alongside the paper clock and tens frame, Monique's repeated use of the word 'form' signalled that the iPad applications were one of a variety of activities that supported students in enacting mathematics understanding. She described the students' use of these activities as evidence of their learning.

Staff in the year level supported Monique's planning for using the iPads as a learning tool. Red River promoted itself as a school that embraced new technologies, and the teachers had a sequenced implementation of technologies across the Prep–6 school. As Monique was new to the school, she was developing an understanding of the school's expectations around technology use in the classroom. Monique did not 'choose what games go on there [the iPad]'. She took time to explore the applications: 'Um, **I** had to come here and actually learn, ok what's this game; and **I** had to go through **them** all' (Transcript 1d; Lines 68–69).

Monique positioned ownership of her professional judgement through her use of the pronoun ***I***, both in the excerpt above and in the excerpt's extension below. Monique asserted that she had to 'actually learn'; her professional obligation was to understand the applications on the iPad. Through her consideration of each game, she used her professional judgement in validating the applications as 'beneficial' for her students, 'and look at what **I** felt would be beneficial for **these** children, yeah. For **my** kids, in **my** class, in **my** studio' (Transcript 1d; Lines 69–70).

Monique engaged personally with the iPad mathematics applications. She indicated that she was thinking and acting as a teacher to understand the benefits of these applications for her students. Her repetition of the pronoun ***my*** (Line 70) indicated her sense of professional obligation to provide ‘other forms’ of learning for the students in her classroom. Despite the use of technology being an expectation at the school, Monique developed a view of the use of the iPads in her classroom as a professional duty, building her reputation as a teacher with technology. By engaging with the iPad mathematics applications, Monique developed her professional view of the applications available on the school iPads, which she felt were best suited to the lower year levels: ‘So, um, yeah, guess it’s, these games won’t be beneficial for when **they** get into 3-4, so unless **it** extends out to other levels’ (Transcript 1d; Lines 70–72).

Monique’s reflections above give insight into the development of her knowledge of teaching. As a beginning teacher, she needed to engage with every aspect of her students’ experiences to determine the possible learning outcomes.

Monique needed to ensure that her students in Prep/1/2 had access to these applications as they may not have been as useful or appropriate for students in Grade 3. This implied a sense of obligation to ensure students used the applications in Prep/1/2 to prepare them for their future schooling.

Monique’s PMM map revealed ways the iPad applications offered reinforcement of the students’ mathematics learning. Monique anticipated that the iPad would help students to ‘demonstrate(s) learning in another form’. Monique portrayed the iPad as one of the learning experiences planned ‘to assist students in reflecting on tasks in class’. Monique validated the nature of the applications to reinforce the content she had shared in class.

Monique valued the iPad mathematics applications as a learning tool that the students could use independently. She assumed that students were confident to use the iPad independently: '**I** guess the kids now are so used to using the iPads at home, so it's easier for **them** [students] to use **them** [iPads] at school to learn' (Transcript 1d; Lines 10–12).

Her use of the statement '**I** guess' displayed a habit of interpretation that students would transfer skills from their use of the iPad at home to the school environment. In this way, Monique acknowledged the iPad as an ontological form that was already established at home. The skillset from the students' home use of the iPad could be useful for students' classroom activities. There was a tension here for Monique; her use of '**I** guess' indicated a supposition that the level of student skills with the iPad would be useful in performing the class task. Monique's personal judgement may have been based on the existing structures in the school, without her own personal experience providing evidence of this skill transfer.

As a beginning teacher, Monique's speech acts revealed her self-positioning with respect to the local moral order of the school and were consistent with her storyline as a beginning teacher. Through ongoing reflection, she was building habits of action towards developing habits of belief in this setting for herself as a professional teacher. Monique's reflections gave insights into her perceptions of the varied learning needs of her Prep/1/2 class. Monique sought to provide a range of learning experiences to meet the students' learning needs. The mathematics applications were an example of a learning experience that incorporated a cultural tool already familiar to the students. Her planning narrative conveyed her developing professional habit of interpretation that 'different forms' may support the differentiated needs of her students.

Monique's implementation of iPad mathematics applications was an expected and valued action in the community at Red River. Beginning with a practical intelligibility of the transference of basic transaction skills from home, Monique's storyline developed to show her habit of belief about what different forms of learning may look like for Grade 1 students using technology to evidence their developing domain knowledge of mathematics.

With the narrative of the pedagogical practices and position of the teacher in relation to the iPad mathematics applications outlined above, I now explore the findings of the students' experiences. I present these findings under the thematic headings of learner behaviour, anticipated future use, and challenges.

5.3 Student Self-positioning of Learning with iPad Mathematics Applications

The interviews positioned the students in dialogue to reflect upon their transactions with the iPad mathematics applications. Students shared these learning transactions through our conversations, which are analysed below from the perspective of gaining improved understanding of the affective and moral positioning of the game-based learning experience.

These findings give voice to the students and support a different way of considering the agency of students in research and in the classroom. The teacher and the game positioned the students as agentive participants, expected to make visible progress with learning operations in mathematics. The game provided a practice space and visible evidence of the student's progress. How the students positioned themselves and the game in our conversation are analysed later in this chapter.

5.3.1 Learner behaviour

The four students shared their perception of learner behaviours through reflective descriptions of their actions in their PMM maps. The way the students in this age group explained their perception of learner behaviours through their active game play provided an understanding of how the students were positioned, or how they positioned themselves, through transactions with the game as active learners. This is important because Monique's pedagogy of game use was explicit in positioning students as active agents in their own learning.

While the four students were at different stages in their mathematics learning journey, all four students maintained a focus on improving their mathematical skills. All four students mentioned choosing levels and operations. Such choices were affordances of the game that enabled the students to self-manage their learning while using these iPad mathematics applications. Each student could choose their own level of game play, which supported autonomy and agency for the students. In Section 5.2, Monique valued the choice in 'form' when implementing iPad mathematics applications. These reflections show how students attended to these forms during the activity. The students' speech acts focused on enjoyment of learning through self-selected challenges; the narrative evidence for this is explored below.

Kate and Samuel described the use of the iPad mathematics applications as an opportunity to practise addition and collect the in-game rewards. Evidence of such actions included Kate's 'getting the pluses' (completing the addition problems) and collecting the maths bugs (rewards for correct answers), and Samuel's 'favourite part is always getting it correct' and that playing Dominoes Addition helped to 'focus on my learning'. Both students referenced the immediate feedback from the game as evidence of their progress, building on their practical intelligibility of their actions in the game as being learner behaviours. This feedback was a direct response from the game to indicate learning progress and formed a common language that students and teachers used to discuss progress. Kate and Samuel both referenced the in-game rewards, indicating a habit of interpretation as agentive mathematics learners.

Charlotte and Jacob's responses gave different details about how they felt the game supported their learner behaviours. While they experienced the same feedback, their reflections gave insight into their meaning making with reference to progression to more difficult problems. Charlotte described how getting a correct answer led to her being able to try 'different math questions'. Charlotte focused on the incremental progression of difficulty in Math Bingo, suggesting that this helped her to visualise her learning progression. She repeated her focus on incremental progression in Interview 2 in response to the sentence prompts: '**I** show **I** am a learner when **I** um, when **I** answer the next question so um then **I** can learn it and then, and then **I** can answer another one **I** can learn different maths questions' (Transcript 1c; Lines 116–118).

Charlotte continued the use of the pronoun ***I*** from the sentence prompt, reflecting her personal ownership of each of her interactions with this game. There was an excitement at the progression through the game to obtain different mathematics questions, indicating that the game offered a teleoaffective space for Charlotte. It enabled her to try new questions, demonstrating her practical intelligence in relation to the game mechanics as visible feedback of her progress, not just through the levels of the game but also as evidence of her mathematics understanding.

Charlotte also described her moment-to-moment thinking when playing the game:

> Yeah like, if **you** get the answers in a row then **it** says bingo and then **you** win a bingo bug if **you** get, um, have the answers really quick. If **you** need one more, and the answer is seven and there is another seven **you** should go on that seven cause then **you** get bingo quicker and **you** get more bingo bugs and **you** can get more, like, maths questions to do. (Transcript 1c; Lines 330–334)

The programmed adaptive features within Math Bingo included repetition and the introduction of harder questions. Charlotte also described the cognitive strategy she used during the game, choosing the position of the answer that would speed up her game play and release the bug rewards more quickly in order to access the next level of mathematics questions. Charlotte went on to reference the four mathematical operations (‘addition’, ‘subtraction’, ‘times tables’, and ‘division’) through her PMM map and interview, indicating her prediction of how this application would support the development of further mathematics skills.

Like Charlotte, Jacob focused on the feedback of the game to explain how it helped him to show his progression in learning: ’Cause if **you** get a whole row of bugs there, **it** will say bingo and then **you** can go off and then **you** can do another one’ (Transcript 1a; Lines 168–170).

Jacob referenced the repetition of mathematics questions as evidence of his moment-to-moment learning, which seemed to support Jacob’s perception of himself as a learner. Jacob’s use of the pronoun ***you*** positioned the iPad mathematics application as having a responsive action through the game mechanics that supported him in seeing his progression, the whole row of bugs accumulated through multiple correct answers to achieve bingo. Bingo signified both a completion of a level and progression to a harder level. Jacob’s goal was to get to harder levels: ‘Ah. The best thing about the math game was when **I** got to hard levels and **I** got to learn’ (Transcript 1a; Lines 92–93).

Jacob’s visible progression within the game ‘to hard levels’ indicated his success in learning. The in-game feedback provided ongoing confirmation of this progress and success as a mathematics learner. His classification of attaining these harder levels as the ‘best thing’ implied that the game mechanics supported his rights and duties as a mathematics learner. There was a sense of a cyclic explanatory loop for Jacob and Charlotte in their responses, with the repetitive presentation of questions in the game and the levelled increase of difficulty developing into a habit of interpretation of what success looked like when using the game to support learning.

The students' reflections on learning through the game provided evidence of the 'demonstrates learning in other forms' described by Monique. Jacob also offered the following evidence of his learner self:

> **I** like it because **we** can get better by the minute. (PMM map)
>
> **I** show **I** am a learner when **I** ... learn things more funfully. (Transcript 1a; Lines 90–91)

The shift in pronoun use from ***I*** to ***we*** on his PMM map suggested that the in-game feedback signalled in the moment of progression a perception that may be shared by his peers. Jacob identified the process of learning as a 'funful' experience. In his reflection on playing the game, it was a learning activity he enjoyed due to seeing his actions progress his learning. Jacob may also have valued the application as this 'funful' learning involved the immediate feedback that enabled him to see rapid improvement 'better by the minute' of his ability to successfully complete the mathematics questions. These two statements, one written and one from our conversation, gave insights into Jacob's account of the teleoaffective nature of this activity. This opportunity to learn things in a 'funful' way was an indication of Jacob's other 'forms of learning'.

Jacob also described how he sometimes solved other mathematics problems by thinking in a fun, game-like way: 'Sometimes when **I** try to um equal them up together, um **I** think of it as a game but, but an addition game that's really fun. So, when **I** did it, um, **I** got it right' (Transcript 1a; Lines 457–459).

He offered his perception that using a game to solve the problem was 'really fun', and was a learning behaviour he valued. While it was not clear if he was picturing the

Math Bingo game or another game, what seemed clear was that positioning mathematics problems as a game was a habit of interpretation that worked for Jacob.

The student learner behaviours reflected upon included specific in-game actions of answering the mathematics problems and the attainment of in-game rewards to exemplify their successful progress. Charlotte and Jacob elaborated that the enjoyment of learning in this application was linked to the repetition and increasing difficulty of the mathematics questions presented in the game. All four students described the learning actions by referencing different game mechanics, which positioned the game as an interlocutor with multiple forms of feedback. These learning behaviours offered insights into how the game-based learning experience was positioned and helped students to form habits of interpretation for themselves as mathematics learners.

5.3.2 Anticipated future use

When discussing possible future uses of the skills and knowledge developed through the iPad mathematics applications, Kate, Charlotte, and Samuel referenced classroom-based activities and tests. Jacob shared a long-term vision of the skills being valued in high school. These short- and long-term uses of the skills and knowledge gave an indication of the value the students placed on their learning from this activity.

The students described their skills being useful in the immediate classroom through tests and progressively harder work. Kate and Charlotte anticipated using addition when 'doing tests' within their current classroom and when 'the teacher asks you to enter the plus signs you can work it out quickly'. The students saw the mathematics skills as authentic as they used them daily in the classroom through different activities, including the digital games.

The students also indicated purposes for their mathematics skills in their short-term future, which involved learning more mathematics skills. Charlotte described her future use of mathematics skills within class-based interactions and saw mathematics as a progressive skillset, leading her to ‘harder math’. She did not see the acknowledgment of increased difficulty over time as a deterrent. Kate also identified that her mathematics skills would progress, with her next step being to focus on ‘minus’ (subtraction). Samuel echoed this progression when he spoke about counting backwards and practising ‘take aways’ (subtraction). Kate, Charlotte, and Samuel’s awareness of these progressive operations indicated that they expected Math Bingo and Dominoes Addition to be a resource that would provide support for their learning progression in mathematics.

Jacob was the only student in this Grade 1 sample who offered a future use of mathematics beyond his current classroom. During Interview 1, Jacob recognised mathematics as a skillset valued in both elementary and secondary school. Jacob explained what he enjoyed about Math Bingo: ‘Um **you** get to learn your addition, and when **you** go older and **you** go to high school **you** can learn more’ (Interview 1a; Lines 158–160). He went on to describe what might happen in secondary school: ‘**They** might ask **you** to do um hard math, and if **you** know then they might tell **the principal** in that school that **you** are doing good with your math’ (Interview 1a; Lines 160–163). The mathematics skill being valued by a possible future principal suggested an anticipated long-term extrinsic reward for Jacob. This also gave insight into Jacob’s habit of belief that skills in mathematics were developed and refined over time, as his peers had already expressed. Indeed, the progressive increase in difficulty implied that mathematics was not a static set of skills for these students, as they all anticipated that the mathematics work would get more difficult.

5.3.3 Challenges

These Grade 1 students described the challenge offered by Math Bingo in different ways. While expressed differently, each student displayed a confidence in attempting to meet the challenges offered in the game.

For Kate, the challenge of the game was completing the mathematics questions. Her strategy was to think about the questions to select the correct answer: '**I** found the maths game challenging so **I** thought about it' (Transcript 1b; Line 156).

Her completion of the sentence prompt, continuing the pronoun ***I***, conveyed a confidence that she could independently figure out the answers to questions in the game. There was an awareness here of the ability to meet the challenges in the self-selected level of the game play. It was hard to describe 'how' addition was figured out, so Kate's 'thought about it' was an insightful statement, indicative of a practical intelligibility of 'doing' through a process of mathematical reasoning. Samuel's persistence in his learning behaviours also conveyed a confidence about his knowledge and skills to work out the answers himself when challenged during the iPad mathematics applications.

Other students, like Charlotte, elaborated that challenges increased in the game as a function of levelling up in the game. On her PMM map, Charlotte described the Math Bingo application becoming 'challenging' as you 'get to harder levels'. She offered this theme of progressive challenge again in Interview 2 two weeks later. Charlotte referenced the increased difficulty as one of the best things about the game: 'The best thing about the maths game was when **I** um ... got to the hard, when **it** did harder levels and then **I** had a go at doing it' (Transcript 1c; Lines 113–115).

The harder levels were imposed by ***it***, positioning the iPad application as an interlocutor, offering a responsive action to her in-game behaviour and adapting Charlotte's learning experience. The anticipation of challenges in the game indicated

Charlotte's habit of belief that the in-game actions were an important component of her learning. Jacob also described the increased challenges by referencing the changing operations.

The quotation below gave insight into Jacob's reflective conversation about the in-the-moment game interactions. Jacob described the game as challenging when the mathematical operation in the game changed from addition to minus:

> **I** found **it** challenging because **I** kept on going on hard, hard um maths and then **I** tried, and then **I** did and when **I** was doing addition, **it** did minus and then **I** tried to do the minus, **I** nearly got it right. (Transcript 1a; Lines 75–80)

His continued use of the pronoun ***I*** displayed first order positioning of his actions in attempting to answer the minus question posed by ***it*** (the iPad). Jacob presented this as an interaction that was personally absorbing and exciting. When the game, ***it,*** increased the challenge to include a minus question, Jacob was not deterred. While he was unsuccessful in completing the minus, he perceived that he was close to success. Jacob accepted the game as an interlocutor, offering increased challenge in response to his in-game action.

In the addition level of the game, Jacob was repeatedly getting answers correct. When the challenge of subtraction was presented, Jacob continued to use his previously successful repetition strategy. Jacob persisted by trying to answer the challenging minus problem and identified repetition as a learning behaviour that almost led to success with the minus problem. He expected the in-game repetition after failure and was part of what made Math Bingo 'funful' as a learning tool for him. This passage suggested that Jacob accepted the repetition and levelling feature of the game as a habit of belief; it contributed to his understanding of the 'better by the minute' and 'funful' learning available to him.

The data presented above suggests that, within the game, students anticipated the challenges, and so they were more likely to persist. As the students already had a practical intelligibility about games that involved challenges, they brought habits of belief and action to the game-based learning experience. This prior knowledge supported the students to anticipate a challenge in the game space, and they were more likely to persist when the game got difficult. It may be that the failure within the game was not stigmatised; instead, it became a part of the habit of belief and habit of action students may bring to game play.

These conversations suggest that the students' practical intelligence of digital games transferred from their home use, and students began to understand these transactions as indicative of learning progress in a school environment. The game also gave students another mental representation of the processes used in mathematics, supporting them to show learning that may not be seen in other activities. The school setting and teacher support of the use of games as a learning tool may be integral to the students' ability to enact their own habits of belief about the value of using game-based learning tools.

5.4 Storylines of the Game as a Learning Tool

The analysis that follows each of the findings sections is through the positioning triangle. The students' storylines are examined to better understand their meaning making, which is supported by the specific game-based learning experience. For the Grade 1 students, the use of the game in the classroom supported a storyline of 'different forms' of successful mathematics learning. The storyline of the game, as an interlocutor, is analysed with a focus on the meaning making that may be supported in the classroom setting. Finally, the teacher's storyline is analysed.

5.4.1 'We get better by the minute': Student self-positioning

The student storyline, *We get better by the minute* (Figure 43), reflected the excitement of all the students in the sample when engaged with the iPad mathematics applications. The students indicated their feelings of being successful mathematics learners through the *do* of their transactions with the application and the *say* of their reflections in their PMM maps and our co-constructed interviews. The combination of the mechanics of the iPad mathematics applications and the local moral order of the school setting supported these students to recognise their own agency during this activity. This storyline was used to present an analysis of the self-positioning of students as learners in this case study.

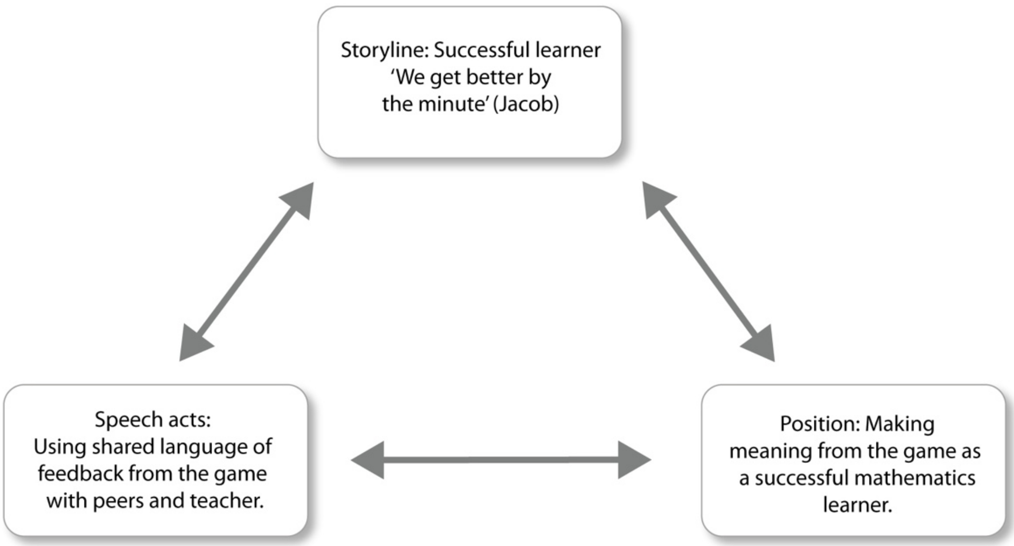

Figure 43: Mutually determinant triad used to explore the Grade 1 students' self and game positioning in the research conversation.

The students' reflections upon perceptions of learner behaviours encompassed different game mechanics of these iPad mathematics applications. For Kate and Samuel, the mini-games and reward mechanisms became the language they used to share their progression. Charlotte and Jacob both referenced the increasing difficulty of 'harder maths' in the levels they aspired to work through. The variety of feedback mechanisms in the game provided an opportunity for students to experience success in different ways. This success led students to a confidence in the real-world application of mathematics in their classroom lives.

The willingness of a student to meet an incremental challenge in the game space is referenced in the game literature as students persisting beyond the point of things being too hard (Beavis, Muspratt, et al., 2015; Hamlen, 2011). These Grade 1 students discussed the challenges presented by the iPad mathematics applications with a willingness to persist and try again if necessary. Their persistence may have been due to their agency as active learners, supported through the presentation of the activity as an independent learning task in the local moral order of the school setting. The game-based learning experience provided a context for both practice and honour as students actively built their identity as successful mathematics learners.

Each student reported progress in their mathematics skills while using the iPad mathematics applications. All students were cognisant of the goal of learning about mathematical operations. However, each student valued different aspects of the application as supporting their personal progression. Improvement for Charlotte and Jacob included quicker completion of addition sums and trying to answer harder problems. Charlotte also offered her completion of levels through the game as an action that supported her to see her learning. Samuel and Kate referred to the attainment of the reward mechanism as evidence of improvement in their addition skills. The varied reinforcement may support more students to recognise their learning during this activity. In turn, this may influence students' agentive learning behaviours. The use of extrinsic rewards in these games is understood to support learner behaviours; however, the behaviourist model of learning does not adequately explain how students become intrinsically motivated to pursue learning through games.

The existing research literature explains this through a behavioural psychology lens of reward mechanisms as being an extrinsic motivational tool offered by the game. The student experience and findings in this chapter suggest that these reward mechanisms go beyond the 'carrot and stick' behaviourist learning theory currently espoused in the literature. Positioning theory may provide a social and cognitive frame that enables a better understanding of how interactions with the game may lead to a cycle of intrinsic motivation supportive of learning.

The iPad mathematics applications were presented as a way to make learning visible for the students. The learning pathways (processes) and goals (products) were made clear with menus and graphics. Further, the learning goals were reinforced with sound, progress bars, and reward mechanisms. These game mechanics are signposts for students to inform them of their immediate success or failure. Students have options to try again or change the level of challenge. For the Grade 1 students at Red River, these reward mechanisms, bugs and stars, became conversation points amongst the students. The students interpreted the rewards as important evidence of their learning that they could share with peers and the teacher, conveyed through the in-game language of bugs, colours, and mathematical operations accessed. The visibility of the learning goals through the reward mechanisms may also have supported students' confidence to participate in the semiotic classroom space. Their meaning making from this experience supported their position as active co-constructors of meaning in authentic classroom conversations.

The in-game reward mechanisms provided instant feedback to the students on their progress, which the game presented to students in aural and visual ways. These representations mapped student progress towards the goals within the iPad mathematics applications. Hattie's (2010) research endorsed immediate feedback as being effective for students' learning. It may be that this structured and immediate feedback from the game was greater than the reinforcement students would receive in whole-class tasks (Erhel & Jamet, 2013; Whitton & Moseley, 2012). This is exemplified by the following two classroom examples. First, if a student completes a mathematics worksheet, there is often a time delay in the correction and feedback given by a teacher. Second, in a class discussion, not all students may have an opportunity to give individual answers to the teacher and receive feedback. Through the iPad mathematics applications, each student received feedback immediately. The students may have viewed the reward mechanisms of the iPad mathematics applications as valuable to track their learning. The teacher's role in validating this activity was a way of showing learning in a different form and offered students a complementary feedback process outside of the moment-to-moment game play.

What about students who do not 'get better by the minute'? The students' ability determined how the game would respond. The programming of the levelling mechanism in the game allowed the students who were not successful to continue playing at a more basic level, for example, playing with single digit numbers and addition. Students who continued to be unsuccessful in the game could ask a peer or teacher for help, or opt out of the game and choose another from the mathematics applications on the iPad. The student's autonomy in this task is a feature of this independent learning time with the iPad.

5.4.2 'I can learn things more funfully': Student self-positioning

Jacob's comment, 'I can learn things more funfully', conveyed an enthusiasm about using digital games for mathematics learning time. Such attitudes towards enjoyment of game-based learning have been documented for over fifty years. Since Malone's (1981) ground-breaking thesis, the phenomenon of student persistence during digital game-based learning has often been quoted and explored.

Behavioural psychologists have explained the phenomena of student persistence and motivation using an ‘input–output’ relationship. This explanation has been developed further by using links to ludic or fun moments in game play being associated with the release of dopamine in humans. The positive effects of dopamine on the human brain are theorised to reinforce intrinsic motivational behaviours to continue game play, which are often described as ‘fun’. However, the way the game-based learning experience was described by these students, in particular Jacob, indicated that the fun was not related to the reward mechanisms alone. In Figure 44, Jacob’s ‘I can learn things more funfully’ indicated that the fun of the game comprised a feeling of mathematics success and of attaining rewards. These linked to learning through a habit of interpretation and may have been difficult for students to articulate as separate processes.

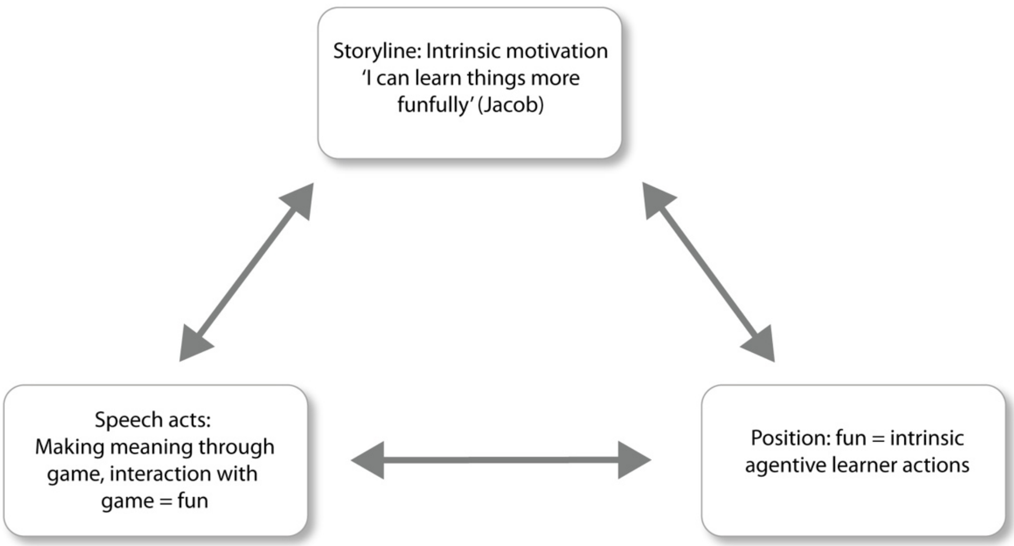

Figure 44: Mutually determinant triad used to explore the Grade 1 students’ self and game positioning in the research conversation.

The cycle of intrinsic and extrinsic rewards may reinforce the student perception of success and lead to motivation. These cycles were a familiar process for the students, supporting incorporation of in-class game play into existing habits of action. When the teacher and community value the game-based interaction as evidence of learning in another form, students may establish habits of belief. The reward mechanism itself does not hold the semiotic power; it is the meaning imbued by the community, in this case teachers and peers, that gives semiotic power to game reward mechanics.

Charlotte's and Jacob's narratives may help to better understand why challenge may contribute to positive affect. Their narratives indicated that these Grade 1 students valued challenge within learning opportunities. Successful completion of challenges was evidence of their progress in mathematics skills. The pattern of seeking and completing a challenge within the game became a valued learning behaviour. Charlotte and Jacob referred to selecting challenges by opting into harder levels. This autonomy to choose their level of challenge is a way students may enact their agency as learners when using these applications. Seeking out challenge may imply a proactive learner identity. In a study of children by Hung et al. (2015), completion of challenges was linked to positive affect. Adult learners in Howard-Jones and Demetriou's (2008) research reported challenge as a motivational aspect of educational games. Perhaps the combination of positive affect associated with completion of challenges builds a habit of belief about themselves as mathematics learners, building on their practical intelligibility of learning through digital game use outside of school.

Learning in this activity was 'funful' for Jacob. Charlotte, Jacob, and Samuel all valued the game as a practice space. This may be due, in part, to the varied feedback and reward mechanisms. There is evidence in the literature that the reward representations may assist to validate learning progress for the student. By having game mechanics that contribute to a positive affective response, the teleoaffective nature of this tool may support students to build habits of belief about themselves as mathematics learners.

The literature refers to the feeling of fun while playing games as a ludic experience. The ludic attitude is often quoted in game-based learning literature as an important driver in the practical intelligibility harnessed by games. In a classroom, we could perhaps better understand this ludic quality of game-based learning experiences by considering the game as having its own set of rules and values, in effect its own local moral order, which contributes to the classroom space. That Jacob used this game-like frame for solving problems outside of the game is telling about how he, and perhaps his peers, applied a habit of interpretation about their learning as a fun challenge in classroom settings.

So, what was 'funful' about the use of the iPad mathematics applications for these Grade 1 students? It seems that a variety of factors contributed to this perception, including the game mechanics and the local moral order of the setting. The students were able to implement their own practical intelligibility and transact with the game-based learning experience to make meaning about themselves as progressing in their mathematics skills. It may only be upon reflection that students start to understand how the different components of gameplay support them as learners of mathematics, beyond the fun nature of the experience and seeing their visible progression due to game mechanics.

5.4.3 Visible learning progression: Positioning of iPad mathematics applications

The site practices in the classroom were important in setting up the iPad mathematics applications as a learning activity. The teachers deliberately positioned the game-based learning experiences as an opportunity for students to self-direct their numeracy practice. Students had a choice of games; only two of the most popular were analysed. This storyline focused on students' positioning of the iPad mathematics applications as a source of visible feedback for them as learners.

The game was programmed to respond to student interactions in certain ways. The game could simultaneously present feedback on progress and adjust the level of difficulty based on the player's previous actions in the game. The students and teacher then interpreted the student experience of these transactions as evidence of learning mathematical operations. Students accepted the game as a legitimate authority on their progress. The meaning-making structure (rewards, feedback, levels, etc.) needed to be experienced to be understood by both the teachers and students. Once implemented, the game-based learning experience may become part of the moral space and accepted practices at the site (classroom); however, if it does not live up to its expected legitimate contribution, it may be replaced or excluded from the site practices for that teacher or student.

The Grade 1 students used the iPad mathematics applications as a repetitive-learning tool, a way of ‘demonstrating their learning in another form’. There was no mention from any students about the game teaching them the mathematics, though they stated that they were learning the operations. The teacher Monique analysed it as a tool to support learners at a variety of points of need. Students’ perceptions of learner behaviours afforded in this activity were bound by the game mechanics employed by the specific applications. The students referred to specific in-game actions, feedback, and reward mechanisms that showed their progress through the game. The students offered these actions to indicate their perception of their development of mathematics skills.

The game-based learning experience was attributed agency; it had been designed and developed with a specific set of affordances for a specific audience. Its contribution to the learning space was as an interlocutor, transacting information with the student directly. The students valued the game feedback and did not perceive the game to have an agenda or sit in judgement of them. In this way, the game could bring its own set of rules and local moral order to the site. The positioning triad in Figure 45 outlines the students’ perceptions of the games as a cognitive and moral site. This gives a different way to consider the game’s potential role as a learning tool.

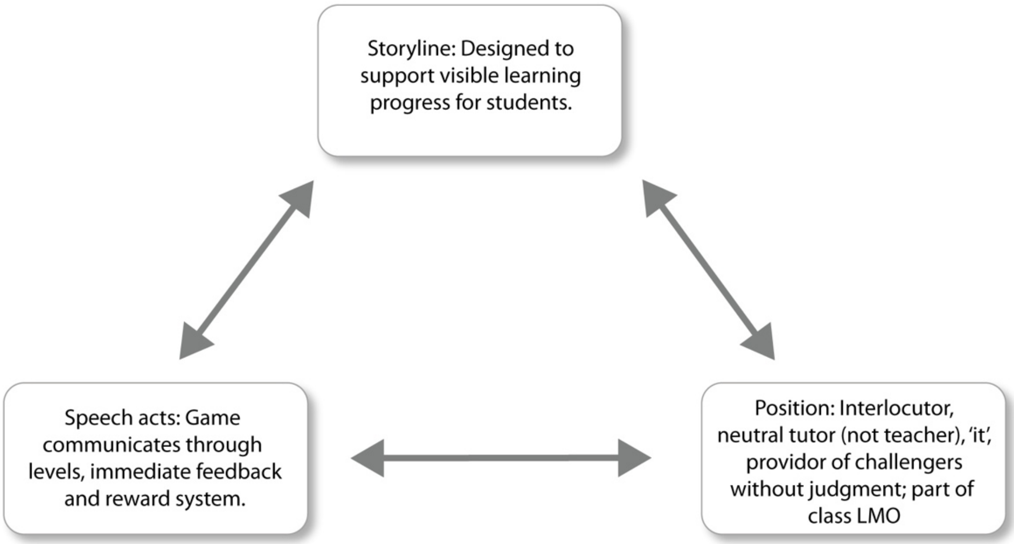

Figure 45: Mutually determinant triad used to explore students' positioning of the game in the research conversation.

Whether through the mini-game reward or increasing levels, students positioned the game as an interlocutor, or a neutral tutor, offering information about progress and not judgement of cognitive ability. It could perhaps be positioned as assuming that all players could be successful in the game with enough practice. The visible nature of the progression points, levels, and learning through the rewards supported the students to develop their habit of belief about their learning with games.

Jacob and Charlotte referenced the iPad as '**it**' in their PMM maps and interviews. They accepted their positioning of the iPad as presenting harder problems and giving feedback as part of the learning dynamic. While they knew the teachers had selected these games, they did not mention the teacher in this learning activity. These two students acknowledged the level of autonomy they had when selecting games at their point of need and so may have felt agentive in their learning when completing this activity. They made their perception of this moment-to-moment learning progression visible by their self-reflection on the game mechanics.

The students classified the game as an ‘other’; it was not a teacher, it was not a worksheet, it was not a test: it was a ‘tool’ and another way to enact their developing understanding. The teacher also classified it as an ‘other’: another form of learning. The game was not specifically the teacher’s tool or the student’s tool; it was both. The reward feature was a way the game exerted its local moral order on the student, enabling the student to correctly make the judgement of personal success in mathematics learning. This positioning of the game may be understood through the positioning triangle (Figure 45) as both teachers and students accepted its communicative acts (rewards and levels) as having legitimate meaning in the classroom.

The semiotic space was at first navigated through the practical intelligibility of the space (playing the game is doing mathematics) and became part of the students’ habits of belief about themselves as mathematics learners (honour). The local moral order offered by the game perpetuated this storyline. It became part of the school culture, contributing to conversations about learning and what learning success looks like in this experience. Perhaps the storylines and pathways for success were well understood by students, including having more options to be successful than other activities in class.

At Red River, learning through technology was a valued opportunity. The use of the iPad mathematics applications for the Grade 1 students was one example of how the school enacted their professional duty to help their students develop skills for an unknown future. They positioned the games as a legitimate part of the learning conversation in the classrooms. The students valued the games’ contribution as a communicative actor in learning transactions. Such an opportunity would not be available without the teachers’ pedagogical planning for the use of this tool in their classroom. The final storyline is of Monique and how she was positioned as a teacher in this technology-rich classroom space.

5.4.4. Games as another form of learning: Teacher self-positioning

Using the positioning triad in Figure 46, Monique's storyline of her personal agency as a teacher in the research conversation is presented. Her storyline as a beginning teacher focused on providing evidence that she was successfully enacting the school's local moral order to support students in differentiated and self-directed learning; using the software and iPad technology, her speech acts in the research conversation were concerned with illustrating the successful use of the technology to position her Grade 1 students as self-directed learners in their use of the tools provided. She positioned herself as meeting her school's local moral order using these activities to differentiate student experiences to meet curriculum objectives.

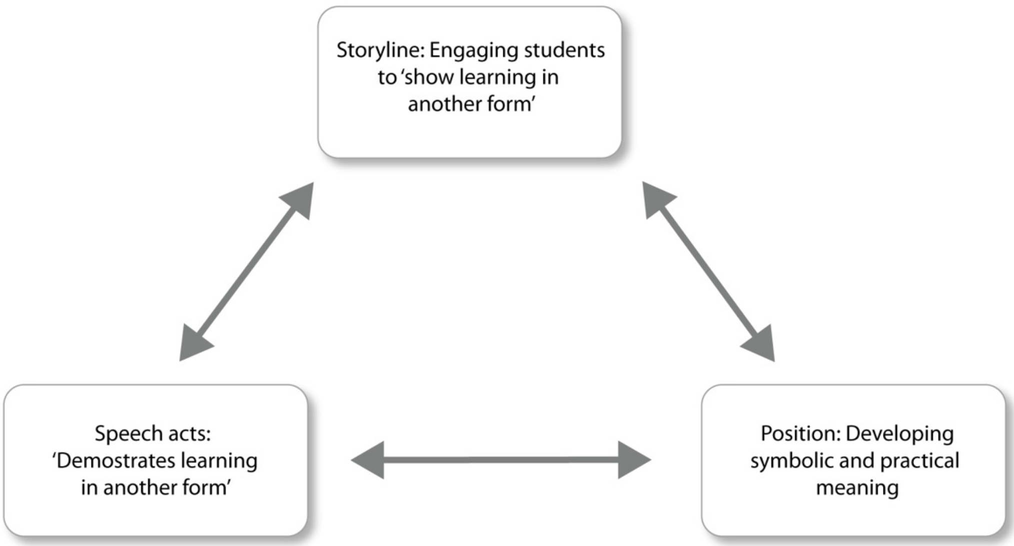

Figure 46: Mutually determinant triad used to explore the Grade 1 teacher's self and other positioning in the research conversation.

The teachers at Red River had curated the iPad mathematics applications. Students made choices from this set of applications during their independent learning time. Students personalised their learning through their choice of application and level of challenge. This level of autonomy facilitated students to enact their rights and duties as learners. Students perceived that the game supported their rights as learners of mathematics to ‘get better by the minute’. Students also felt they were active in demonstrating their duties as learners when the applications presented harder levels. The student reflections support that they are enacting their agency when using these applications.

Charlotte’s reflection supported Monique’s suggestion of transfer of practical intelligibility of the iPad. As the students engaged in the activity, perhaps their focus in the moment was on the cognitive work in the game, propelled by a personal sense of achievement through the immediate feedback mechanisms. For some students, like Kate and Samuel, feedback signals progressed with the current concept, and for others, like Charlotte and Jacob, they had habits of belief that the game would progress to support new conceptual knowledge. The students did not see the repetition within the game as troublesome, as they might when a teacher poses a list of similar problems; the positioning of the iPad application was a different form and was taken up by the student in an individual capacity. The students were able to use their practical intelligibility of digital games to confidently tackle the problems in the iPad mathematics applications. In the moment it was fun; this sense of ludic positioning may also be an important teleoaffective aspect that games bring with them to the classroom setting.

Habits of belief for Monique included the transferability of the practical intelligence of iPad use from home and her own professional moral obligation to support her students to show their learning in different ways, using other ‘forms’. Her students’ reflections on their game play reinforced this. The shared symbolic understanding of the game by both the students and Monique supported multiple ways of making meaning as a mathematics learner in this classroom.

5.5 Chapter Summary

The use of the iPad mathematics applications allowed the students to work, choose a level, develop their skills, and see their personal progress. The game choices gave students autonomy to choose the level of challenge that suited their perception of their learning needs. Kate, Charlotte, Jacob, and Samuel all described their learner behaviours in positive ways when using the iPad mathematics applications, despite them using different games. Their shared experience of attaining the reward mechanisms in the games held importance in their parallel play during numeracy time. The confidence of the students may have been due to the teleoaffective nature of game design and game play, which teachers and students recognised as fun through their habits of belief.

The analysis of these findings takes the research further in the following ways.

A teacher's choice of pedagogy may be an enabler of student agency. Teachers occasion the use of iPad mathematics applications as an independent learning task. The game type selected by the teacher and made available to the students may limit the exact nature of the students' agentive actions.

The students' discursive reflections gave insights into the game mechanics that supported them to move beyond habits of action in mathematics learning towards true belief of themselves as successful mathematics learners. The students and their teacher positioned the game-based learning experience as a valid form of differentiated learning, which enabled students to visibly demonstrate their learning. This game-based semiotic space provided a teleoaffective, ontological interaction that could support students to develop a habit of interpretation of their own progress in this space.

The recognition of active learner behaviours as habits of action through game play may support students in developing a habit of belief about the potential role of games as a learning tool. Students enacted their agency by choosing the application that suited their learning needs. They reported actions in the game that supported their skill development. Kate, Charlotte, Jacob, and Samuel described similar learner behaviours when using the iPad mathematics applications, despite them using different games. All four students felt they were making progress with their learning. This finding gives insight into how the students perceived games as a semiotic space and supported development of habits of action for their ongoing learning journey.

Teacher implementation of games with a variety of feedback elements may be helpful for these very young learners to enact their agency. Students gained instant feedback on their progress through a system of rewards within the game. Students referenced different aspects of these reward elements as evidence of their learning. Kate and Samuel enjoyed the levelled rewards as well as getting the mathematics correct. For Charlotte and Jacob, it was getting feedback that the mathematics was correct and progressing to harder mathematics. The combination of autonomy and high reward may be factors that harness a cycle of intrinsic and extrinsic motivation for students when using game-based learning experiences. The immediacy of feedback may be important for these students in their feeling of engagement, recognition of success, and habits of belief of themselves as learners when using games.

This section offered a way of framing the students' interactions with the game using positioning theory. This framework supports an understanding of the interactions in the game that students identified as supportive to see their learning in moment-to-moment interactions. This, in turn, may influence teachers' perceptions of learning through games and may support offering further game-based learning experiences to these students. The cycle may lead to a shift from habits of action towards a true belief about how games may affect student perceptions of themselves as learners.

This chapter contributes to understanding students' self-positioning when engaged in game-based learning experiences. Each student in this sample responded to the iPad mathematics applications in different, albeit positive, ways. They each perceived that they were active and progressing in their learning while using the application. The game itself may not be important in instilling this sense of active learner agency; it may be that the game represents a semiotic space for the students, which they can transact with to build habits of belief about learning using digital technology. The success of games as a cultural tool in the classroom may be due to this previously unexplored semiotic space between the student and the game. Does this pattern continue with different types of game-based learning experiences? The next two chapters explore a play-based construction and programming collaborative experience and a digital game design experience, respectively.

Chapter 6: Narratives of Lego Robotics

6.1 Introduction to Red River Grade 3 Narratives: Using Lego Robotics

This chapter presents findings from the Grade 3 students at Red River. These students used the Lego Robotics software as a collaborative group. The game-based learning experience involved the students building and programming Lego robots, using physical Lego and interactive digital software. The narratives of the four students—Brian, Lily, Rosie, and Jackson—are explored through the themes of learner behaviour, identification of new knowledge, 21c skills, anticipated future use, and challenges. The final part of this chapter analyses these findings by referencing the storylines to elucidate the relationships between the students, teacher, and the game-based learning tool.

This is the second student sample from Red River. The Grade 3 students were part of a multi-aged Grade 3/4/5 class. The narratives presented in this chapter shed light upon the progression of learning experienced by students at Red River. Grade 3's use of digital technology progressed from the use of iPad mathematics applications in Chapter 5. The Lego Robotics kits supported the Grade 3 students to manage their own learning about programming and coding.

Red River supported all students to develop skills as lifelong learners across their seven-year learning journey. Students developed an understanding of learning as a continuum from novice towards expert. One way students enacted this continuity of learning was by students as experts in the classroom. Teachers encouraged students to ask an expert for assistance in the classroom. The expert student selected would have more experience in a topic. This approach was used throughout the school. Judith, the Grade 3/4/5 teacher at Red River, referenced the use of student experts with the Lego Robotics kits:

> We've got three little experts, the ones who used it when we started. They were the first ones to experience it, so they became experts. So, children would actually go and ask them for help, so they would actually go across and ask 'can you come and help me', and they would go through the process of solving whatever the issue happened to be. (Transcript 2f; Lines 11–16)

The attention to students as experts was evidenced through the cooperative nature of the learning environment at Red River. Teachers at the school supported students to develop learning behaviours beyond relying on the teacher for assistance. Students regularly enacted their agency as learners through the learning activities offered by the teachers.. They experienced being a novice and an expert at different times across different topics. This strategy sought to assist students to develop skills as lifelong learners.

The use of Lego Robotics formed a normal part of technology use within the school. This technology was available to Grades 3, 4, 5, and 6. While Lego Robotics is not strictly defined as a game, this activity utilised a familiar cultural tool for students in a play-based building and programming activity. It is also a relevant play-based cultural tool (Bruner, 1983) for this age group, as the programming environment has clear rules, feedback, and goals, meeting the definition for a game-based learning experience in this thesis.

The group of four students worked with one Lego Robotics kit. The school had three Lego Robotics kits and three computers (two laptops in the classroom and a desktop computer in the conference room), which were loaded with the Lego Robotics software. I observed Brian, Lily, Rosie, and Jackson selecting, building, and programming two robots. We were situated in the conference room as this was a familiar environment for the students undertaking this activity. As in the previous chapter, the agency of teachers in providing these kinds of learning experiences is important. The teacher, Judith's professional knowledge and planning for game-based learning experiences is now analysed.

6.2 Teacher Professional Knowledge About Learning 21st Century Skills: Judith's Narrative

Judith had a clear overview of the learning progression planned to scaffold the students' skills in using technology across their primary school life.

Judith's PMM map focused on the students using technology as a tool 'to enhance their learning'. She noted Lego Robotics as an opportunity for students to develop a holistic set of skills. In particular, she listed 21c skills: 'co-operation', 'problem solving', and 'social development'. Judith saw Lego Robotics as a vehicle to 'capture the enthusiasm of the students':

> Ummm, basically what **we** do is **we** have a series of different children go through and **you** can see the engagement, the enjoyment, the excitement and what **they** do then is, um, actually share it with others, so **we've** got three little experts, the ones who used it when **we** started. (Transcript 2f; Lines 9–13)

Judith's use of the word 'basically' in the very first line contradicted the complex learning interactions she went on to explain. Judith believed the staged introduction to Lego Robotics would support students to become experts. Her use of the collegiate ***we*** in the very first line of the transcript excerpt above included other teachers in the planning and pedagogy. Judith described Lego Robotics as an 'exciting experience' for the students. This indicated that Judith and the other teachers at Red River valued the students' ludic experience. Enjoyment of learning was part of the local moral order in this setting. Judith went on to describe the expectations of the student experts:

> **They** were the first ones to experience it, so **they** became experts. So, children would actually go and ask **them** for help, so **they** would actually go across and

> ask ‘can **you** come and help **me’**, and **they** would go through the process of solving whatever the issue happened to be. (Transcript 2f; Lines 12–16)

Judith made her perception of the rights and duties of her students clear in this passage. She explained that these first students were becoming experts and would be confident to assist their peers. As more students used the Lego Robotics, they could call upon an expert peer. Judith saw the Lego Robotics as an opportunity to support the students as learners with differentiated needs.

By becoming experts, who were confident to support their peers, learner agency was supported. Judith detailed the ways learner agency was seen in the class, giving further insight into the local moral order of the school and the expectations of learners, which technology could help make visible. Lego Robotics provided an opportunity for students to ‘articulate their learning to others’ in varied ways, including ‘oral interaction’, ‘written’, ‘video’, ‘thinking routines’, and ‘photos’:

> And so **they** were sharing **their** knowledge with each other, and **their** experience, and **they** were also articulating **their** learning, which is a learning intention of **ours**, that **they** have got the oral interactions, and also at times written down **their** thinking, and **they** have videoed it as well as taking photos, and complete some thinking routines. (Transcript 2f; Lines 16–20)

To become an expert, the students needed to develop and display a wide range of skills. Students showed these skills through the construction of reflective media to document their learning progression. Judith described the multiple ways the students interacted with the Lego and their peers. This included ‘students taking pictures’, ‘recording videos’, and ‘demonstrating the use of thinking routines’. Judith’s understanding of the skills the students needed to become experts went beyond being the first to use the Lego Robotics kits. She explained that this reflective learning was not a unique part of the Lego experience but an expected learning behaviour for the students to enact across the curriculum at Red River.

This expectation of students to display learner agency through production of artefacts formed part of Red River's local moral order. Judith's use of different technologies enabled these students to identify and record their own learning moments in varied ways. Judith articulated her habit of belief that different technologies were a valuable way of differentiating the experiences for her students. Judith was a leader of this curriculum development and valued the use of technology to support visible learning progression for all students, aligning her professional rights and duties with her expression of her true beliefs about supporting all students to evidence their learning through different processes and products.

Judith focused her habit of action in her classroom praxis on the small-group learning experience. Judith explained how she reinforced specific learning behaviours: '**I'll** just check to make sure those dynamics are actually working, because sometimes some of **them** are so enthusiastic that **they** distract all the **others**, and it is just a case of reminding **them** of the expectations' (Transcript 2f; Lines 32–34).

The way Judith supported appropriate learning behaviours with the Lego Robotics evidenced the accepted rights and duties of the students at Red River. Judith's role as a teacher included monitoring and guiding expectations of student learning behaviour. Judith shared the future benefits she saw of these skills:

> Well, **we** encourage group work, so it doesn't matter where **they** go in **their** lives **they** are basically able to cope with working with **others**, so **they've** got the skills to verbalise what **they** are thinking, to go about sharing **their** problem solving, and listen to if **someone else** has a better idea, 'Oh **let's** do it that way'. Um, so **they** take on board **other people's** opinions of things, and the dynamics of the

> group will dictate how well it will go, or how rough it can be. (Transcript 2f; Lines 40–45)

Judith used the pronoun ***we*** to encompass her teacher colleagues. In doing so, she gave insight into the tacit local moral order she believed teachers understood in this school community. Judith's implementation of the Lego Robotics was one way to support students to apply and develop problem-solving and collaborative communication skills. Judith explained the group dynamics and social interactions in this activity as important life skills. She saw these skills as central to the way students worked, both in school and beyond. Judith's narrative gave insight into the local moral order of the school through their everyday classroom praxis. Her own habits of action and belief informed the use of game-based learning experiences that supported differentiated learning.

In summary, Judith's narrative displayed how Red River supported learner agency. Judith's discussion of her PMM map gave insights into the tacit practices within Red River's local moral order to support all students to develop lifelong skills. Judith implemented Lego Robotics as a game-based learning tool. At one level, the students developed construction and programming skills. At another level, students also developed 21c skills such as communication, collaboration, and problem-solving. As students worked towards becoming experts with the Lego Robotics, Judith's expectation was that students would also establish a range of ways to document the process and products of their learning.

6.3 Learning With Lego Robotics: Student Self-Positioning

This section presents the narratives of the sample of four students who experienced the Lego Robotics: Lily, Rosie, Brian, and Jackson. Each student's narrative is developed with reference to the themes of learner behaviour, identification of new knowledge, 21c skills, anticipated future use, and challenges.

Judith grouped the four students as two experts and two novices. As not all students had used Lego before, this variation of previous experience supported insights into the ways students may transact with this differentiated learning experience.

6.3.1 Learner behaviour

The types of learner behaviours the students reflected upon were influenced by the amount of experience they had with the Lego Robotics. Lily and Rosie had not used the Lego Robotics before, and their narratives centred on what was novel to them in this first experience. Both Lily and Rosie described three actions: locating the correct Lego pieces, using the USB cable (cord), and following the instructions. Lily's PMM map stated, '**I** learnt when you try and find the bits and pieces that **you** need for **your** Lego creature is [*sic*] hard to find, because they are all mixed up' (Lily, PMM map).

Rosie used vague language in her conversation with me, mentioning the right pieces and right pictures without much explanation. This highlighted that the novelty for Rosie was the Lego and digital interface:

> Rosie: Putting the right pieces
>
> Fiona: Putting the right pieces. Did **you** get a chance to program at the end **Rosie**?
>
> Rosie: Yeah
>
> Fiona: So, what was happening on the screen?
>
> Rosie: **You** had to put the pictures in the right place. (Transcript 2a; Lines 13–18)

Rosie focused on novel actions in this learning experience of selecting the right-sized Lego 'pieces' and placement of 'pictures' (coding block images) in programming. The absence of a pronoun in her first statement (above) was indicative of a beginning understanding in this activity, with the pronoun ***you*** in the last line further portraying her self-positioning as a novice.

Her use of the general term 'pictures' when talking about programming suggested a beginning understanding of how this visual programming software worked and confirmed that it was an accessible format for the range of student abilities in this age group. By getting involved in the group and performing concrete actions, Rosie worked towards developing habits of action to support her learning about the Lego Robotics. Rosie knew what the others had done but did not yet feel that she owned the actions.

During the session, the small group of students focused on counting the raised surface of the Lego blocks to ensure they were selecting the correct pieces for both the plane and the bird robots. Rosie was very involved in locating the right pieces in the box of parts. Rosie began to understand the types of components needed when making the robot, perhaps highlighting the visible duties she used to support her rights while learning in this new activity.

The action of finding the right pieces to match those pictured in the instructions was one of the new experiences for Lily and Rosie. The actions of selecting the correct pieces and using the programming blocks provided simple behaviours for the students to be involved in as they learnt about building the robots. As novices in this task, Lily and Rosie felt they were learning new things and attended mostly to the concrete tasks they undertook when describing their learning. This is expected as these concrete tasks are the starting point for developing a practical understanding of the building and coding process. Through these habits of action, practical intelligence beyond the skill itself is developed.

While the Lego was also new to Lily, she reflected on her prior skills that helped her in the task, describing the similarity of how she organised jigsaw pieces to how she might approach the Lego Robotics: 'Maybe like when **you** have a puzzle, like a very big puzzle, and **you** can't find the right pieces to join it up all together to make a picture, so maybe **you** could, ummm, like put a pile here, do the colours' (Transcript 2a; Lines 47–49).

Her realisation that organising the Lego pieces was useful to this learning experience demonstrated a habit of action. Lily's connection to solving a puzzle transferred a personal skill from outside the classroom into the learning experience for the group to benefit from. Lily found this organisational strategy to be a helpful learner behaviour that assisted her to contribute to the group. Lily also showed her learner agency as she made connections between her life outside the classroom and that inside the classroom.

Lily felt that the Lego Robotics program was interesting. She valued the structure of the program to support her building of the robots. She felt that this new learning experience was creative for her as she followed the instructions to build the creatures. Her actions as a learner in this structured activity led to success in building the robots as directed: '**I** found Lego interesting because **you** can um, create **your** own things and **you** can create things that the program shows **you** to' (Transcript 2c; Lines 51–52).

Lily focused on novel aspects of the Lego Robotics to describe her specific learner behaviours in this experience. She felt confident to meet the learning goals of this structured activity and was able to highlight a strategy to combat the difficulty of finding the correct pieces. Her reflective dialogue gave insight into how her habits of action developed into habits of belief about her role as a learner.

Rosie highlighted the collaborative nature of this task when she described building as the best thing about this session: 'The best thing about this topic was when **I** did the Lego and **I** had a turn at building **it**' (Transcript 2e; Lines 19–20).

The use of ***I*** in this statement signalled ownership of this active learning behaviour, perhaps indicating a sense of empowerment of being involved with the group in building the robots. The opportunity to be involved in building was an agentive learner action Rosie performed to gain confidence with this activity. The pronoun use occurred in this conversation a few weeks after the activity took place. As a novice, Rosie was excited to be part of the building group; her later reflection showed her developing habit of interpretation about her ownership of her learning actions.

Brian and Jackson were more familiar with the Lego Robotics. Both had Lego at home, played Minecraft (which can be compared to a digital Lego form), and had used the Lego Robotics at least once before in this school setting. Brian and Jackson focused on different aspects of their collaborative experience with Lily and Rosie, contributing to a second storyline for these students as experts in this setting. The following examples highlight the moment-to-moment learning and wider skills Brian and Jackson reflected upon after the Lego Robotics activity. When Jackson shared his PMM map, he began by talking about building the plane: 'Ummm, **I** think the plane was very easy, but, **we** still had to use **our** brain and estimate' (Transcript 2b; Lines 67–68).

The pronouns used suggested that Jackson perceived building the plane as a personally easy task. The pronoun ***we*** indicated that Jackson believed there was opportunity for everyone to think and estimate as part of the group collaboration. Estimation occurred several times, for example, when the specific piece needed was not located in the box, or when another piece of the same size but different colour was substituted, with the bumps on the Lego being used to gauge the suitability of the piece. '**We** used our brain' showed Jackson's perception of cognitive action as part of the group. Jackson gave insight into his rights and duties as a reflective learner who made connections from old to new learning. He identified specific mathematics skills being practised in this activity. Jackson perceived this first robot as easy but still held new learning for him:

> **We** used addition, with the maths, like all addition and stuff. (Transcript 2b; Line 72)
>
> **We** used estimation, estimating, maths and using the mice [to hover over code on the interactive screen]. (Transcript 2b; Line 74)

The ease with which he identified the mathematics skills in this activity gave insight into the local moral order of the school, where students discussed their connections with peers and teachers. Jackson highlighted persistence as an action supportive of his learning, along with anticipation of new things and the need for cognitive engagement when faced with a challenge. The statement below focused on Jackson's personal expectations and enactment of his rights and duties as a learner when he completed the question stem in the second conversational interview: '**I** show **I** am a learner when **I** persist' (Transcript 2d; Line 14).

Jackson's awareness of his own persistence may indicate learner agency. By continuing the use of the pronoun ***I*** from the sentence stem, Jackson accepted the first order positioning of the stem and conveyed the importance of persistence as part of his own learner behaviours. This habit of action is important to note as part of Jackson's learner self.

In the excerpt below, Brian highlighted Lego Robotics as an opportunity for active learning. He identified that his duty as a learner was to use the Lego for 'finding out new things': '**I** show **I** am a learner when **I** am using Lego and finding out new things' (Transcript 2c; Line 34).

Brian expressed his learner agency through the continued use of the pronoun ***I*** in the above excerpt. As a student at Red River, Brian perhaps felt empowered to pursue his rights as a learner through active engagement with the learning experiences offered.

Lily, Rosie, Jackson, and Brian were all able to describe learner behaviours they enacted during the Lego Robotics experience. As novice learners, Lily and Rosie focused on the novel aspects of this equipment and were able to participate in the building and programming of the robot. As more experienced learners with this equipment, Jackson and Brian articulated that they drew upon mathematics skills and general skills, like persistence, when building the two robots.

6.3.2 Identification of new knowledge

As these students had different levels of prior experience with the Lego Robotics, their reflections on the development of new knowledge can also be separated to highlight types of knowledge for a novice learner and that of the more experienced learner. By participating in this open-ended group activity, all four students could describe new understandings.

The new knowledge highlighted by Lily and Rosie focused on the concrete set-up of the Lego robots. For Lily, this included the need for the USB cord (cable) to attach the robot to the computer. Her PMM map stated, '**I** know when you plug in the cord to the computer to make the **Lego** move, the **Lego** will move' (Lily, PMM map).

Attaching the USB cable worked well for the first robot but became a problem for the second robot, as Lily explained: '**You** have to make sure that the **creature** stays still so that **it** doesn't move a lot and **it** doesn't break when **it** moves' (Transcript 2a; Lines 8–9).

The USB cable flipped and broke the robot when the program was initiated, which was disappointing for the group. While unexpected, the point was notable for the group as it created a challenge for the students developing practical intelligence of what worked in one situation but not the next. The students applied this decision-making in the moment to see what worked and was a developing habit of action for all the students in this group.

The whole experience of building with Lego and following the instructions in a graphic format was new for Rosie: '**You** had to put the pictures in the right place' (Transcript 2a; Line 18).

Rosie was not at all familiar with using Lego outside of school. Perhaps this group task scaffolded her in this activity to participate when she felt able. For Rosie, Lego Robotics was a task she could participate in at her self-selected point of need. At this stage of her learning, Rosie was building habits of action; the concrete interactions with the Lego Robotics were her focus. The whole experience for Rosie was new, and the problem of the bird was beyond her current confidence with the Lego Robotics. This did not diminish her enthusiasm but did affect her ability to confidently contribute to the group in the time of crisis.

The new knowledge for Lily and Rosie as novices focused on game components and mechanics. For Brian and Jackson as experts, their focus was problem-solving to get the robots to work as expected.

Brian had previous Lego building experience and had used the Lego Robotics previously with another group of students. He was working towards being a classroom expert with the Lego Robotics. When reflecting upon the knowledge he had developed as part of the activity, Brian used the example of his problem-solving for the bird: 'The knowledge **I** used in this topic <u>will come in handy when **we** tried </u>using the um, motor to make the birds wings flap, and stuff' (Transcript 2c; Lines 68–69).

In this excerpt, Brian reflected on his previous experience with Lego Robotics by changing the future tense of the prompt to past tense. The excerpt above <u>uses an underline</u> to show how Brian changed the tense of the sentence stem. He referenced his previous experience of Lego Robotics, when he made a robot leg and the cable moved, as an application of new knowledge in relation to the bird. The shift in the use of the pronoun ***I*** to ***we*** indicated that while the idea about using the motor was his, he was consciously positioned as a part of the group making the robot. This exemplified the process of accountative positioning, with the roles being shared amongst the group in this collaborative Lego experience.

Brian described his use of the motor as an application of prior knowledge to the new robot bird. This was important to Brian as he revisited this moment in each of the two interviews, giving an impression of this habit of action as he built his skillset with the Lego Robotics. This was an example of a direct use of Lego-specific knowledge that Brian saw transferred between the two separate experiences of building different robots. In identifying the application of the Lego-specific problem-solving, Brian had reflected on his habit of action in the group effort to fix the bird.

Like Brian, Jackson saw Lego Robotics as offering an interesting opportunity to ‘try new things’. The shift from the pronoun ***I*** in the sentence stem to ***you*** in his response positioned his statement as a more general experience that others may also find interesting: ‘**I** found Lego interesting because ... **you** get to try new things’ (Transcript 2d; Line 18).

Jackson did not elaborate on the exact nature of the new knowledge, yet he did indicate it as useful as he worked towards being an expert: ‘The knowledge **I** used in this topic will come in handy when **I** ... maybe do it independently’ (Transcript 2d; Lines 44–45).

Absent from Jackson's responses was specific reference to the new knowledge of programming Lego Robotics, which was evidenced in the other three students' narratives. This may be due to Jackson's familiarity with Lego and perhaps Minecraft, which includes programming components. As this was part of his everyday life outside school, it may be that the programming he experienced at school was an extension of his previous interest and so not considered new as it was to the other students who had only experienced programming at school.

The responses from the four students also illuminated their perceptions of new skills in this game-based learning experience. All four student narratives fitted with the activity-based and visible learning local moral order at the school. Novice learners Lily and Rosie focused on the physical and concrete aspects of doing specific actions, developing a practical intelligibility of the processes for learning about the Lego Robotics. The expert learners Brian and Jackson focused on combining previous knowledge to problem-solve when the program did not work as expected. Both of these different stages of learning were important in the development of each student's practical intelligibility of themselves as learners when using game-based learning experiences.

6.3.3 21st century skills

All four students identified collaboration as part of the skillset they had developed during this activity. Lily, Rosie, and Jackson outlined the benefits of working in a group, placing the Lego in a position that they believed might 'teach' them to work together and to demonstrate collaborative social skills. The idea of working in a collaborative group was part of the local moral order of the school and was displayed through the language and action of the teachers, students, and parents at the site. It was perhaps not surprising that the students focused on this as a meta-skill when describing their interactions.

Lily identified the Lego Robotics as valuable in 'teaching' productive collaboration in two statements on her PMM map:

> **I** think **Lego** teaches **you** to work together because **you** can make the creature faster if **you** work together. (Lily, PMM map)
>
> **I** think we do **Lego** robotics during learning time because **it'll** teach **us** to cooperate, negotiate and communicate nicely. (Lily, PMM map)

Lily positioned these two statements as her personal opinion using the pronoun ***I***. As a learner, Lily described the dual benefits of working as a group: both the ability to build the robots faster and to develop a wider 21c skillset. Her perceptions of the 21c collaborative and communication skills were also expected by her teacher Judith. Lily described these collaborative skills as an important process and product of her learner agency:

> Ummm, **I** show **I** am a learner when **I**, um when **we** work together, like um. When **we** work as a team because if **you** just do **it** by **yourself**, like **it** will be slower, and if **you** work together **it** will make better stuff. (Transcript 2c; Lines 14–16)

Lily's pronoun shifted from the ***I*** in the sentence stem to the repeated ***we*** when she stated her answer. This demonstrated her repositioning of this statement to reflect her group experience. Her belief that completing the task 'slower' if she was alone and making 'better stuff' when working as a group asserted that collaboration was valuable to enhance her learning experience. Lily's perception was that the game offered her, and her peers, an opportunity to not only speed up the process but also produce higher quality evidence of learning during this activity. Lily expressed a habit of belief about group work, which aligned with the teacher's expectations and local moral order of the school.

Rosie also identified the opportunity to work in a group and collaborate through sharing with others as conducive to showing her understanding: '**I** show my understanding best when **I** can ... ... share with a partner' (Transcript 2e; Line 10).

When responding to the dice prompt 'The skills from the Lego Robotics will come in handy when . . .', Rosie focused her response on the skills of cooperating in a group and did not mention Lego or programming: 'Hmmm ... maybe when **you** are at home and have to share something, **you** would co-operate then. When **you** play outside with **your** friends' (Transcript 2e; Lines 61–62).

Rosie used the term ***you*** as a second order, accountative self-positioning, giving a generic application for the wider skill of cooperation. Her awareness of these 21c skills was not as developed in her PMM map or interviews as Lily's was; however, that Rosie articulated the more general applications of cooperation indicated that she had a habit of belief about the social purpose of such tasks.

Brian and Jackson recognised collaboration during group work as a right and duty for all students:

> Brian: **You** have to socialise, **you** can't just keep **it** all to **yourself**. (Transcript 2b; Line 80)
>
> Jackson: It wouldn't be fair if um, **you** just hogged all the **Lego** to **yourself** and **they** just didn't have a chance to turn around. (Transcript 2b; Lines 83–84)

Both Brian's and Jackson's statements positioned the Lego as a performative tool that they had a moral obligation to share. Jackson used the word 'fair' to describe the accepted group duty to support peers' access to this activity, with a focus on sharing and turn taking that supported Brian's sharing statement. Within the learning community at Red River, the ideas of fairness and equity of access to learning materials were a visible part of the local moral order in the setting. This supportive language use promoted cooperation, and all learners in the setting understood it as a right and duty.

Brian also described the 21c skills of problem-solving and collaboration on his PMM map. By using the example of the robot bird, which did not work as expected, he described his role in identifying and solving the issue. The statement below shows the pronoun shift that evidenced Brian's perception of his role: 'When **we** bilt [*sic: built*] the bird there was a boblem [*sic: problem*] that **we** could not get the wings to flap so **I** thought of [drew picture of solution]' (Brian, PMM map).

He prevented the group from dismantling the bird robot when it did not work as expected. Taking on a leadership role was an action influenced by his agency as an expert within this group. Brian's use of ***I*** positioned him as responsible for solving this problem. He re-used the motor from the plane robot they had made earlier and attached it to the wings of the bird. This was a successful solution for a very short time. After a moment of success, the cable twisted and made the bird flip and break. Despite this setback, Brian was confident to lead this group when they were not sure what to do next. He stopped them from dismantling the bird robot. He maintained ownership of this solution through his narrative in the later conversation.

6.3.4 Anticipated future use

Unlike the iPad mathematics applications in Chapter 5, the Lego Robotics did not have a clear classroom future use. It may have appeared from the outside to be a standalone task, which helped students to develop 21c skills and begin to explore principles of programming. The Grade 3 students predicted their future use of the knowledge and skills they developed to be relevant both inside the classroom and in their wider world. As with the Grade 1 students, the Grade 3 students' experience of the classroom was understood to be a 'real-world' application.

The social skills Lily practised in this small-group activity had immediate use within her school life. Lily also referenced her new knowledge that she could extend upon when using the Lego Robotics again: ‘Because there are lots of different kinds of pieces, instead of making what the **program** says **you** can make, maybe **you** can make **your** own things … and try to make it move’ (Transcript 2a; Lines 72–74).

In the above excerpt, Lily used ***maybe***, alluding to the possibility to create her own moving robot. The possibilities offered by the Lego Robotics kits seemed to be exciting for Lily. After just one experience of using the Lego Robotics kits, Lily displayed confidence in using the kits to make her own robots, not only those in the program. Through sharing this future use, Lily gave insight into her projected agency when she uses this tool again, and an emerging habit of interpretation that supported her to work with new technologies.

In Interview 2, Lily articulated the wider skills she had utilised beyond the Lego Robotics. Lily shared her recent experience of the National Assessment Program—Literacy and Numeracy (NAPLAN) test, which is administered to all Grades 3, 5, 7, and 9 students across Australia. Lily felt that her actions in the NAPLAN test demonstrated her self-reliance through finding ways of problem-solving:

> The knowledge **I** used in this topic will come in handy when, like, for example if **you** are doing **something** like **NAPLAN**, and **something** is really tricky, **you** need to learn and need to know how to do **this**, and which way should **you** go that’s right for **you**. (Transcript 2c; Lines 72–75)

The pronoun shift from ***I*** to ***you*** indicated Lily’s repositioning of the sentence stem to incorporate her peers in this nationwide NAPLAN experience. She indicated an awareness that the NAPLAN task was designed to be difficult. This was a recent experience for her and she shared it as an example of incorporating an authentic, wider experience into her school life. The knowledge she, and her peers, had developed with the Lego was legitimised in this example by Lily as a valued real-world skill. She saw the Lego Robotics as preparation for 'something like NAPLAN', where there were multiple acceptable solutions. It was her right and duty as a student to be able to approach these unknown tasks with confidence.

These examples also highlighted Lily's perception of her own agency, where the problem-solving of a 'tricky' question was a chance to show her knowledge. Lily's focus on collaboration and problem-solving skills exhibited a view of herself as enacting her learner agency in line with her habit of belief about the kinds of actions she should take as a learner. The connections she made indicated that the Lego Robotics experience was valued as an opportunity for Lily to learn new skills about programming and building robots, and practise skills like problem-solving that were valued in wider school life.

Rosie anticipated her future use of these skills. She also offered an in-school application for the next time she used Lego robotics when she would 'put more pieces in' (Transcript 2a; Line 66) and that '**I** could make one up of **my own**' (Transcript 2a; Line 129). These two statements suggested that she had confidence to take on a more active role next time she used Lego Robotics. Using the Lego Robotics at school, as part of a group, was an opportunity Rosie valued. Her use of the pronoun ***I*** positioned her as developing her habit of belief in relation to this technology, and her understanding of how to transact with the technology as a form of practical intelligence was emerging.

As Brian had used the Lego Robotics before, his anticipated future use had a more specific focus than Lily and Rosie's had. Brian's focus was the specific Lego pieces and how he could use them in new ways. He considered his knowledge about the motor in the robots as something he had found useful. Brian offered a caution about using the motor, with reference to the bird: ‘And **you** have to be careful of where **you** put the **motor**, because **it** might flip how **it** did in the **thing**, **the bird’** (Transcript 2b; Lines 54–55).

Brian’s focus on the way the motor coiled the cord and flipped the bird reminded him of a similar experience at an earlier time using the Lego Robotics, when he worked with a different group to build a robotic leg. Brian’s use of pronouns ***you*** and ***we*** suggested he had positioned himself as part of the previous collaborative group: ‘That’s what happened once when **we** were building a **leg thing**, **we** were building a **leg** and **it** kept twisting’ (Transcript 2b; Lines 58–59).

It seemed the USB cord, which was used to connect the robot to the computer, was compromised by the action of the motor. This had become a point of consideration for Brian in the building and adaptation of the robots he was involved in building. It was something that Brian had now experienced on at least two occasions. The movement of the USB cord had become a piece of specialised knowledge, learned through experience, in these Lego activities. Brian was becoming an expert in anticipating the kinds of specialised problems that may be encountered with these robots. Brian’s reflective discourse on this experience gave insight into how a habit of interpretation affects the development of practical intelligibility across several interactions with the Lego Robotics.

The future uses that Jackson identified were both inside and outside the classroom. When thinking about the skills developed in Lego Robotics, Jackson offered, ‘The skills **I** used in this topic will come in handy when … when **I** do um **Lego** or um **robotics** and maybe when **I** do **Minecraft**’ (Transcript 2d; Lines 61–62).

With the continuation of the pronoun ***I*** from the sentence stem, Jackson identified Lego, robotics, and Minecraft as places he would be able to use these skills in the future. As an opportunity for transfer, these skills were directly relevant to Jackson’s real life.

When prompted further on what he would do to solve the bird problem next time, Jackson referred to Brian's plan, positioning Brian as a problem-solver:

> Fiona: Next time **you** do the bird, **you** might think about how to put the motor on?
>
> Jackson: **He's** already thought about it, but, **you** don't need, actually like, **he** told **me** how **he** was going to do **it**. (Transcript 2b; Lines 113–115)

Here is an example of second order positioning. Jackson used the pronoun ***he*** to position Brian as already having a solution to try next time. Jackson went on to use a third order positioning of others who may also solve the problem with the bird. Jackson was hopeful that another group might be able to figure out the problematic bird robot: 'Maybe the bird won't work for **us**, so maybe next time **someone** will do it, **it** will just work, that will be funny' (Transcript 2b; Lines 122–123).

That another group may figure out the problem with the bird was not a cause for jealously. Instead, it sounded like it would be a happy moment to be shared with others in the class. Jackson's anticipated future use gave insight into his own learner agency, which group and cooperative work may enable just as much as through his present and future individual pursuits.

Jackson's two excerpts above exemplified the collegiate learning community at Red River, where the local moral order of the school setting was conducive to groups of students sharing goals and successes. In this way, the students may have anticipated the Lego Robotics as a teleoaffective learning experience, which aligned with the already supportive cognitive and moral practices of the school site.

6.3.5 Challenge

For this group of students, the bird robot posed the biggest challenge when it did not work as expected. As noted through this chapter, the bird construction had presented a few challenges to the group. When reflecting on the experience, Lily identified the need to deviate from the instructions of the program and swap certain pieces to make the wings stay on. Lily explained the challenging part of the building process for her:

> Lily: That um ... **I** thought it was easier to make **the bird**. But when it got to the end it got tricky putting the wings on.
>
> Fiona: So what did **you** do to figure that out?
>
> Lily: Hmmm, well **we** had to like swap some bits, and build the wing properly.
>
> (Transcript 2a; Lines 118–122)

Lily's personal surprise that 'it got tricky putting the wings on' prompted the group to rethink how to 'build the wings properly'. I attempted to continue this first order positioning of her to probe how she figured it out, but Lily used ***we*** as second order positioning to describe her actions as part of the group effort to rebuild the wings. In considering her rights and duties as a learner, Lily had invested herself as a part of this collaborative group, using active problem-solving to come up with a shared solution to rebuild the wings to flap. This exchange also suggested that when faced with a problem, being part of the group may have reduced the frustration Lily experienced.

In our conversation immediately after the learning experience, Lily identified herself as part of the group using the pronouns ***you*** and ***we***: ***you*** when offering a physical solution to the twisting of the cord and breaking of the bird, and ***we*** perhaps indicating a group responsibility to work through the instructions again. In her PMM map and Interview 1, Lily described what she might do to make the bird work:

> Lily: Maybe **you** could, like, untangle **the cord** that was like tangled up.
>
> Fiona: Yep, untangle the cord ... what other things would help?
>
> Lily: **We** could go back to the instructions and start over again, to see if **we** didn't miss anything. (Transcript 2a; Lines 35–39)

In this situation, Lily identified that the tangled cord was a problem for this robot, and she offered two possible solutions: untangling the cord and starting the construction over again. These two actions showed Lily applied practical intelligence when working with technology that was new to her. This challenge was not demotivating for Lily. She believed that as a group, trying again might lead to a working bird. Her faith in repetition to make the technology work could be interpreted as a habit of belief that Lily held about persevering with technology.

In Interview 2, Lily offered very similar responses to the prompts about challenge and surprise. The shift in pronouns was still evident, supporting the reliability of her positioning of answers given immediately after the activity. Lily seemed to identify as an agentive group member. In the excerpt below, Lily's pronouns changed, again indicating that being a member of the group may be supportive of meeting both expected and unexpected challenges in this activity:

> **I** found Lego challenging so **I** um, so **we** had to go to a different step. This way didn't work, that the **computer** showed **us**, then **we** had to use **our** own way. (Transcript 2c; Lines 26–27)
>
> **I** was surprised when, like, **we** finished doing the programming and when **we** actually programmed **it**, **it** didn't really work, and **it** broke into pieces. (Transcript 2c; Lines 39–40)

Lily showed her perception of the shared ownership in this experience in the above excerpts. Her pronoun use again shifted from ***I*** in the given prompt to ***we*** as she shared her recollection, just as it had in Interview 1. Lily again offered her previous personal positioning two weeks earlier as part of this group collective action. The rights and duties of Lily and her group to act as agentive learners was also evident in her example of when the group found their 'own way' to make the bird work. Lily's understanding of the flexibility of the learning tool displayed a habit of belief that the Lego could be adapted in the moment. In this way, Lily positioned the technology as a learning tool, a way of developing these skills while building the robots.

When prompted about what she would build next with Lego Robotics, Lily explained that she would try something with a different level of challenge:

> Lily: Maybe **we** could do another creature, one that's not so hard and not so easy.
>
> Fiona: Ahhh, ok, so which was the **bird**: too hard or too easy?
>
> Lily: Too hard.
>
> Fiona: So **you** need another step in between, and then what would **you** do?
>
> Lily: Probably after **I've** got the skills to know how to do the **bird**, maybe **I** can go back to the **bird**. (Transcript 2a; Lines 133–139)

Lily's recognition of her rights and duties positioned her as a learner who could gauge and adjust her level of challenge. She identified that the bird was perhaps too hard, as her judgement was that it did not work. She did not take this as a defeat; instead, she saw an opportunity to try another robot to learn the skills to be able to remake the bird. Her habit of belief about the process of learning was shown as her pronoun use moved from the group ***we*** in Line 133 to her own learning action ***I*** in Line 138. This was further supported by her second order, personal accountative positioning, displaying her own agentive actions she perceived as being supportive of building her skillset with Lego.

Lily echoed Jackson's earlier statements; her ability to articulate a possible sequence of skills to improve her ability next time gave further insight into the local moral order of the school setting. The behaviours and thinking of these students formed part of the visible learning journey when using the Lego Robotics, where their reflective dialogue could also be a form of practical intelligibility as they developed their own learner agency.

It may be that these opportunities for reflective conversations helped students to develop their habits of belief about the different ways they could show their understandings.

When asked what surprised her, Rosie shared her perception that the robot bird did not work:

> Fiona: Ok [redirecting chatter off topic], what surprised **you** about **your** learning and Lego today?
>
> Rosie: **I** thought the **bird** would work at the end, but **it** didn't ...
>
> Fiona: **It** did work, what did **it** do? **It** just ...
>
> Rosie: **It** broke into pieces [laughs].
>
> Fiona: [Laughs] Before **it** broke into pieces, **it** was making a lot of noise too.
>
> Lily & Rosie: Yes. [Both laugh]
>
> Rosie: But **it** didn't work. (Transcript 2a; Lines 111–116)

Her focus on the bird robot not working as expected was a problem-solving storyline that ran through the narratives offered by all four students. In Rosie's case, she had trouble articulating the exact problem with the bird, offering that 'it broke into pieces and didn't work'. This did not seem to be a point of upset or frustration for Rosie. It was unclear if this was because of the game-based learning space, where failure was anticipated as part of learning, or if this was influenced by the culture of learning in the school. Maybe working as part of this collegiate group, with Brian and Jackson as more experienced leaders, allowed Rosie to feel part of the group. She did not perceive the robot not working as a personal failure but something absorbed as, and to be solved as, a group.

When Rosie reflected on this same prompt two weeks later, she expressed her surprise at the bird not working as expected in a similar way to the above excerpt: 'Um

… **I** was surprised when **we** did the **bird's** head and it didn't work. And like, um, **it** didn't work **I** thought **it** was going to work, and **it** didn't' (Transcript 2e; Lines 35–36).

Rosie's surprise supported this as a point of cognitive conflict that had remained with her since the event. As her first experience with the Lego Robotics, her expectations of following the instructions and the robot working were reasonable. It may be that working in the group with more experienced students had supported Rosie to express this surprise without frustration, as her use of ***we*** again signalled she shared her learner agency within the group. The challenge Rosie put forward also emphasised the benefits of working in a collaborative group, as she could observe and wait for the next turn to develop her confidence slowly: '**I** found Lego challenging so **I** ... um ... waited patiently for the next turn' (Transcript 2e; Line 5).

Her passive waiting 'for the next turn' indicated that in this activity, Rosie was enacting her habit of interpretation that she as a novice should wait to contribute to the group. Her inactivity may have been part of her own set of learning behaviours; her 'patience' may have been a tried and true strategy for her to observe and prepare to contribute. Being in a group and taking turns may have positioned her to feel less personal responsibility to solve the problem.

Brian's response to the challenge posed by the bird robot was different to Rosie's. He took an active role as one of the class Lego experts. It was Brian who had stopped the rest of the group from dismantling the bird to rebuild it. Brian offered this as a confusing scenario: '**I** found it pretty confusing when the **wings** wouldn't flap' (Transcript 2b; Line 7).

The use of the word 'confusing' denoted Brian's cognitive engagement with this unexpected problem. He thought the wings might have been out of alignment: 'Yes, the wings ... **they** were different heights' (Transcript 2b; Line 9).

Shortly after this, he realised there was no motor on the wings and so repurposed the motor from the Lego plane they had built earlier. This clever solution worked; however, the weight of the motor and the USB cable placement led the bird to flip and break. Brian was active in this situation, showing a transfer of practical intelligence from his previous experience with the robot leg. He included this solution in an image he drew on his PMM map, recording his thinking solving this challenge.

A little later in our conversation, Brian recounted another confusing episode in this session. This time the confusion came from the programming of the plane: 'Oh, the plane, **I** found it quite confusing with the **programming**, it was like, **it** didn't work at the beginning, and then **I** took the **thing** [block of instruction in the programming] off, then **it** started going again' (Transcript 2b; Lines 103–105).

Brian's confusion here signified another challenge in the Lego Robotics. Even though the group had followed the steps in the building and programming, a bug in the program meant the plane did not work. Again, Brian's confidence as an expert in this small group was exemplified when he took off particular programming blocks, leading to a working plane.

When challenged in these ways, Brian successfully solved two different problems with the Lego Robotics: physical construction and programming. Two weeks later, Brian's response to the dice prompt about challenge supported a consistency in his learner agency in this scenario: '**I** found the Lego challenging so **I** tried and tried to think of what **I** could do to make **it** work better' (Transcript 2a; Lines 9–10).

Brian continued the use of the pronoun ***I*** from the sentence stem and took ownership of thinking through a solution to make the Lego robot work. His position as a leader of this group was clear. Brian's continued use of the pronoun ***I*** and his discussion of his actions in the learning experience indicated his perception of himself as an agentive learner, working towards being a Lego Robotics expert within his class.

Jackson had mentioned the plane model as an easier model to build and program. Later in Interview 1, he explained that the bird was a greater challenge:

> **I** think the **bird** was the **challenging one** because whenever **we** used to try to get the **motor** together **it** always used to break, and whenever **we** put the **motor** on **it** just kept on spinning and spinning into knots. **It** was no good. That was pretty hard. (Transcript 2b; Lines 95–99)

For Jackson, the robot bird presented an example of a challenge. The motor broke the robot, and this was an unexpected failure for the group. The use of ***we*** positioned Jackson as a performative part of the group, someone trying to make this work. The use of the word 'whenever' suggested multiple tries of attaching the motor and repeated defeat. Perhaps the culture at Red River of collaboration was part of the reason the group did not give up. Jackson was able to explain the group's attempts to fix the bird robot, exemplifying a confidence in generating conversations about active learning behaviours. Having a group to actively problem-solve with may be a component that supports the development of habits of belief around the wider skills of learners.

Two weeks later, Jackson's response to the following dice prompts showed how he envisioned enacting his rights and duties as a learner. This gave insight into his learner agency. Jackson highlighted persistence as an action supportive of his learning along with anticipation of new things and the need for cognitive engagement when faced with a challenge:

> **I** found the Lego challenging so **I** ... ... thought maybe. (Transcript 2d; Line 22)

> The best thing about this topic was when **I** ... tried to make the **wings** flap. (Transcript 2d; Line 34)

In Jackson's personal enactment of his rights and duties as a learner, he identified cognitive engagement and a goal-oriented action. While he did not elaborate further on these two statements, Jackson's reflection on the bird building showed a consistency in his habits of belief about himself as a learner.

6.3.6 Summary of findings

The students identified a range of cognitive, moral, and affective skills, like cooperation and mathematics skills, which were drawn upon as part of the Lego Robotics session. The language the students used in their interviews and reflections gave insights into the self-positioning of each student as either a novice or an expert in the Lego Robotics session. Over the time of data generation, the group maintained their narrative of the whole group experience of success with problem-solving the bird. Brian maintained his agency as the problem-solver of the group, using his previous experience with the Lego Robotics to provide a solution.

The identification of problem-solving across this student group highlighted how students may access differentiated learning outcomes through the same activity. All four students felt included and active as part of finding the solution. Each student reported experiencing confusion or a challenge, yet this was not a deterrent to their progress or perception of learning. The student narratives presented framed these hurdles to highlight their habits of belief about themselves as learners, accessed through this game-based learning experience.

As with the iPad mathematics applications, students saw the Lego Robotics as an interlocutor, providing items for students to build and program and giving immediate feedback on progress. The way the teacher implemented the Lego Robotics also gave students opportunities to develop social skills that contributed to learning in addition to the cognitive gains of learning to code and program.

These findings were used to generate four storylines, which are now analysed with positioning theory (Harré & van Langenhove, 1999).

6.4 Storylines of Learning With Lego Robotics

The Grade 3 students at Red River were involved in the Lego Robotics as a productive process of 'becoming' a learner. The programming and coding were cognitive skills, which were the aim of the Lego Robotics activity but were only one part of the teacher's desired outcomes for the students in this activity. The active problem-solving and collaboration were front and centre for the teacher and students in this activity. The pedagogy used by Judith in the implementation of this game-based learning experience encompassed a multi-ability grouping of four students and an opportunity for them to practise the 21c skills of collaboration and problem-solving. The students described these aspects of the experience, and these themes are analysed next through the student and teacher storylines.

6.4.1 Collaboration: Student self-positioning

Lego Robotics provided opportunities to show active learning behaviours in a collaborative activity (Figure 47). The opportunity to build as a group perhaps aligned with active duties students could perform as learners in this activity. Lego Robotics was a task where students could participate at their self-selected point of need. Teacher Judith identified the Lego Robotics as a differentiated task, which supported both programming and the 21c skill collaboration. For example, Rosie was not familiar with using Lego outside of school; this activity gave her time to develop a practical intelligibility about Lego and programming, through working with Brian and Jackson as experts.

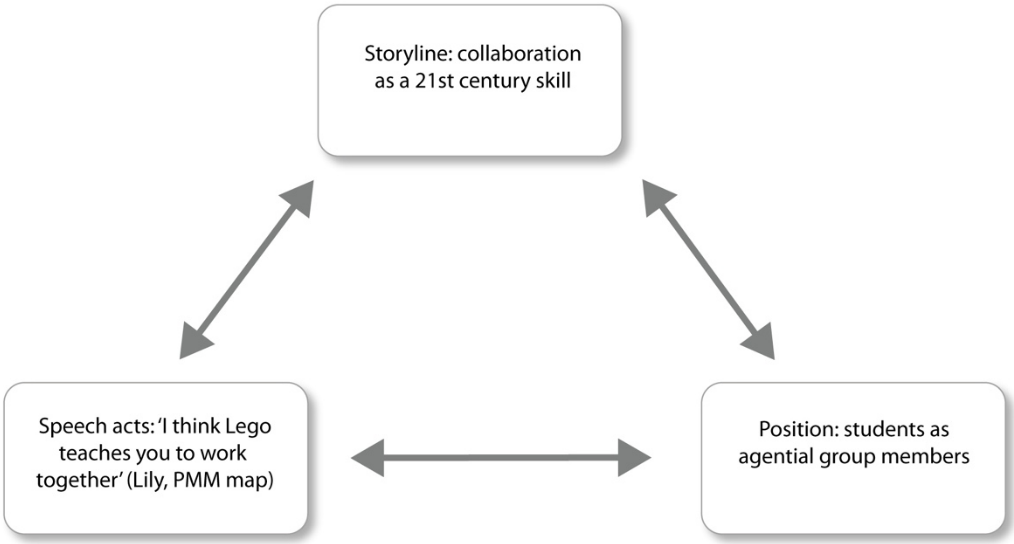

Figure 47: Mutually determinant triad used to explore the student's self and other positioning in the research conversation.

Considering the individual student in this group work, there was a strong sense of learner agency from all the group members in their reflections. The narratives presented here may be classified as lived curriculum (Huber et al., 2011), an activity that supported students to author their own narrative of cognitive engagement through active problem-solving. This collective narrative showed a crossing-over point of the game's local moral order and that of the school setting. The pedagogical choice of the game-based learning experience supported students to further practise and transfer skills valued in the school setting.

Both Judith and Lily positioned the Lego Robotics as an entity that supported the building of social relationships. Lego Robotics was part of a wider school program at Red River in which technology was a learning tool. Judith described that she encouraged students to document and discuss their learning journeys in a variety of ways. It may be that this was common across the local moral order of Red River, and Lily evidenced this when she identified more than the domain knowledge and skills developed.

In this sample, students displayed agency as a group and agency as individual learners at different times. Rosie's understanding of 21c skills was not as developed as Lily's was. This may be significant as it sheds light on the differentiated learning focus of this task. The students were able to provide evidence of their learning within the experience against their own personal goals and abilities. As in Chapter 5, the game represented a semiotic space where they could be successful in meeting goals. Though their personal meaning making could vary, there was an underlying perception of success and confidence when engaging with the Lego Robotics.

Consider Rosie who accepted the position in this group as a novice by helping to build the robot as directed by the others in the group. This was not an example of first order positioning as outlined by Harré and van Langenhove (1999), as there was no direct discussion of roles in the group; instead, this was likely a personal positioning, where Rosie chose a performative position within the small group, waiting for direction from more knowledgeable others. Perhaps this was an example of her exercising her agency as a novice in this activity, observing and helping with certain aspects of the task as a way of building her skills and understanding in this space. By the end of the experience, Rosie reported confidence to contribute next time. These behaviours resonate with opportunities for peripheral participation (Lave & Wenger, 1991), where a novice can dip into an experience and build skills alongside a more knowledgeable other.

The students repeatedly drew on the varied actions as evidence of their successful learning behaviours with this tool. Gee (2008) highlighted that a game-based learning scenario promotes the individual to feel a sense of authorship over their experience. In the Lego Robotics activity, this individual authorship was seen when Brian described his solution using personal pronouns. A shared group ownership was indicated in the narratives of Lily, Rosie, and Jackson.

Perhaps this is telling of the local moral order in the school, with the rights and duties of learners central to the lived curriculum. In this differentiated environment, the students were able to reflect on the same experience in different ways, articulating their personal learning journeys. Lily and Rosie focused on the 21c skill of collaboration, which was highlighted as part of a desirable skillset across this school's environment. Lily also described collaboration as a valued skill in her recollection two weeks later. Brian and Jackson focused on fair use and participation. These examples reflected the rights and duties within the school where everyone was active in their learning.

Regardless of their status as a novice or expert with the Lego Robotics, this game-based learning experience supported all four students to participate in, and identify, their agentic learning behaviours. The language used by the students to position their remembering as part of the group gave an insight into the sustained roles the students took on in the group in relation to their personal learning journey.

6.4.2 Problem-solving the robotics: Student self-positioning

The students' own habits of action and belief influenced their participation in the problem-solving involved in this activity. In the group, Brian was a more knowledgeable other, working towards being an expert. He used his previous experience of attaching and programming the motor to solve the problem with the bird. He used what he had learned with the motor in making the leg model and applied it to the bird. Brian had confidence to transfer his prior experience to help solve the challenge that had been facing the group. His ownership of the solution was evident in his responses, and his self-positioned role as a group leader was stable.

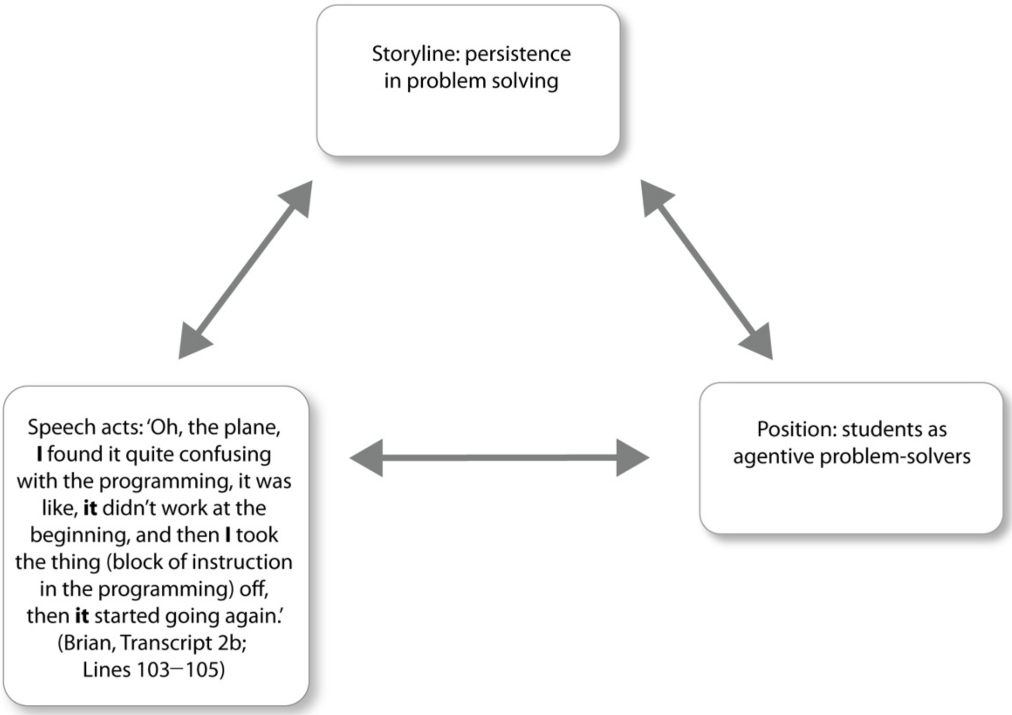

Figure 48: Mutually determinant triad used to explore the student's self and other positioning in the research conversation.

The moral space of the classroom also gave rise to the students showing knowledge from other domains to support problem-solving (Figure 48). Student duty to use relevant knowledge from other areas, including Jackson's estimating and counting and Lily's jigsaws, gave further examples of agentive learner moments that showed them exercising their moral duty. The Lego Robotics may have positioned the students, giving an open-ended task for students to respond to. Students' positioned themselves and contributed to the group in different ways. The Lego Robotics provided a point of difference to other class tasks, making the skills required obvious to both students and teacher.

The students at Red River displayed a confidence to apply processes and products of learning to different learning experiences, including NAPLAN. These conversations gave insight into the students' habits of belief enacted in this school setting. Lily, Rosie, Brian, and Jackson all reflected on the direct application of skills for the next time they used the Lego Robotics. They were also cognisant of the applications to other situations in school, like NAPLAN, and in their life outside school. Their anticipated use of the collaborative and problem-solving skills indicated a habit of belief that this task was a worthwhile use of their time.

In our conversations, the students seemed to have positioned the Lego Robotics as a performative interlocutor, providing them with challenging problems to be solved. This storyline is presented next.

6.4.3 Providing problems to solve: Positioning of Lego Robotics

It is noteworthy that neither of the robots made worked as expected, despite the students following all instructions. These glitches within the programming did not act as a deterrent to the students. The students actively met these unexpected challenges using the available Lego Robotics pieces and their other programming experiences to solve each problem. Brian's focus on a working robot and collaboration in the group modelled the active learner behaviours expected at Red River. The cognitive conflict created in this learning experience was a prompt for discussion and an example of productive failure, as defined by McGonigal (2011). In these examples, the Lego motor was identified as an item that had to be carefully used, and that building a working robot was not always as simple as the guide showed.

The positioning triangle (Figure 49) presents the storyline of the Lego Robotics as a problem to be solved. The hands-on nature of students building the robots and using the digital interface to program the robot provided a reflexive space for students. Students had control over all aspects of the interaction, with immediate feedback from the Lego Robotics signalling success or failure. This could be empowering as a 'teacher-free' activity, supporting students to share ideas and collaborate to try to be successful. In this way, the Lego may have had a performative position in the dynamic transaction.

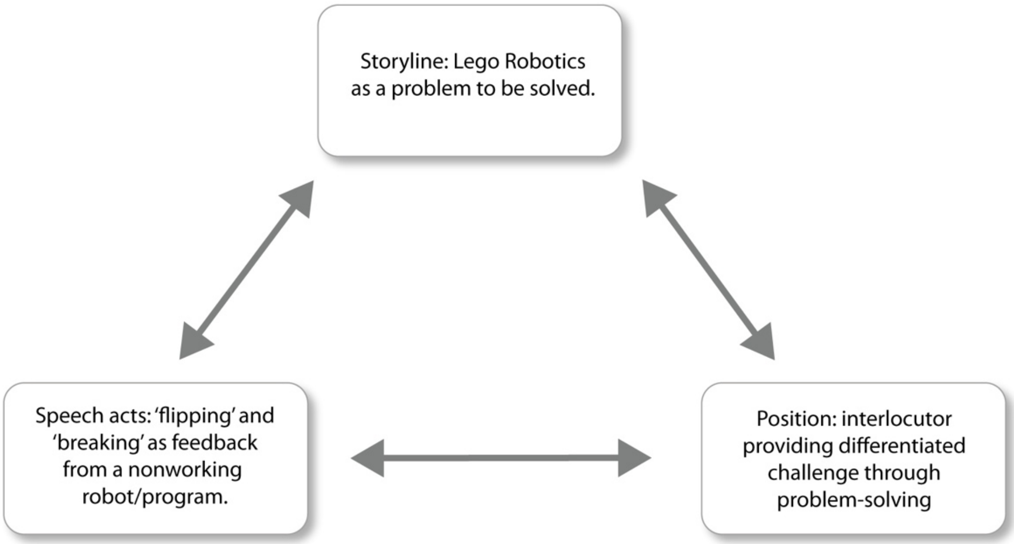

Figure 49: Mutually determinant triad used to explore the students' positioning of the game in the research conversation.

The Lego itself had a performative role in positioning students as agentive problem-solvers. Persistence in the face of failure is a recurring theme in the games and learning literature (Annetta et al., 2009; Clifford & Chou, 1991; Malone, 1981; Williams, 2011), which might be to do with emulating epistemic experiences (Bielaczyc & Kapur, 2010; S.-H. Wang & Wang, 2016). There was no opt-out of the experience as found by Razak and Connolly (2013) with students of a similar age. This may be attributed to the school culture as a community of learners, with a local moral order of supporting students to reflect on learning to make their learning visible. Lego Robotics became an opportunity to develop and rehearse these wider skills in the collaborative play space, supported by peers, in a safe place where students saw challenge as an opportunity to implement further active learning behaviours.

As a site, Lego Robotics may have brought its own moral order, which the students perceived as aligning with the moral order of the school site. The ways the teacher implemented Lego Robotics as a differentiated group activity; it was shared fairly within the collaborative group and provided clear actions for students to engage in, showed the alignment to the school's local moral order. While the Lego Robotics was exciting for the students, the novelty did not inhibit the students' ability to interact in positive ways. The students differentiated the available meaning making and accessed it in different ways to meet their current needs. Repeated use of the Lego Robotics would support learners progression, building their practical intelligence of building and coding robots.

The teacher Judith had sequenced the Lego Robotics as part of the whole-school plan for learning technology integration. The final storyline for this chapter considers Judith's moral duty as a teacher and how her epistemic authority was lived through the curriculum at Red River.

6.4.4 Epistemic authority and the moral duty of a teacher

Judith's planning and pedagogy went beyond the game space itself, with the learning goals understood as making a working robot and developing 21c skills. There were additional interactions that Judith hoped would support students to feel agentive in their learning, and this went beyond simple interactivity of putting blocks together and following instructions. The collaborative nature of the Lego Robotics activity as students enacted it was evidenced in this chapter as a way of differentiating this task. By placing students in a mixed-ability group, Judith was fulfilling her moral duty to address the coding domain knowledge of the curriculum in addition to the teleoaffective collegial space and enacting the local moral order of the school as a place where all students could progress from a point of need (Figure 50).

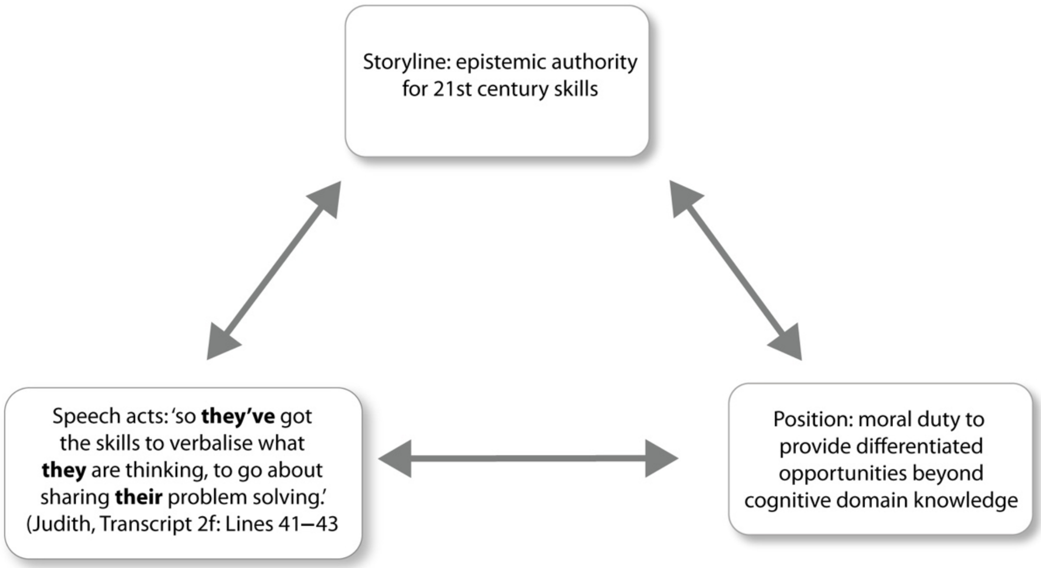

Figure 50: Mutually determinant triad used to explore the teacher's self and other positioning in the research conversation.

The use of the Lego Robotics was not an abdication of responsibility on the teacher's part. Instead, it was a way of empowering the students within a safe practice space for a range of social and cognitive skills of value. By providing this type of activity, Judith was enabling both novice and expert students with opportunities to enact their learner agency and support each other in the learning process.

The students' moral positioning and agency at Red River were enacted through the planned pedagogical interactions: with the teacher, with cultural tools, and with each other. The teacher's epistemic authority of pedagogy that positioned the Lego Robotics as a collaboration and problem-solving activity for the students enabled the intertwined cognitive, affective, and moral spaces.

6.5 Chapter Summary

The teachers and students at Red River showed an understanding of the varied interactions required as students moved from novice towards expert in using the Lego Robotics. The differentiated nature of the Lego Robotics kits supported students of varying levels of confidence to engage with both building and programming. In their reflections, the students identified their collaboration and problem-solving as consistent habits of action during the learning experience. Within this experience, it was also notable that the students met the challenges as opportunities to be creative and solve specific problems. Having such experiences may be valuable in empowering learner agency.

The local moral order of the school setting is important here. The school embedded the novice-to-expert learning journey as part of the expected student learning behaviours from Prep to Grade 6. We can see that Red River supported progression of student ability through different digital games at Grade 1 and at Grade 3 levels. The experience of the teacher in the setting may also have influenced the students' ability to identify the wider social learning that was taking place in these types of student-centred activities.

The Grade 3 students exhibited awareness of their moral rights and duties as agentive learners when working in this small group at Red River. They enacted a variety of learning behaviours to make connections between their existing knowledge and the new knowledge and skills they were developing from novice to expert during the Lego Robotics experience. Students saw these skills as applicable to their immediate classroom and home lives.

The students' and teacher's understandings of the game site's contribution to learning took a progressive step from that seen with the Grade 1 students' use of iPad mathematics applications. The Lego Robotics not only required more creative input from the students, but it also provided an affective space for the students to interact in an authentic activity and develop social skills with others, making visible their own habits of action and belief about themselves as learners. In itself, the Lego Robotics was a packaged opportunity to learn coding and begin to understand the physical structures of robotics and application of logic algorithms. When utilised by Judith in her classroom, the local moral order of the school and its goals of equipping 21c learners was realised through mixed-ability grouping of students.

These students were aware of the opportunities for rehearsal of these learning behaviours and actions. They were agentive as far as their own abilities and experiences allowed them, while they actively participated at their point of need. The moral space offered by the game included both the students' decision-making about the programming and problem-solving and a way to live out equitable social practices of collaboration.

Chapter 7: Narratives of GameMaker: Studio

7.1 Introduction to Forest Springs Year 9 Narratives: GameMaker: Studio

Chapter 7 presents findings and analysis of the co-constructed conversations with the students at Forest Springs. The findings are presented to show the students' perceptions of learner agency as they created their own digital games. In contrast, other datasets in this thesis position the students as consumers of existing games (Grade 1 iPads mathematics applications and Grade 3 Lego Robotics).

The chapter begins by introducing the school context at Forest Springs. The findings for the three students—George, Obi-wan, and Phoebe—are presented according to the themes learner behaviour, identification of new knowledge, 21c skills, anticipated future use, and challenges. As in Chapters 5 and 6, these findings are then analysed with reference to storylines and positioning theory.

7.2 Introduction to the Sociocultural Positioning of GameMaker: Studio

Forest Springs was a Years 7 to 12 school in Melbourne's inner suburbs. The context of this school was inclusive of the learners' physical setting, social culture, and academic values that underpinned the learning community enacted within the school.

Seven core values guided the curriculum at Forest Springs, including determination, creativity, and responsibility (Name Redacted, 2016). These values were supported through teaching and learning approaches that encompassed the students as active participants in the school community. The school values and practices aligned closely with research pertaining to enacting agency as a learner (Buckingham, 2008a; DET, 2013; Mercer, 2012), wherein students were supported to build both social and academic skills through interaction within the classroom and school community.

Forest Springs offered classroom programs, like Making a Difference (MAD), and lunchtime clubs and groups to further support students. The school context reflected the social and cultural demographic of the school community and supported students and teachers to be proactive members of this community of learners. The school environment and culture supported the academic learning (domain knowledge) and the affective and moral development of students.

The moral context was emulated within the classrooms at Forest Springs by implementing projects that modelled real-life work, known across the literature as epistemic scenarios (Bielaczyc & Kapur, 2010). The focus of the GameMaker: Studio project was digital game design. As a school project, it provided an authentic context for students to develop and apply their new knowledge and skills. This approach linked closely to the school's philosophy, supporting socioconstructivist learning experiences, where students were encouraged to develop their learner agency through everyday interactions.

The dataset generated at this school provided a window into the student and teacher perceptions when building a game as a learning object. In this project, the GameMaker: Studio software was seen as having informational power, which the students learned to manipulate to create their own digital game. As students gained an understanding of how to program, they also made meaning for themselves as learners with technology in a more general sense. The co-constructed dataset from these students at Forest Springs traced the students' perceptions of the informational power they developed while building their programming skillset.

Digital games are often referred to as a cultural tool for this generation (Hung, 2010; Klopfer, Osterweil, Groff, Hass, et al., 2009b; Prensky, 2007), with this project leveraging an area that is usually a leisure activity, albeit as a consumer of existing content. The Year

9 elective was the first time in the Forest Springs curriculum that the GameMaker: Studio software (YoYo Games, 2016) was used. These students were unlikely to have encountered this program in a prior school setting. The GameMaker: Studio project was likely to be the first time they had had creative and technical control in planning, coding, and developing their own digital game. It was anticipated that, through the production of their own game, students would build their understanding of, and skills in, the digital game design process. Students progressed from being consumers of content to being creators of content.

The software itself was a tool for the students to learn how to code for their planned game. When the students interacted with the software, they were given immediate feedback on the success or failure of their code through testing the program (YoYo Games, 2016). This exchange between student and software provided the co-constructed learning experience reflected upon through our conversation. The students were building a game under the direction of their teacher, who implemented this project as an assessment task. Some of these interactions were asynchronous and included interactions with the game software, testing of the game artefact, seeking help from online sources, and conversations with the teacher that may have been before, after, or during interactions with the GameMaker: Studio software.

The teacher presented GameMaker: Studio coding activity as a project and took four weeks of class time during Term 2. The class followed the IDPE technology design process (Victorian Curriculum and Assessment Authority [VCAA], 2014) and incorporated learning the elements of scripted coding to make a digital game. The project culminated with students playing and evaluating the games of peers. The teacher's professional knowledge is now analysed to disclose the reasons this agentive, epistemic experience is provided for the students.

7.3 Teacher Professional Knowledge to Create an Epistemic Project for Students: Rey's Planning Narrative

During our conversation, Rey spoke at length about the pedagogical choices she had made in developing this project. GameMaker: Studio had an interface that supported the students to develop a working knowledge of the Boolean logic conditionals (if, then, not, etc.) and code using a game-based approach. Rey continued,

> **I** like that **they're** understanding the building block components to **it** and starting to program. And as **they** get more advanced **we** can put coding in and **they** can start to use mathematics too, so there's like these little hidden agendas in GameMaker: Studio which **I** really like. (Transcript 5c; Lines 28–31)

Rey's pronoun use conveyed a confidence in her role as a teacher, guiding the students through this new territory. Rey's pronoun use shifted between ***I***, ***we,*** and ***they***. Her use of ***I*** indicated her first order positioning of her own expertise in sequencing the learning experience, which she had refined over the last few years. Her use of ***we*** acted to co-position students, implying a collegiate environment of collaborative work towards a common goal. ***They*** positioned students as responsible learners, using a third order positioning (the students were not involved in this conversation; it was just Rey and me) to exhibit a habit of belief about how her pedagogical choice supported the rights and duties of her students.

Rey identified the 'little hidden agendas' of GameMaker: Studio (Line 30). These inbuilt opportunities used different types of programming to increase student challenge as their skills developed. She combined software and pedagogy to create a classroom that functioned as a microscale community of practice, with access to the online wider digital community as needed. Rey cited a key reason for this pedagogical choice as the constantly changing work environment in the digital technologies field:

> Because also if **they** are going to be a game developer, **you** don't get taught that much. **You** would learn a certain amount in **your** degree, and then 10 years after **your** degree none of that is relevant and **you** have to learn **your** own stuff by **yourself**. So, it is sort of trying to teach **them** those concepts and lead on. (Transcript 5c; Lines 48–51)

Rey's awareness of the rapidly changing digital technologies work environment was seen as an opportunity to model epistemic learning resources with the students (Roberts, 1996; Russell, 2002). Modelling the learning resources used within the 'real-world' digital community was an example of how this layered unit offered an experience for the students to use authentic epistemic tools (Shaffer, 2006; Squire, 2011b). The pronouns ***they*** and ***you*** used by Rey in the above extract indicated a form of second order positioning of the students in the future.

Her teacher view conveyed the state of the outside employment world that the students would soon be a part of. Rey indicated that this project supported the agency that needed to be part of the students' ongoing skillset. Despite this future workplace pattern being removed from Rey's control, she saw a significant part of her moral duty to prepare students for this reality. It was an example of the multiple rights and duties Rey enacted for herself and for her students. In addition, the pronouns used above suggested a shared learning journey in this elective class, where Rey was active in supporting her students to experience the skills required to be a game designer.

At the beginning of our conversation, Rey gave insight into her multilayered planning for this project. In her PMM map, Rey referred to aspects of coding and design as an authentic link for the students to the real world. She elaborated on the opportunities this project encompassed as an introduction to aspects of game design as a career. She envisioned part of the student experience as follows:

> Ok, so um, for game maker to **me** it's thinking about, lots of kids say—oh, **I'm** going to be a game developer. So, one, this starts to get **them** thinking about that reality of what's involved in making a game so that **they** can look at it from a career perspective. It's a huge career perspective and it's a great one but it's really hard to get into so, to get **them** breaking it down and thinking about 'what part of game making would **I** want to do' and 'is it really what **I** want to do'. Like, what part do **they** like about? (Transcript 5c; Lines 7–12)

Rey's use of pronouns above indicated third order positioning of the students as enacting their agency throughout this project. Her pedagogical design of the project required the students to engage first as consumers, then as supported producers of a digital game. By implementing the IDPE process, students had creative control of the game developed, making this an authentic and personalised experience for the students. The structure of this four-week project helped the students to break down the variety of tasks involved in game design and production. Rey's hope was that the project would inform the students' subject selection, career choices, and future work.

Rey's true beliefs shaped this project. Rey expressed these beliefs in more detail as she explained each step in the pedagogy of delivering this project to the class.

The topic began with students viewing the TV show *Good Game* (Carr, 2015) and reviewing a range of game types before choosing their project topic. The students were given insights into additional roles beyond playing games and were invited to be reviewers as another layer to this project. By beginning with reviewing real-life games, Rey positioned the students as consumers of games, developing their critical eye to include key features and mechanics of games. The next step was to begin the production of a game, and GameMaker: Studio was positioned as the learning tool that would help develop a new programming skillset. The authentic link to real-life games and game development was an intentional layering of this learning sequence. The excerpt below is an example of how Rey ensured all students had a clear starting point, even if they were not gamers:

> Yeah, design the piece, and that big picture. And **we** do things like watch *Good Game* beforehand to understand what makes a good game review, and what it is that people are looking for in a game review. So **I** make them write a game review so that **they've** played a game to think about. (Transcript 5c; Lines 100–104)

Rey was also aware of the links to current subjects the students could make, like English, to support the development of storylines and when writing their game reviews. Rey saw an opportunity to integrate existing skills and help students identify transferrable skills:

> Yeah, that sort of idea, that there is a story line. So, it does bring in a little bit of English in a way, and some kids **you** can see their strength or weakness in that, but sometimes it builds up their, you know, skills, like, **they** might not be good at English normally, but **they** love computer games and **they** want this awesome computer, you know, story, so it gets them into that. (Transcript 5c; Lines 60–64)

The extracts from the interviews above show the interplay of rights and duties that Ray consciously enacted as she planned the game-based learning experience. The inclusion of elements like the game review, development of the game design, and collegiate discussions supported students to enact their agency through this epistemic experience. Rey's habits of belief about how best to meet the students' needs extended beyond the immediate school activity and included her true beliefs about how to support students to develop their practical intelligibility about their ability to design and program a digital game and possible future careers.

7.4 Student Self-Positioning of Learning With GameMaker: Studio

In this section, the students' self-positioning of learning during their GameMaker: Studio project is presented. These findings are then further analysed with reference to how students positioned and made meaning from the GameMaker: Studio project. George and Phoebe worked with partners who were not part of my research, while Obi-wan worked by himself on his own game.

Students' data is presented under the themes developed in their interviews and PMM maps. The themes available for the GameMaker: Studio project were learner behaviours, identification of new knowledge, 21c skills, anticipated use, and challenges. Each theme is presented with supporting analysis of the student data.

7.4.1 Learner behaviour

George identified in his PMM map that the learning goal of this task was to make 'a game from scratch'. He listed a range of actions he had taken in this project, including developing characters, storylines, and the attention to detail needed to code the game itself. The new experiences offered in this project were of interest to George. The process of designing a game and learning the details of coding were elements George expected to involve challenges: 'really learning how to make a game from scratch, **I** think **it's** quite challenging, um, 'cause there's lots of like, details like characters and then like objects' (Transcript 5a; Lines 89–91).

By identifying the actions of planning and coding the game, George's pronoun use gave insight into his agency as a learner in this experience. He could see how the details came together to make a whole game, displaying a habit of belief that designing a game is a purposeful challenge.

Obi-wan anticipated coding and logic in the range of skills he was developing. By using the words 'helps' and 'links' in his PMM map, he identified skills he developed in

English (subject) and his current and future interests in this aspect of the ITS elective class.

In Interview 1, Obi-wan explained his PMM map: ‘makes **us** want to learn, so as **I** said before, most **people** in the class do actually play computer games, so **they’re** making one now … So, **they’ll** go: Hey, **I** can relate to this, this is fun’ (Transcript 5a; Lines 53 and 56).

Obi-wan chose to extend his PMM map to speak on behalf of his classmates; using ***us*** in the top left of his map, he asserted that the game-making project ‘makes us want to learn’. He also perceived that his peers were active in game player culture, as he was. This example of third order positioning by Obi-wan gave insight into the value he attributed to this game-based learning experience. His assumption that his peers would also ‘find this fun’ is supported by published data stating that 86% of Australian teens use technology to play games at home (Macpherson, 2013). Obi-wan considered the experience a fun endeavour, giving us a glimpse of the teleoaffective experience this project provided.

During our discussion, Obi-wan hesitated to verbalise the word ‘fun’ when he explained his PMM map to me. Although he had written ‘fun’ in his PMM map, Obi-wan’s hesitation to verbalise this in our conversation indicated a moral tension in his do and say. In the extract below, this hesitation is indicated by an ellipsis (…) in Line 44:

> Um, **I’m** making a game based on a series that I like, called Halo, So, yeah. Um, it’s sort of a platformer, it’s fairly simple but does have some complicated stuff in it, um learning to make a game is, it’s fu … its not boring, not really boring at any stage. **We** are always doing new stuff, figuring new stuff out. It’s engaging, it gives **me** a drive to do **my** work, like, yeah **I** really like this. **I’ll** do really well spending extra time after school. (Transcript 5a; Lines 42–47)

In the above extract, Obi-wan placed the learning of his classmates alongside his own. The shift in pronouns throughout the excerpt from ***I*** to ***we*** and back to ***I*** again suggested that Obi-wan identified as part of this community of learners. The active nature of the community of learners—'**we** are always doing new stuff'—supported Obi-wan's confidence in his agency to do well in this project. His enthusiasm to spend extra time on this project was further testament to Obi-wan's cognitive engagement with, and moral value of, this project. Obi-wan felt he would succeed in this project.

The complexity of Obi-wan's pronoun use is indicative of his perception of his rights and duties (Pinnegar et al., 2011) as a learner. Obi-wan gave the impression that he understood this project as a way of experiencing the real-life work of a game designer. He seemed to enjoy many aspects of the project and identified learning in this project as accessible and engaging, with serious future applications for him. The tension between his written record and his spoken explanation revealed a moral tension in his own narrative of learning. The language Obi-wan chose was perhaps an insight into his true belief of how his enjoyment of this task influenced his ability to succeed in the challenges this task presented. The pronouns used extended his attribution of these perceptions to include his peers. Taken together, Obi-wan's habits of belief while programming the game as something '**I'll** do really well spending extra time after school' revealed his perception of the social order of honour this task presented for him. It was a way for him to enact his true belief; he was a gamer and valued learning about game design and development.

Phoebe's first interview about her PMM map began with her explanation:

> Well, **we** are doing GameMaker, um, and basically **we** can learn about how to make games. **They** can be as simple as **we** like or as complex as **we** like. Um, something **I** am really big on is **I** think being creative comes into it a lot. **You** can

> sort of make a story, or put an idea into a game and **I** think that's really good. Um sort of **you** can think of it as an artwork kind of thing. (Transcript 5a; Lines 5–9)

The shift in pronouns from ***we*** to ***I*** and back to ***you*** gave insight into Phoebe's view of the collaborative nature of GameMaker: Studio project. Phoebe worked with a partner to develop their game, and the pronouns suggested a layered experience of collaboration and learning about game design. Her use of ***we*** seemed to indicate that she was aware of multiple differentiated opportunities for other students in the class, while ***I*** highlighted that this topic was an opportunity to explore her own creativity and self-expression. The pronoun traversed back to ***you***, which may have been to invite me into the space to consider this project as an 'artwork'. It might be that using GameMaker: Studio supported this project to be valued more than the usual school project. The game may have represented an authentic real-word artefact for Phoebe, providing a way of making meaning in a new context. Her habit of belief seemed to be that her creativity would be valued in this project.

All three students expressed a habit of belief about themselves as agentive learners in this project. Obi-wan's familiarity with game culture seemed to position his identification of fun as being part of the epistemic experience, an idea that provided some moral tension for him. He expressed this perception of fun differently to George, who reflected on the novelty of the experience. Both George and Obi-wan considered this project to be fun for different personal reasons. George was excited by the novelty and unknown challenge, while Obi-wan saw an opportunity to build a game that linked to his real-life game play. Phoebe valued the creative aspects of the task.

7.4.2 Identification of new knowledge

George began Interview 1 by identifying the new knowledge this project required for him. George referenced the storyline and purpose of the character in *Freddy's Journey*, drawing similarities to the mechanics of other popular games. He used the language of game design, with storyline, characters, and game presentation (e.g., coins, items, and 2D platformer) central to his explanations:

> Yeah, **it's** about learning game maker, and **my** game is about, um **my** game is called 'Freddy's journey' so it's a platformer game, like Mario. So, **you** can collect coins and then items along the way. So, **it's** kind of like an adventure game. And, well, the objective of **this** game is to like, basically, Freddy is lost so like **he's** trying to find **his** way home. Yeah. So, um, really learning how to make a game from scratch, **I** think **it's** quite challenging, um, 'cause there's lots of like, details like characters and then like objects. (Transcript 5a; Lines 85–91)

He seemed confident with many aspects of this task, conveying the challenge of details as part of his anticipated learning. His duty as a learner was to code and build a working game. If this had been a high-risk challenge (Clifford & Chou, 1991; Howard-Jones & Demetriou, 2008), I would have expected key words in the PMM map and interview that could become excuses for not being able to meet the parameters of this task (Boyle, Connolly, Hainey, & Boyle, 2012). The absence of these words suggested that George was ready for this challenge and was approaching this task as an agentive learner through his repertoire of existing habits of action and belief around learning.

As a confident gamer, Obi-wan identified that new knowledge for him was learning about coding and design. Obi-wan used his PMM map to draw together the subject areas that would also transfer to support the development of his game. As a differentiated pedagogical activity, Obi-wan identified that everyone in his class, ***we***, were always learning new things: '**We** are always doing new stuff, figuring new stuff out. **It's** engaging, **it** gives **me** a drive to do my work, like, yeah **I** really like **this**. **I'll** do really well spending extra time after school' (Transcript 5a; Lines 45–47).

He identified ‘doing’ and ‘figuring’ out ‘new stuff’ as part of the experience in every lesson of this project. Having such an open-ended task seemed to ignite Obi-wan’s enthusiasm towards this project. Despite being a gamer, game design was a new skillset for him to learn, one he was excited about developing. This excitement was supported by his true belief that he would be able to succeed in this task and enjoy both the process and product of game design.

For Phoebe, everything about the GameMaker: Studio project was new. She described it as an experience that was different and interesting. She relished the opportunity for creative freedom to make her own digital game. Phoebe used the pronoun ***I*** to convey her confidence in completing the GameMaker: Studio project:

> **I** found the GameMaker studio interesting because it was something very different. **I** haven’t done it before and **I** was actually really interested in it. **I** could make whatever **I** wanted to and put **my** ideas into practise, um be really creative with it. (Transcript 5b; Lines 93–96)

Like Obi-wan, Phoebe identified the differentiated nature and autonomy provided by this task as a way of supporting her to realise her own plans and ideas. Again, the unknown challenge was not a hurdle for any of these three students. These students felt that their work on the project would lead to success to program a digital game.

Phoebe identified the whole process of making the game as being the best thing. She used the various milestone examples to describe a building of pride in her work. The sequence of digital game design activities was supportive for her learner agency. The differentiated nature of the project meant that she could navigate and successfully complete the task, using both existing and new knowledge: ‘The best thing about the **GameMaker** was when **I** had finished the **whole thing** and like seeing the write up and the sketches and the evaluation and then the **game** as well, really proud of **myself** after that' (Transcript 5b; Lines 112–114).

For Phoebe, the process of making the digital game led to a teleoaffective moment signified by pride that her habits of action had led to this final product. When Phoebe identified 'the write up and the sketches and the evaluation and then the **game** as well', she described the cognitive, moral, and affective components that were lived at the practice site of this game design project. It was evident that this project was not a mechanical task of following the steps and plugging in code; it required her full investment in each stage to ensure that the game was truly an original expression.

Comparing George, Obi-wan, and Phoebe's descriptions of new knowledge further supported the teacher's understanding that the GameMaker: Studio project had differentiated features that made it compelling and useful for these students to invest their time to develop new knowledge about programming in a creative frame. For Phoebe, this was important as she was able to implement her agency as a creative and artistic student to make meaning for herself in this project. Obi-wan felt his experiences as a gamer fed into his ability to be successful in this task, and George also welcomed the challenges. All three students expressed habits of action that they believed would help them successfully complete this project.

For these three students, the new knowledge about planning, designing, and coding games they had developed made the project exciting. The use of GameMaker: Studio alone may not have led to the teleoaffective experience described by the students. Rey's design of this task and pedagogy of delivery may have supported the students in their moral, cognitive, and teleoaffective engagement with this project, as all three students valued the project as an opportunity to develop new knowledge about game design and programming.

7.4.3 21st century skills

Across the previous two data chapters, the types of 21c skills available to the students through the game interactions and classroom varied. The nature of the project for this year level supported students to experience the widest range of 21c skills of the three case studies presented in this thesis. In addition to the critical-thinking skills presented in the previous data chapters, the GameMaker: Studio project supported students to exercise their creativity in designing the digital game and developing communication skills using coding languages. The students reflected upon the collaborative and communication skills as they worked in pairs and gave peer feedback on the development of the project. Problem-solving was also a focus for these students, supported through peers, using the help files and video tutorials within the GameMaker: Studio online support system.

George recognised the open-ended nature of this project as an opportunity for both creativity and problem-solving: 'Yeah, yeah. And **I** also put creative 'cause, really **you** can do anything with **it**, different characters, planning out **your** story line, even the ending. And it also makes **you** think outside the box' (Transcript 5a; Lines 114–116).

In addition, George described the process of giving feedback on the games of peers as one of the learning goals:

> Um and **I** also put 'putting **yourself** in someone else's shoes, 'cause **it's** actual was, 'cause **it's** really, not really, but quite hard especially like newbies like **me** starting from scratch. So, um, if **someone** makes a game that um, well, that's um, not really good maybe um **I** can learn to not harshly criticise that person. (Transcript 5a; Lines 104–108)

The pronouns George used in the two extracts above move between the first order positioning of his own work in this project and third order positioning of generalising his experiences to include his peers. His assertion that ‘it’s really, not really, but quite hard’ gave insight into the learning curve George experienced. He expected parts of this project to be difficult and that his peers would also experience this difficulty. Here, George shared his habit of belief that this task would be challenging but achievable for him.

The opportunity for creative control in this project, as well as learning something that was difficult, was put forward by George as an opportunity to learn to be more supportive of his peers in their work, too. He saw Rey’s inclusion of critique and peer feedback as skills worth his time and effort and were perhaps valued as they mirrored the skills required in the real world of game design.

In the above extracts, George used the pronoun ***it*** to describe the kinds of ‘hidden agendas’ GameMaker: Studio had, from supporting his creativity to make up storylines and characters to thinking outside the box and thinking like others to learning to code from scratch and even giving empathetic feedback to peers. During the project, George recognised his own habits of interpretation that this project would help develop a variety of his wider skills.

While Obi-wan completed this task individually, he identified collaboration and communication several times as important aspects that contributed to the development of his game. In the following excerpts, Obi-wan’s habits of action in this setting were clear; he implemented information and feedback from his teacher and peers to improve his own programming skills:

> **I** show **I** am a learner when **I** listen to what **my** friends or the **teacher** has said, and um, act upon it. Like, **I** do that, **I** say, oh so this is how **you** make the sprite jump. Ok, **I’ll** use it. (Transcript 5b; Lines 108–110)
>
> **I** show **my** understanding best when **I** can, um, well, probably when **I** can um get, or have something done for **me** like, um, a **friend** helped get the character to

> shoot, and **I'm** able to reproduce that **myself**, without assistance after it's been explained. (Transcript 5b; Lines 125–128)

Phoebe identified collaboration and creativity as a support to her learning about how to make games. The pronoun ***we*** identified her partner as an integral part of developing the game and gaining a breadth of ideas to make a 'complex' game:

> Well, **we** are doing game maker, um, and basically **we** can learn about how to make games. They can be as simple as **we** like or as complex as **we** like. Um, something I am really big on is I think being creative comes into it a lot. You can sort of make a story, or put an idea into a game and I think that's really good. Um sort of you can think of it as an artwork kind of thing, that um. (Transcript 5a; Lines 5–9)
>
> And also working in pairs is really good 'cause **we** can collaborate ideas and um get different things off **each other**. (Transcript 5a; Lines 17–18)

Phoebe described the GameMaker: Studio project as an artwork. Her story and artistic vision came alive through the design and programming of the digital game. Phoebe valued this project as an opportunity to produce a high-quality digital game with her partner and showcase a range of their combined talents. Phoebe felt both collaboration and creativity were important skills developed during this project.

Built into the project was the opportunity to critique the games made by peers. Peer feedback was valued as part of the collaboration and communication skills in this project. Unfortunately, George's game was not completed in time for this component of the project, and he got his dad to critique his game. Obi-wan and Phoebe had positive experiences of the peer feedback process.

Obi-wan positioned the advice from George as a constructive aspect of this process:

> George did **my** um ... well, critique. So um yeah **I** thought that was really constructive, like **I** read what **he** said and thought, Oh yeah, **I** thought that too. Sometimes **I** was like, Oh, OK **I'll** improve that. **I** didn't notice that, **I'll** improve that. And so yeah, it's always better getting someone from outside to do it to see if **it** makes sense because if **you** come up with the idea **you** know how **it's** all supposed to work, but **other people** don't. (Transcript 5b; Lines 137–142)

Interestingly, Obi-wan reflected on the feedback he received on his game but not on the feedback he gave to another peer. He focused on the game working and 'making sense' to his peer, George. By including peer feedback, Rey embedded a real audience for the students' games, supporting another process in this task. In this way, the students shifted their perspective from being immersed in game design to consuming each other's games with their new knowledge of design and programming. Obi-wan accepted feedback from George in a positive way, agreeing with the viewpoint expressed and showing an intentional agency to improve certain aspects of his game.

The nature of the task, and the classroom setting, acted as a supportive learning community Obi-wan valued. The feedback on other people's games by a critical peer provided Obi-wan with a confirmatory presence, 'yeah I thought that too', and some areas beyond his own thinking, 'I didn't notice that'. This confirmed for him that 'it's always better to get someone from the outside' and that sharing work with a 'real' audience, beyond the teacher, had value. A 'real' audience may have contributed to the moral and teleoaffective nature of this task for the students.

Like Obi-wan, Phoebe focused on the feedback given for her game, not the feedback given to others:

> Yeah **it** was good, um, constructive criticisms [*sic*] though what was, **you** know, what was good, what wasn't, what needed improvement, really good feedback **I**

> think. So, not from **your** pair or anything, just something, **someone** who doesn't know, so it was really good **I** reckon. It was a good part of the whole process. (Transcript 5b; Lines 146–150)

Having the opportunity for peer feedback was an aspect mentioned by all three sample students. They saw it as an opportunity to contribute in positive ways on the products of learning. Having peers as an authentic audience for the students may also have been a positive feature of the project, with all three students mentioning the value of critique they received from a peer. This insight into the moral space highlighted the students' sense of duty to support peers in their learning journey. Missing from the reflections was how students felt about giving peer feedback and if they further reflected on their own game in light of the feedback they had given a peer.

Missing across this dataset was any of the students discussing the feedback they had given others. Perhaps the feedback was seen to inform the peer, but not the self, as part of this reflective process. This may have been due to students' previous experiences of peer feedback, or due to the age group of the students, as they may not have seen the double reflective space open to improve their own work. This omission by all three students suggested that the process of peer feedback was a habit of action for them, as they gave and received feedback from others willingly. The next step would be to help students develop their habit of interpretation to use their feedback of others' work to reflect on their personal project.

The development of the game had multiple stages. Each of the three students saw value in the design, development, and programming stages as a process of learning. The differentiated nature of this project is an example of a nested epistemic task. At a basic level, this was a graded class project, but it also offered the students clear links to the programming community. The GameMaker: Studio project is an example of a task with multiple entry and exit points for students to experience success in learning to design and program a game.

7.4.4 Anticipated future use

The students in this sample offered both short-term and longer term uses of their new skills in game design and programming. As these students were in Year 9, they were aware of their subject selection and pathways towards career options through their choice of being involved in the ITS elective. The student reflections below may have been influenced by the time of year and local moral order of the school, where students were being introduced to the Victorian Certificate of Education (VCE; Years 11 and 12 programs comparable to the United Kingdom's A Level program) subject selection as part of their choices for Year 10 subjects.

George described the programming skills as helpful if he were to become a software engineer in the future. As a new coder, he saw programming as applicable to coding games as either a leisure activity or career. George valued these skills and saw them as directly related to an epistemic field:

> Um, the skills **I** used from GameMaker will come in handy when, well again, in the future if **I** decide to become a software engineer or something, **it** will come in handy. And **I** guess it will also be come in handy, like, during the holidays, like, if **I** am bored. (Transcript 5b; Lines 199–202)

George mentioned software engineering as a future career option. That he also saw game design as a potential leisure pursuit indicated that he valued learning this new skill. In both formal and informal settings, George seemed to be developing a habit of belief about himself as a programmer.

Obi-wan made connections from this project to his mathematics and English subjects. It was likely to be valued as an extension of his school-based skills. Obi-wan outlined on his PMM map that game design was of interest to him. In Interview 1, he extended on the possibility of programming or game design as a career. In looking to the future, Obi-wan listed a variety of possible career pathways, including an author and a lawyer. Obi-wan's response to the 'I want to be' stem gave insight into the ongoing development of his future self:

> When **I** grow up **I** want to be, well **I** always wanted to be an author but that's on the side. Like **I've** gotta have a stable job first. Maybe a programmer or game developer or, um, a shot in the dark, lawyer. (Transcript 5b; Lines 227–230)

He dismissed his childhood yearning to be an author as a side pursuit. The absence of pronouns indicated distancing language to position the newer influences on his career aspirations, including programmer and game developer. As he was an avid gamer, it was possible he would have included being a game developer in his previous self-projection. By placing the law option last, Obi-wan may be viewed as providing a protective cover story, as described in the work of Clandinin and Connelly (1996). It may be a career he would have liked to have, but it was difficult to get into this career so he perhaps did not want to get his hopes up. This represents a cushioning of his longer term identity construction, open to possibilities rather than locking in one option and facing failure or disappointment.

Phoebe also anticipated that the skills developed in the GameMaker: Studio project would serve her into the future:

> Skills **I** used from GameMaker will come in handy when, um, yeah, like if **I** grow up and **I** become something to do with technology maybe, like a programmer or um, it could just come in handy when um, in everyday life. **I** know how to design stuff for a particular audience and, **you** know, implement, **you** know some of the coding into that. So yeah, like that. (Transcript 5b; Lines 184–188)

Beginning with programming technology, she also anticipated that designing a product for an audience would be valuable in her everyday life. She articulated that the coding skills were transferable beyond making games and useful beyond the project itself. Her continued use of the pronoun ***I*** supported her performative first order positioning, locating herself as being confident with the new skillset and agentive in identifying when she might draw upon it in the future.

All three students' reflections indicated a habit of belief about the value of the skills of programming and design in their lives. The project had influenced their meaning making as lifelong learners, giving them domain knowledge and skills that they valued and that they predicted would be valued in the real world.

7.4.5 Challenges

As this was the first time any of the students had designed or programmed a digital game, there were many unknown challenges when they began the project. George, Obi-wan, and Phoebe accepted the potential challenges in this project as both stressful and exciting. This section outlines a variety of challenges the three students reflected upon in our conversations.

While George accepted the learning focus of the task, he was quick to explain in Interview 1 that the details of programming might be quite challenging for him: 'Yeah, and even a slight detail like coding something will just make the **game** … **you** know … stuffed up' (Transcript 5a; Line 93).

However, the possibility of the game not working due to a small error did not seem to deter him, as the next thing George said was that this was an 'interesting and fun idea', beyond the experiences he would seek out himself: '**I** also find it interesting, 'cause **I've** never made a game before, and **I've** played games before, but never made one' (Transcript 5a; Line 94).

For George, the opportunity to code was powerful. The use of first order self-positioning indicated his willingness to participate in the project and become a creator of games. He developed an awareness of the specific details that he would need to attend to, to ensure his game worked the way he had planned. His key words included ‘interesting’, ‘fun’, and ‘challenging’ as he explained the details needed to develop his game. The selection of these words supported George’s awareness of his agency and his habit of belief about following the process provided in the project to build a working game as a product. He approached the unknown as an achievable challenge; it was part of his learning: ‘**It’s** kind of hard, but hard in a good way. So, **you** learn lots of stuff’ (Transcript 5b; Line 43).

The ‘stuff’ George hoped to learn was not specific, displaying an awareness of many unknowns he could need to learn about ‘from scratch’ (colloquial term meaning: from the beginning): ‘So um, really learning how to make a game from scratch—**I** think it’s quite challenging, um, ’cause there’s lots of like, details like characters and then like objects’ (Transcript 5a; Lines 90–91).

The challenges were what made the project interesting for George: ‘**I** found the game maker interesting because ... there is just so much stuff about it. There are like lots of stages to create a single game’ (Transcript 5b; Lines 40–41).

Throughout the above passages, George repeated the word ‘interesting’; this indicated his motivation to learn about GameMaker: Studio for this project and that the anticipated challenge was a welcome one. George shared a strong perception of his habits of belief about learning, with his use of the pronoun ***I*** positioning this project as a rich opportunity for him to enact many aspects of his learner agency.

Obi-wan's habits of belief about meeting challenges were similar to George's. Obi-wan was also excited about the challenges to be faced in making his game. He drew on the collaborative nature of the classroom ('local resources') for support when needed:

> **I** found the game maker challenging so **I**, um, used **my** local resources, **my** friends, **my** teachers, um, **I** didn't really use the internet that much. **I** think **I** used it once. And um, like, **I** just asked them, Hey, do **you** know how to do this? Um, sometimes **they'd** say no, sometimes **they'd** say yes, this is how **you** do it, and um, help **me**. (Transcript 5b; Lines 87–91)

When given his own word choices (not from the question stem), he used the term 'tad frustrated' instead of challenge or difficulty. In asking his friends and teacher for help, Obi-wan displayed his learner agency as part of the learning community. The nature of the classroom supported a ready source of collegial advice when needed, giving insight into the lived local moral order in this site.

An example of a common challenge in this collegiate classroom was learning to program gravity. Many students struggled with programming gravity into their game, which was noted when characters jumped and continued to move upwards on the screen. During my observation of an early lesson, this struggle was vocalised across the classroom, and several students were collaborating to figure the program out. Their discussion then moved onto the search terms, which may have located the solution in the help files. It took most of a 45-minute period for the students to locate, develop and share the code between them to program gravity. This example illustrated the collegial nature of the project's classroom environment. It also exemplified the unexpected challenges the programming environment presented to students.

Both George and Obi-wan reflected on the specific challenge of gravity. George identified that this project was 'quite challenging' in his PMM map. The challenge George identified was stressful, but this was not a source of frustration for him; instead, he saw it as a part of his learning. George's example of programming gravity highlighted this challenge:

> Fiona: When **you** put 'quite challenging' here [refers to PMM map] has this happened to **you** yet, or are **you** just aware it could happen?
>
> George: Yeah, um, **it's** happened. Like with the gravity, the jumping thing
>
> Fiona: Umm hmm
>
> George: Yeah, **we** haven't figured—well **we** have figured **it** out, but before that **it** was quite stressful, like how do **you** make this jump? Eventually **we** found **it**. (Transcript 5a; Lines 122–128)

George used the pronoun ***we*** as a way of positioning his experience as part of his peer group. The collegiate classroom space had supported him to seek a solution for the challenge of programming gravity to make the characters jump in the game. This was a shared problem with his peers, and they solved this together using online tutorials. Despite it being stressful, the student group persisted to figure out the programming needed. This cycle of identifying things he did not know and finding out about it displayed a pattern or learning cycle that George was implementing, stemming from his habit of belief about his own learning behaviours when faced with a challenge. In this case, he positioned the game as a setter of problems, with many possible solutions.

Obi-wan indicated that gravity was a challenge by using the term 'tad frustrated', positioning ***it***, his avatar (in-game character), as the source of the challenge: 'not boring, hasn't been fun—well a tad frustrated when **it** kept spasming off the page' (Transcript 5a; Lines 66–68).

Again, as we saw with George, this was seen as an achievable challenge and was overcome with assistance from the learning community.

Phoebe identified the challenge for her was making her design come to life. She noted both the constraints of time and the intricacies of programming as contributing to the challenge:

> **I** found the game maker challenging so **I** ... um ... some parts of it um, **I** designed and **I** couldn't do because ah, well **I** was running out of time so **I** couldn't complete what **I** wanted to do, so **I** had to sort of change it around a bit, um, yeah, it's quite, like interesting to know how long some stuff does take, and um quite interesting to see what makes things, other things, work and sort of, not work. (Transcript 5b; Lines 28–33)

Phoebe's continued use of the pronoun ***I*** from the sentence stem above evidenced a first order personal positioning through her action to meet her duties as a learner to complete the task. In doing so, Phoebe positioned herself as an agentive learner. When there were challenges to completing the task as planned, Phoebe expressed her autonomy to change the plan and displayed confidence to continue to meet the set goal of a working game. By reconstructing her goals, Phoebe showed a habit of action as a learner to adjust her work to meet the requirements of the project within the time frame.

The students expected that learning to program would be a challenging learning experience. There were some common challenges, like programming gravity, which became a collegial endeavour to solve in the classroom. They also noted other continuous challenges to do with designing the game and meeting timelines. These demonstrated that GameMaker: Studio was a site of practice, as the students noted different dimensions of domain knowledge and moral obligations within the teleoaffective classroom in their reflections.

7.4.6 Summary of findings

The GameMaker: Studio project for the Year 9 ITS elective at Forest Springs was a carefully planned learning experience for the students involved. Students articulated a range of learning moments they anticipated and experienced during this topic and saw the challenges they faced as a part of their learning. The use of GameMaker: Studio in this class provided differentiated opportunities within a clear design brief for the students to work towards. The goal of 'making a game' as a product was part of a bigger, and equally important, design process valued by both the students and the teacher. Part of the reason it was valued may be because of the clear link to the real-world epistemic community of practice in game design.

Importantly, the way Rey implemented GameMaker: Studio had strong pedagogical purposes, as seen in her explanation. By including the IDPE process for technology design and coding, Rey supported the students to share problem-solving and design ideas within the games they were making with their peers. There was a constant conversation and sharing within this learning environment as a socioconstructivist learning space (Olson, 2010) and learning community (Ito, 2008; Lave & Wenger, 1991) supported by the technology and their work towards the goal of making their own game to share. The data sample shared evidence that, over four weeks, the students saw their progress in design and coding and felt successful in this learning experience despite some challenges.

All participants expressed aspects of challenge through the learning journey and pride in their progress. They saw the final product and evaluation as opportunities to share this experience with a peer audience. Bringing together the PMM maps and interviews for the Year 9 students enabled elaboration of the ideas that the students saw as important in their learning in this context. Perhaps this layered pedagogy of designing and making digital games in GameMaker: Studio supported a learning space where the students could personalise their learning while developing skills valued in the wider game design community of practice, like coding, that they perceived as authentic in their lived world.

Reflecting on the data in this chapter, students and teachers identified and described learning in these situations as both collaborative and fun. The motivation and challenge of this project served as a vehicle for students to articulate moments of learning. Learning goals were not hidden from the students; instead, the project was perhaps seen by the students as an invitation to take up the challenge and develop their ability to use specific domain knowledge and skills over time. Students and the teacher were confident sharing the skills and knowledge they had learned.

The language that each of these students used to represent their thinking gave an important insight into their varied approaches to enacting their autonomy and learner agency in this space (Scardamalia & Bereiter, 1991). It was also indicative of just three voices from a differentiated classroom of 27 students. If we were to ask each student who had participated in this project, they would likely report different perceptions of their learning journey in this task. While their finished game may have been a motivator, learning to design and program along the way was clearly just as motivating, with all three students in the sample anticipating and meeting various challenges. In addition, the incorporation of the programming skills into each student's visions of their future selves suggested a shift in their own meaning making from being a consumer of games to a producer of games. The storylines of these students, game, and teacher are now analysed using positioning theory.

7.5 Storylines

In this analysis, two student storylines of challenge and pride in the completed product are presented and discussed. Learning to program the game was the storyline attributed to the GameMaker: Studio software, and the teacher storyline was framed by the moral duty to design a real-world programming experience for her students.

The students' reflections provided clarity about how the GameMaker: Studio project supported their moral rights and duties as learners. Predominantly, these rights were identified as skill building, with a clear short-term duty to create the playable game and a possible longer term career pathway. The students' anticipation of the challenges when starting to design their game using GameMaker: Studio, along with the autonomy they had in this task, may have been a key motivator for them to enact their agency. Students were excited about creating possibilities for their own learning, though the types of opportunities they focused on varied for each student.

The GameMaker: Studio project provided an opportunity for the three students to be active in their learning and demonstrate their learner agency. The project instilled a level of autonomy for the students, which they responded positively to (Martínez & Stager, 2013). The three students put forward and explained the ways this project supported their rights and duties as learners. The rich opportunities for learners in this project were clearly diverse; this was a differentiated task where students could experience success in different ways. None of the students in this class had experienced coding before. George, Obi-wan, and Phoebe all embraced the opportunity to learn coding, taking on this challenge with enthusiasm.

7.5.1 Challenge: Student self-positioning

George's words were selected as the quotation for this storyline, as he articulated the unknown challenges of designing and programming his game in both cognitive and teleoaffective terms (Figure 51): '**it's** kind of hard, but hard in a good way. So, **you** learn lots of stuff' (Transcript 5b; Line 43).

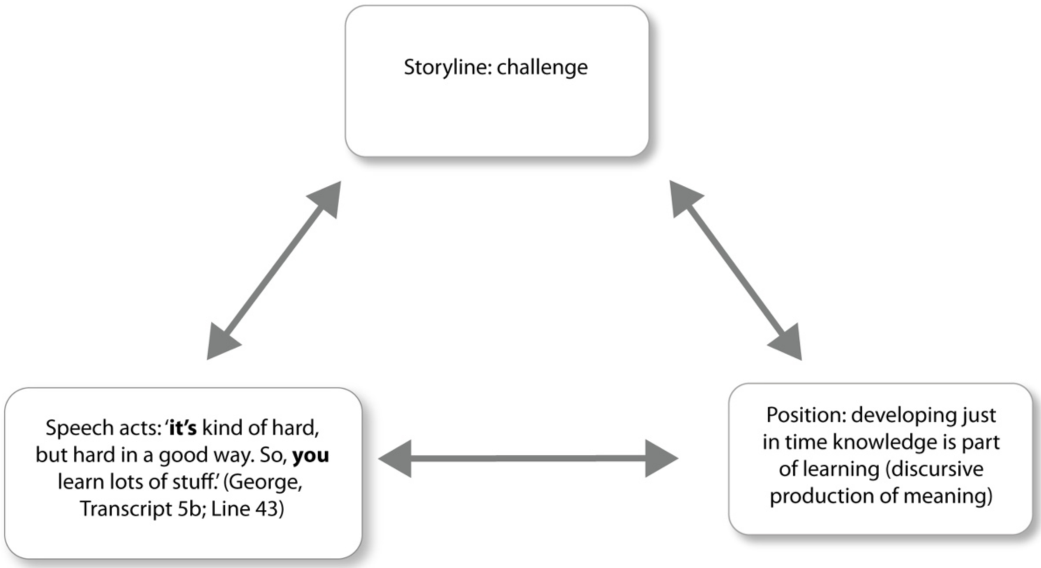

Figure 51: Mutually determinant triad used to explore the student's self and other positioning in the research conversation.

These students identified the challenges experienced as 'interesting', 'frustrating', and 'fun'. In their references to frustration, the students were quick to point out the ways they solved the challenges by using resources at hand. This pattern of teleoaffective reference to the GameMaker: Studio experience by the students indicated that they felt they had the resources to complete the task successfully, even if they needed to discover the resources as they progressed.

The analysis indicated the language these students used throughout our conversations. There was a sense from the students that they were part of a collegiate classroom space, and they expected problems as part of the learning process. The students did not reference that a problem might be too hard to solve; instead, they were active in redesigning their project to ensure they completed a playable game. These strategies supported the students to work directly with challenges and solve them together. This confidence may have been encouraged by the ITS classroom teleoaffective space, access to resources within the knowledge domain, and by the teacher's design of the project.

The quotations also indicated that the use of the word ‘challenge’ could have a variety of meanings for different students. For these three students, the challenges were an expected part of this experience. Their habits of action and belief within this site of production included an understanding of the need to struggle, persist, and meet different challenges by developing new research and communication skills with peers and the digital interface. This process of drawing on resources exhibited their learner agency and supported students to build a game they would be proud of.

7.5.2 Making a game to be proud of: Student self-positioning

In the data from the PMM map and first interviews, the students provided their perceptions of this learning space as both engaging and purposeful, with relevant and authentic links to the real world. The analysis of this data highlighted their agency in this activity and confirmed they each had clear ideas about what the learning would look like for them. The students saw this as both a process, of coding, creating, and making, and a product, a playable game, which were tightly woven as evidence of learning.

When Phoebe reflected on the game she had produced, she included various elements of the design process to explain how proud she felt with her finished product (Figure 52).

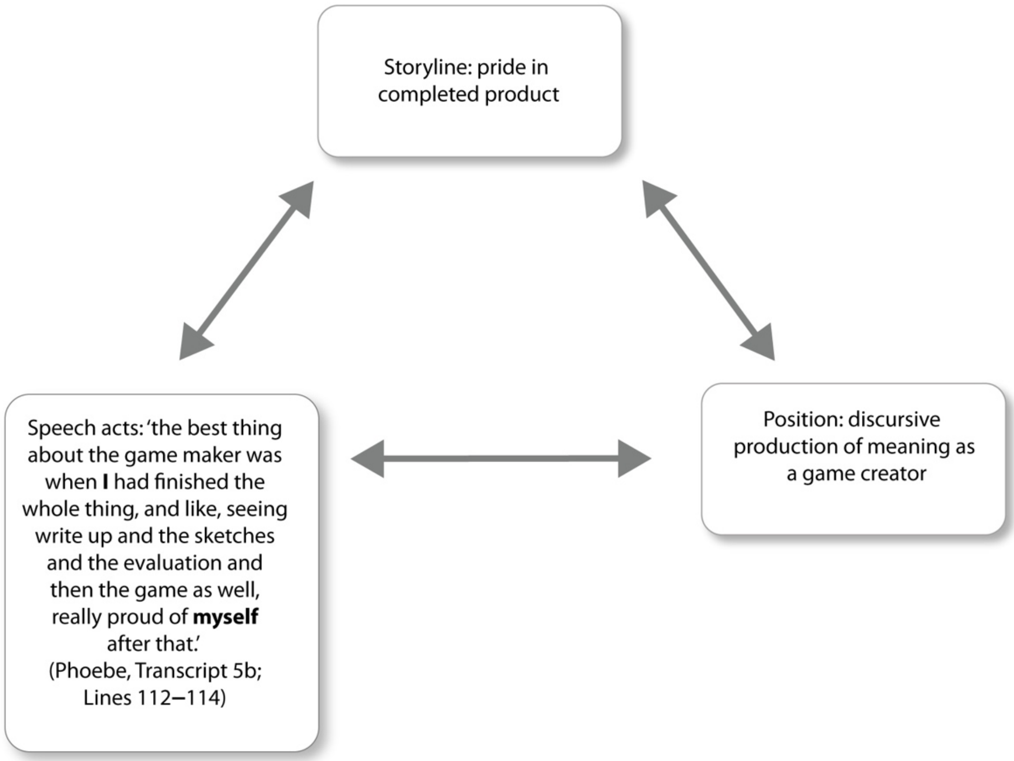

Figure 52: Mutually determinant triad used to explore the student's self and other positioning in the research conversation.

This pride was not simply due to possession of a new game but through students' immersion in the total experience of being a game designer. Being involved in all aspects of game design supported the students to make new meanings about themselves and their abilities. All three students incorporated these new programming skills into their perceptions of their future self. The students positioned themselves as agentive both in their own game design and in a possible future self, using elements of game design in their future life.

The students did not easily earn this pride. The only way to learn about coding was to actually work with code. Through the hands-on experience of coding, the students used trial and error to refine their programming terms and their game design as they figured out what was achievable in the time frame. This refinement of their original ideas was a valuable experience for them as they applied their habits of interpretation to enable their own successful completion of this task. It is unclear if it was the teacher's design of the project or having the peer-review process that was part of the teleoaffective and moral framework that propelled these students to complete their game.

These two storylines for the students evidence that their engagement with the GameMaker: Studio project required more from the students than simple motivation supported by feedback mechanisms, and more than 'sneaking in' a coding language. These storylines, and the preceding dataset, exemplify that the students were aware of, and relished being part of, the cognitive, moral, and teleoaffective space created by engaging in this project. Part of this may have been due to how the students positioned the game as a creative real-world tool.

7.5.3 A real-world tool: Game as positioned by the students

This age group of students saw the GameMaker: Studio project as an opportunity to develop a new skillset, using technology from the real world. These students were excited about becoming digitally savvy and meeting the challenges set using the GameMaker: Studio software. The game contributed to the existing site-based ontology, enabling a wide range of authentic, real-world programming challenges for the students to conquer.

How students succeeded in this task was not limited by their own knowledge, as the pedagogy employed by the teacher in this classroom enabled a socioconstructivist collegial environment for the students to work together and use their 'local resources'. Obi-wan trusted his peers to access the help files and share their knowledge with him. Such local resources included feedback through the GameMaker: Studio interface; for example, when the character in the game flew off the screen, students knew they needed to learn how to program gravity. In addition, the students applied a habit of action around help seeking in digital spaces by accessing the help files and video tutorials for the program. Students then shared this new knowledge with each other to solve the programming problems encountered.

The use of GameMaker: Studio in this classroom supported a moral view of knowledge being pursued and owned by the community. In this way, the practice site created in the classroom was similar to the real-life practice site in gamer communities, where online communities may support the novice-to-expert journey (Figure 53).

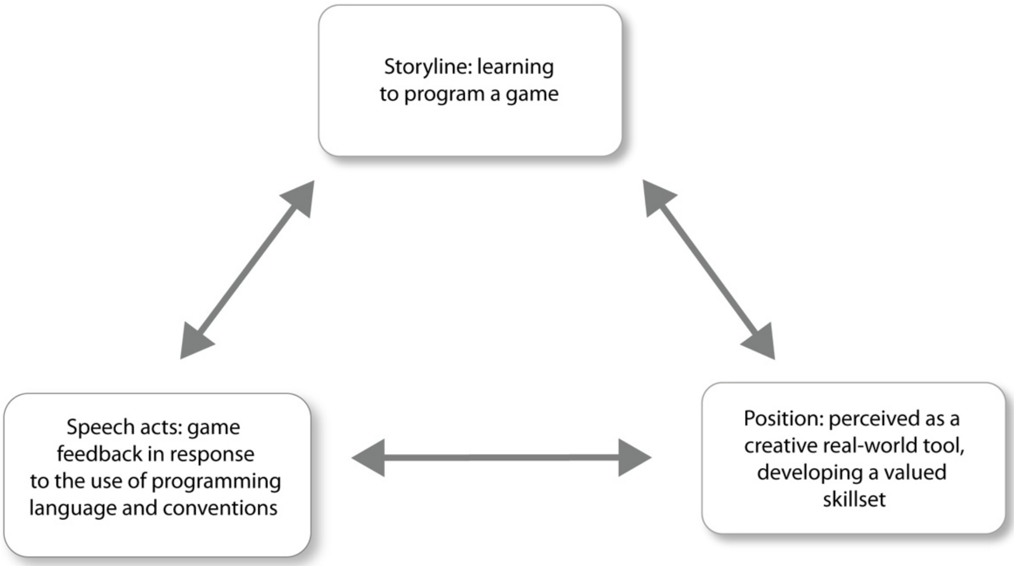

Figure 53: Mutually determinant triad used to explore the game positioning in the research conversation.

The students' practical intelligibility of digital games was leveraged here to provide an opportunity for a rich and authentic learning task that encompassed creativity and design processes in addition to learning to code a digital game. The game-based learning experience was a window for students to develop their skills using this cultural tool.

While in dialogue with GameMaker: Studio, the students shifted their self-perception from being consumers of games to being producers of games. The transparent process, following the IDPE structure, gave the students concrete actions and documentation to support their learner agency and shift in self-perception. The teacher's purposeful selection of this programming tool provided extension and challenge for students at their emerging point of need.

7.5.4 Designing a real-world programming experience for students: Teacher positioning of game

Rey's careful planning of this task to meet the students' perceived rights and duties (Pinnegar et al., 2011) made a bridge for the sample students between their current learning experiences in this class and their lived reality outside of school. Rey built her active first order positioning of the classroom as a community of collegiate learners on her own true belief of the safe exploration of new knowledge and induction into part of a community. Her intention was to have the students experience the real world of a game designer, and from the student reflections, it seems she achieved this goal.

Through the GameMaker: Studio project, Rey met her moral duty as a teacher to provide a differentiated experience for her students to learn about game design and programming. This self-positioning is reflected in the positioning triad shown in (Figure 54).

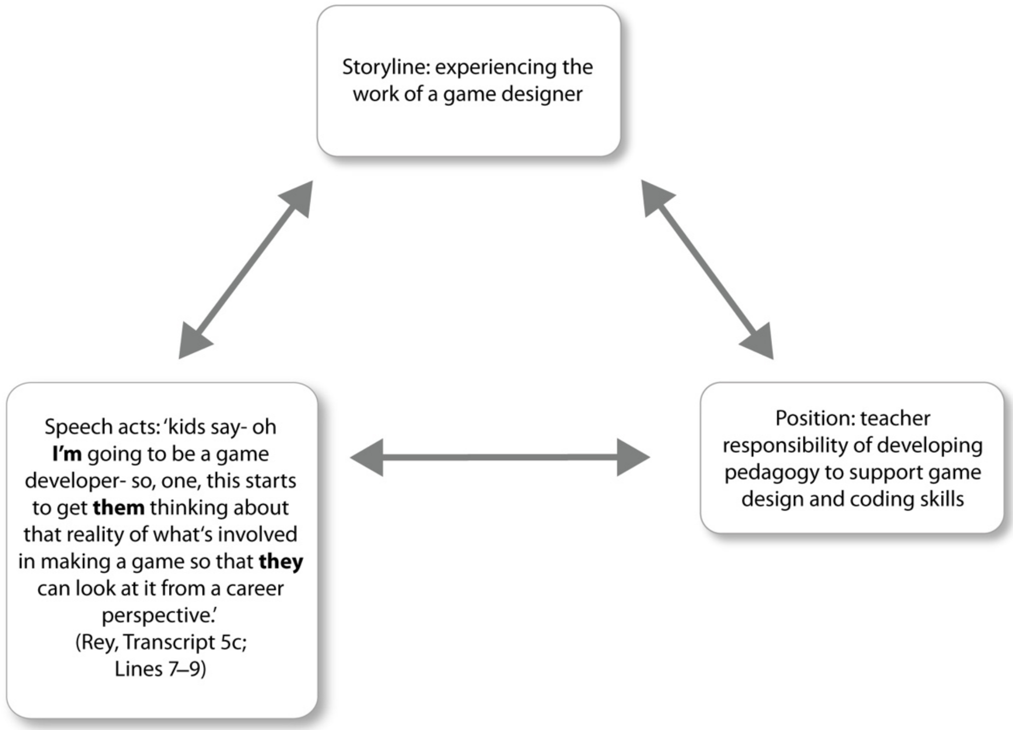

Figure 54: Mutually determinant triad used to explore the teacher's self and other positioning in the research conversation.

The realities of being a game designer include being creative to develop characters, storylines, and plots, while applying an understanding of coding to bring the game to life. The process and product Rey scaffolded had been refined over the preceding years to ensure students accessed and modelled a wide range of epistemic experiences through their project.

This game-based learning experience designed by Rey supported students to be active and agential learners. They developed their artistic expression, skills of collaboration with peers, and communication with the software to create their working digital game. The local moral order of the classroom was recognised through this lived curriculum and supported students to access and accept new identities through understandings at the practice site of designing a game. Rey's pedagogy enabled the students to exhibit their learner agency in new ways.

7.6 Chapter Summary

The Year 9 students identified the GameMaker: Studio project as an epistemic experience. The students could clearly identify a range of new skills learned in this project, and they were excited about the possibilities to develop and display their learning through this authentic task. The local moral order of the school and classroom supported students to take ownership of their project and the skills they needed to research and develop. The teachers' planning had clear links to the real-world work of game designers.

The students anticipated and met several challenges throughout their design and programming of their digital game. These cognitive challenges were met with enthusiasm and were often solved collegially using both online resources and peers. The pride that accompanied the final presentation of the digital game to peers for critique also contributed to the students' teleoaffective experience. In this narrative, the students positioned the game as a creative real-world tool, which they relished using to develop their programming skills. Rey had refined this project to create a differentiated epistemic experience, which aligned to her sense of moral duty as an IT teacher.

The students offered projections of their future selves, indicating there was opportunity to both consider and rehearse emerging identities in relation to their new knowledge in this project. Through this game-based learning experience, students identified many moments of agency and showed a shift in their own meaning making towards producing possible future selves through this technological experience.

The Year 9 students were aware of the opportunities within this project, and they were excited about the actions and behaviours that would lead them to a new skillset of digital programming. They were agentive in anticipating challenges and actively participated in the local moral order to support each other to solve those challenges. All three students were successful in completing working games for their peers to critique, and they reported the whole process and resulting product as a valued teleoaffective experience. The GameMaker: Studio software in this narrative was positioned as a tool to make their games come to life.

Chapter 8: Game-Based Learning Experiences as Practice

8.1 Outline of Discussion Chapter

This chapter begins by presenting the key findings from the three analysis chapters (Chapters 5 to 7). The discussion of these findings respond to the overarching research question: 'How do game-based learning experiences contribute to student perception of self as a learner?' The research questions are recast as headings for the subsections of this chapter. Using practice theory (Schatzki, 2010), the findings are discussed through the research questions to give insights into the students' cognitive, moral, and affective relationships with game-based learning experiences. This discussion recasts the findings to illuminate the students' agency through their cognitive, teleoaffective, and moral experience of games and how this may influence their lived curriculum in classrooms.

This thesis contributes to new knowledge in two ways. The first is the development of a research methodology that acknowledges and attends to participant agency within the complex sociocultural setting of classroom learning experiences (Chapters 3 and 4). The second is the theoretical understanding of games as an ontological site, supporting dynamic transactions to develop a learning relationship with the students, which is discussed in this chapter.

This thesis began with Bruner's (1983) conception of play as a way children experience the world. Humans use play from a young age to learn about the social and physical world. The use of play and games in school classrooms has long been thought beneficial to students, with little research that interrogates the perception of student experience when using game-based learning tools. The relationship developed between the student and the game is of interest in this thesis. The place of teachers as enabling this relationship through student-centred pedagogy was explored, using co-constructed dialogues with the teachers. The students' experiences were also explored through their own words, contributed as their reflections upon specific game-based learning experiences. This aligns with Bhaskar's lens (quoted in chapter 3) that the game becomes social experience and structure that become the reason for student's to reflect on their agency during learning experiences.

Data was co-generated with students and teachers to gain insights into their perceptions of learning when using games in classroom settings. The analysis of this data gave insights into the unique interactions available which students identified as supportive of their learning. The data generation tools were designed to reduce the limitations of the ages of the students in these samples and support dialogue from what the students were comfortable to offer. This discussion chapter is arranged to address the overarching research question: How do game-based learning experiences contribute to student perception of self as a learner? With discussion through the three subquestions recast as section headings; How do students identify and describe experiences of learning through games?, Are there aspects of games which students identify that support them as learners?, Why and how do teachers plan for their students' learning using game-based learning experiences?

The discussion that follows is organised through practice theory (Schatzki, 2010) by attending to the discursive self-production that gave rise to the understandings, teleoaffective structures, and rules from the teachers' perspectives in general and of the student groups experiencing each game type. The site ontology of games as a curriculum making practice is put forward. This thesis offers important insights into pedagogical practices of teachers which may increase student understanding of themselves as agentive learners.

8.2 Key Findings

The students' accounts of game-based learning gave insights into their perceptions of learner agency through three different game-based learning experiences. The students referred repeatedly to their learning during game play but did not mention that they were being taught by the game. The students reflections refute the use of games as a stealth learning tool, as across all three age groups and game types students had great clarity about the key knowledge and skills developed.

Considering the language the students used to describe their learning, there was a focus on completing challenges and achieving the goals of the game. It may be that the students saw their agency in meeting the challenges of the game-based learning experience and that this was motivating for them. Students described specific challenges and how they used their 'local resources' to experience success in the game. It may be that games were understood by students to have inherent cognitive challenges, and they were positioned as agential and active learners rather than passive recipients. Students implemented their habits of belief that the problems set within the game were solvable and so drew on their habits of action and the community of learners around them for support towards their success.

In particular, each dataset offered the following insights about the students' relationship with the game-based learning experience.

The Grade 1 students found the iPad mathematics applications supported their recognition of progress with their mathematics knowledge and skills. The in-game feedback mechanisms supported the students in both the teleoaffective recognition of the game and their moral duty as agentive learners.

The Grade 3 students using Lego Robotics displayed their ability to draw on different knowledge domains to support their building and coding of the robots. The students were also aware of the moral rights of their peers as learners in the classroom, which they explained through their inclusive social practice with the use of the Lego, which also influenced the teleoaffective experience of problem-solving as a collaborative group.

The Year 9 students completing the GameMaker: Studio project recognised the significance of this epistemic experience as an opportunity to develop a new skillset in coding. The students identified a moral duty to complete this project to a high standard; additionally, this was realised by different students as a novel skill, an opportunity to become a game designer, and as a creative expression of self. The teleoaffective experience, as students moved from being game consumers to game producers, included moments of pride through their accomplishment of the finished planning, designing, and coding of a working digital game.

Across all three samples, students made connections between the game-based learning experience and their other subjects. It may be that the teachers' strategic implementation of these games as pedagogy supported the students to identify the skills they had developed. Students sought connections to content and skills, which they identified during their game-based learning experiences. This in turn may imply learner agency, where students felt enabled to demonstrate their learning through the interactions in the game.

Teachers offered the game-based learning experiences with a cover story that students enjoyed games. As seen in Chapters 5 to 7, the carefully designed pedagogy that accompanied game use in the classrooms belied this frivolous sounding cover story. This discussion chapter theorises the reason games may be deemed fun for students by considering their socially located self within the teleoaffective nature of student experiences with classroom games. Game-based learning was not simply a way of amusing the students, as the teachers' interviews showed a deep understanding of the serious learning that can take place when using games. In fact, teachers sought specific games that could be supported by the schools' existing infrastructures to meet the present and future needs of their students. The progressive complexity of the game types and student learning outcomes over the years of schooling demonstrate that the use of game-based learning was valued for its contribution to learning for students of all ages, but for different outcomes and reasons. Such reasons include the cognitive challenge, differentiation, and the recognition of student agency during game play.

As outlined in the literature review (Chapter 2), educational game designers are aware of the need to provide students with experiences that support their engagement and identification of progress: 'Student engagement and self-recognition of progress and learning are important design factors when developing problem-based learning experiences' (Kimmons et al., 2011, p. 341).

My analysis further described the complex space offered to the students when they were using games. The game space represented the understandings of learning the student may have had, the moral and social expectations of the game, their own performance in the process, and their own positioning of themselves as learners. Students also evidenced their application of content and their development of wider skills. The practical intelligence of using games as a learning tool may not be best assessed through testing or surveys but through dialogical interactions with peers and teachers. The students' conversations led to their sharing of lived experience and their resulting meaning making as a type of ongoing formative assessment.

My data contributes an empirical study of the problem of using games in the classroom, as we do not understand exactly how and why they are effective. By using an interpretive analysis of co-constructed conversational data, the students' own words gave insight into their habits of interpretation, habits of belief, and tensions in the use of game-based learning in classrooms. The empirical evidence in this thesis provides insights into how students and teachers positioned the games and how they fitted with their habits of belief about the game-based learning experience. This study provides evidence to look beyond claims of learning by stealth, progressing the research landscape to investigate the students' understandings of themselves as agentive learners. The research methods required co-generation of data with both students and teachers, with written and dialogical interactions focussed on their perceptions of learning.

The ontological site offered by game-based learning experiences was demonstrated visually through the four theoretical frameworks presented through the use of practice theory through the Venn diagrams. These frameworks supported close attention to the multiple influences on the social, moral and cognitive interactions in classroom spaces, which may help students and teachers recognise their own agency. This evidence is now discussed to elucidate the ontological site of the game and the teacher and student understandings of the emerging relationships with learning.

8.3 Positioning Game-Based Experiences Through Practice Theory

This section contributes to an understanding of the complexity of the teacher and student perceptions of using games. Building on the themes; learner behaviour, identification of new knowledge, 21c skills, anticipated future use, and challenges; and domain knowledge, the participants' discursive meaning making is used to shed light on the positioning of the students as agents within their own learning journey, supported by the vision and practice of the teachers in the settings.

The research methodology I developed attended to a range of sociocultural factors in classroom settings. It aimed to capture the teachers' and students' discursive reflective practices to understand the cognitive, affective, and moral aspects of their learning experiences. The data generated in the co-constructed interviews served to validate the existing literature in the following ways:

- Motivation and challenge were strong themes in the teachers' reasoning for use and the students' reflections on use.
- All teachers mentioned that games were accessible and fun for students, and the experienced teachers went beyond this to describe suite of skills they saw transferred to and from the game-based learning experience.
- Students used evidence from game play (including immediate feedback mechanisms) to exemplify their processes and products of learning.
- Teachers and students approached games as a serious learning tool within the classrooms I observed, aligning with the education literature at the time of data collection.

The teachers were attending to all three circles and their overlaps in the games as practice model (Figure 55). The teachers' careful selection of games linked to wider culture and brought society into the school environment. Examples from the teachers included Monique's links to skills from home life, Judith's reference to 21c skills, and Rey's development of the GameMaker: Studio project as an epistemic student experience with direct links to industry. These teachers did not use the games as an abdication of responsibility; they were part of carefully curated forms of praxis. The teachers also attended to the curation of progressive game types, explaining that they considered different types of games to offer students more sophisticated knowledge and skills over time. The sociocultural research methodology supported the teachers and students to reflect upon their perceptions of learning.

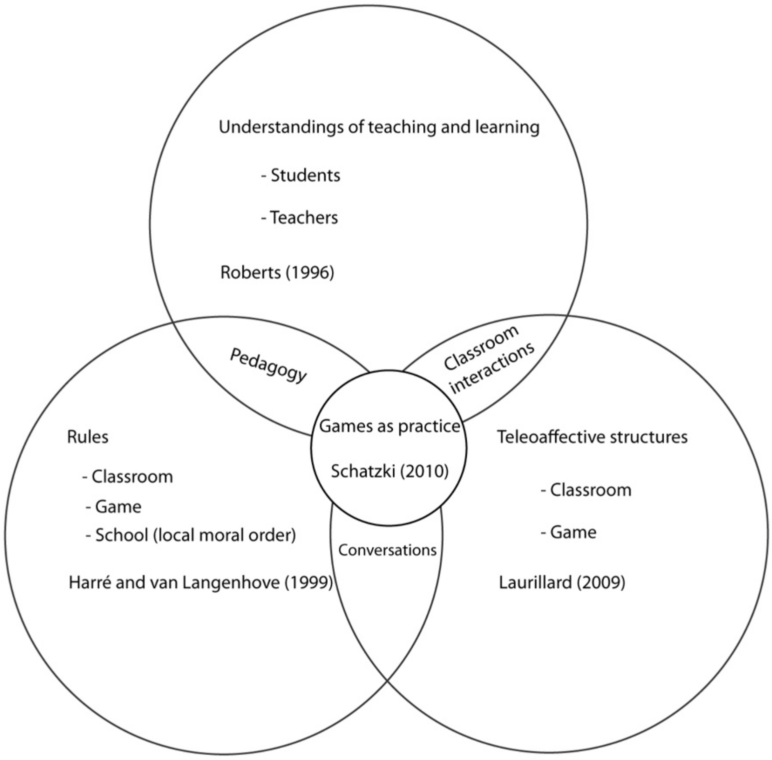

Figure 55: Practice theory for teachers envisioned as a Venn diagram.

The findings from my study also uncovered an area not supported by the existing literature. The expert teachers did not refer to the game as a stealth learning tool, instead referring to a range of 21c skills and extension activities that were differentiated and adaptive to the growing student content knowledge and ability with the game. The teachers implemented games as an opportunity for students to be agential in their daily work. Teachers saw games as a layered pedagogy that exposed students to opportunities to practise domain knowledge and develop other skills, including 21c skills. In this way, the teachers' professional duty to meet the varied learning needs of their students was met through game-based learning experiences.

8.3.1 Why teachers use game-based learning experiences in classrooms

The teachers' intentions in their planning to implement game-based learning experiences in their classrooms were influenced by all three spheres of practice theory (Schatzki, 2010). The complexity of the different influences on planning games as pedagogy was seen in the dataset presented in the findings. Teacher pedagogy is unpacked with reference to the student evidence.

The students and teachers in this sample seemed open to the range of ways the game-based experiences could help students demonstrate their learning in new ways and in other forms. For teachers in this sample, the differentiation available through the games was a great help in their classrooms (Figure 56), and the students reflected on this with their teleoaffective accounts of game use, collaboration, and understanding of their own learning pathways. In developing spaces for action, student agency was encouraged through the use of games.

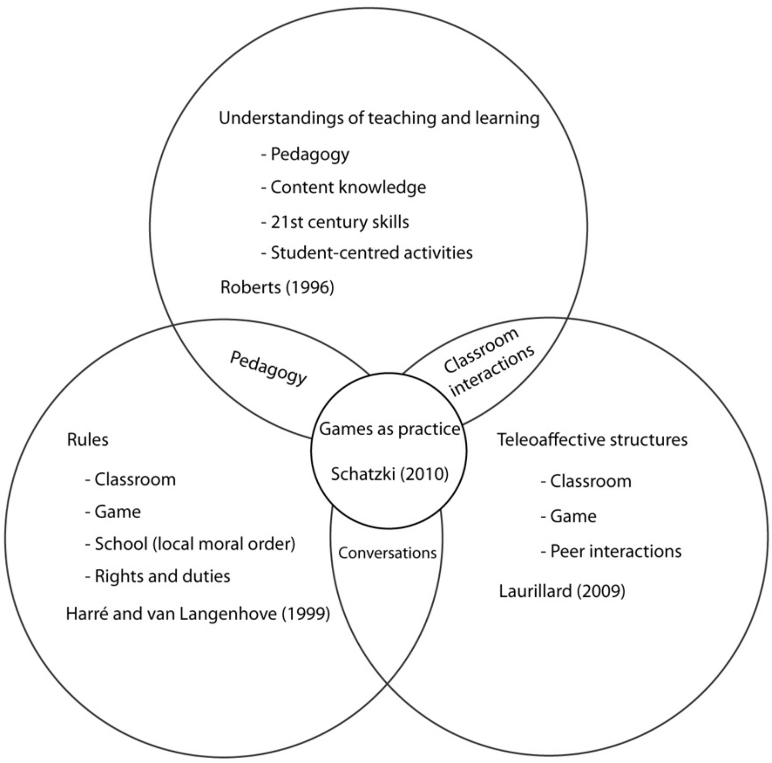

Figure 56: Teachers' planning seen through practice theory.

These understandings were easy for teachers to identify in the game-based experiences and led to a teleoaffective experience of pride in the students' production and progression. This idea contributes to the second aspect of the visualisation of practice theory in action: the overlapping space between the understandings and teleoaffective structures (Figure 56). The teachers' pedagogy may be seen as empowering the students as there were clear actions the student could 'do', may 'do' and do 'do' when engaged with the game as a learning tool.

Teacher intentions may be understood as a way of enacting their own agency to meet professional responsibilities (rights) and the learning needs of their students (duties). The complexities of teachers' everyday planning are discussed with reference to the sociocultural praxis of schools towards becoming communities of learners.

One of the biggest chasms between the literature and the realities of teaching and learning is the expectation that games teach concepts by stealth (Shute, 2011; L. Wang et al., 2015). The teachers in my study did not reflect this expectation. The games presented to the students as a learning tool were offered in addition to other activities in the classroom. The use of games was not a hands-off approach to educating students, and games were not relied upon to teach in isolation.

Teachers' reasons for using game-based learning experiences included content mastery and development of other skills like collaboration and problem-solving. The teachers planned and conducted the game-based learning experiences as an engaging way for students to demonstrate a range of skills in addition to content understandings. The research method I developed supported reflection on the planning for game-based learning in classrooms. This highlighted that current research may simplify the complex nature of teaching and learning into behavioural exchanges. Through the reflective accounts I was able to gain very specific insights into teachers praxis. As a reflexive researcher I was able to analyse the context and practice from planning to the students' perceptions of learning.

The following section discusses the sociocultural nature of classrooms with reference to this type of activity and how it may be understood through practice theory (Schatzki, 2010).

8.3.2 Teacher pedagogy and student learning

It is not enough for the teacher to provide a game-based experience as a learning activity; the students must also understand, and engage with, the educational value of the activity. The students in my study made clear which behaviours in the game-based experience demonstrated their learning. The students were conscious and cognisant of how their actions in the game were showing their learning. The idea of that an activity can sneak in learning belies the very nature of what teachers, and students, know learning to be. If we consider that at a basic level, learning is being able to recall and apply domain knowledge, the student's agential and independent recall and application of their understanding of the domain knowledge is the evidence of learning teachers seek.

It is worth adding a caution at this point. The use of games in educational contexts could be seen to position the student to exhibit particular behaviours. It is possible to conceive that games might be used as a way of exerting power over students, or as a form of their submission to the authority of the teacher. For example, game-based learning experiences could have the potential to be used as a domination, or in subversive ways as pictured in the dystopian fiction of *Ender's Game* (Card, 1999). There is also the possibility that game-based learning may not be accepted by the students as a legitimate learning tool, as found in studies of adult learners (Whitton, 2007b). It is important to realise that, through the empirical evidence in this thesis and other studies, the purpose for the use of games in educational environments does not report the use of games as a submission of students but as an empowering part of the learning journey. Teachers in this study consistently referred to games as enabling students to evidence learning. The game seemed to provide a shared language and purpose for the teachers and students, making a previously tacit process for the students into one that students could enthusiastically explain and not interpret only through the teachers' professional feedback.

8.3.3 How teachers plan for teleoaffective student experiences

The students' reported teleoaffective experiences included excitement and pride at the successful completion of the activity: collecting bugs, a working robot, or a playable game. As we have seen, the game design gave constant feedback and a programmed adaptive response to the student's actions in the game, supporting the positive emotional experience. This link between positive emotion and pedagogy is understood by both novice and experienced teachers (Zembylas, 2016) and is not seen as a dualism; the emotional experience of the student should be considered to inform any classroom pedagogy.

The bond between emotion and pedagogy is understood as part of tacit teacher practice, which can be labelled as an intuitive teleoaffective pedagogy. That is, a pedagogy that harnesses an endpoint which has a positive emotional effect. In the case of the site ontology of games, the games used in this study can be classed as having positive endpoints for the students involved. This may be attributed to the types of differentiated games selected for the students to use, with each game giving students feedback on their progression. The teacher might then enter into a teleoaffective cycle (with the students), where games are seen by both parties to lead to positive learning outcomes, and so games are used again in other topics.

Monique, as a beginning teacher, evidenced such a teleoaffective cycle. She believed that students would understand the iPad mathematics applications and show learning in different forms. The experienced teachers in the sample had implemented games in their classrooms over a longer period of time. They still believed that the games would work and could articulate an understanding of games as contributing deeply to students' learning. Within our dialogue, these teachers also offered longer term development of student understanding, with Judith including using technology to share their learning in varied ways (audio clips, video, or blogging) and Rey describing the epistemic value of a career pathway for game design. In all three cases, the students' interests and agency were central to the selection of the game and the development of the lessons around the game implementation. With each implementation, the students experienced success in their progress towards the set outcomes, and this supported the teachers to implement the games in the following year.

8.3.4 How teachers position learning: Local moral order

The rights and duties of the teachers in my study were made visible in our dialogue. The school provided resources that enabled teachers to implement these game-based learning experiences for the students. To become aware of, and experience, games as practice, the teachers accessed and applied their own sense of agency as teachers who could use differentiated activities, of which games are one pedagogy. Their sense of duty to meet the rights of their students as 21c learners was reinforced when students not only enjoyed the activity but could also independently provide evidence of their learning, sharing their meaning making process, actions, and progression. Such visible feedback and evidence was a valued aspect of this pedagogy for both teachers and students.

The choice of the game-based learning experience as a tool was influenced by what was available in the school and the outcomes the teachers were designing curriculum for. The selection of games to implement required careful curation of games against outcomes and developing pedagogy to ensure effective implementation of the games with students. In this way, teachers went beyond seeing games as only a cultural tool, and shifted their understanding to encompass games as a learning tool. Some considerations teachers made when choosing a game as a learning tool included the way the game supported students to interact with it, the feedback and adaptive programming it provided, and the ease with which teachers could assess student progress in the game.

When the teachers were explaining their game selection and use, their language around the game showed how they lived out their own rights and duties as a professional to support the rights and duties of their students. Such evidence was explored in detail in the findings (Chapters 5 to 7) through the professional knowledge of the teachers. One of the resounding benefits of the use of game-based learning experiences is that teachers observed students showing agency as learners. The teachers recognised that students enjoyed the learning experience and took responsibility for completing the game, despite challenges and sometimes failure.

In the literature review and theoretical frameworks, Doyle's (2015) work on agency was highlighted as he encouraged the use of ambitious teaching pedagogies in classrooms. From the evidence presented in this thesis, I argue that the everyday practice of teachers already incorporates examples of ambitious pedagogies. Compelled by their own moral duty and professional agency to attend to the rights and duties of their students, teachers implemented games and other practice sites for students to make meaning as learners. Through the provision of these pedagogies, students had opportunities to think and act in new ways, which were not always available through other class activities (worksheets, discussions, etc.). Teachers were skilled at identifying tools that would engage the students as agents through learning processes and products.

The game-based learning experiences in these schools provide a positive implementation story of classroom learning. The nature of my study was not to present what was good or bad about game use in classrooms, but what was really happening for teachers and students. The teachers planned activities which will provide opportunities for students to achieve learning outcomes, and this positive frame is mirrored in the student perceptions of using games as learning tools. It is these insights which may seem to be biased in my presentation of learning with games, however that the students recognise their actions in the games as linked to their learning outcomes may be the factor which is seen as motivation when using games.

The takeaway understandings about why teachers implement game-based learning experiences include an often unspoken, tacit pedagogical understanding of the need for students to be agentive in their learning and have opportunities for differentiation of their experiences. Together, the learning environment and the teachers' pedagogies empower student agency, and game-based learning experiences are one approach deemed successful. This in part may be due to the way students approach games.

8.4 Games as Practice: Students' Perceptions of Games as Learning Experiences

When considered as a site of practice, and attending to the other three dimensions, game-based learning pedagogies may assist students to recognise their agency as learners. The students' agency was visible to me in our dialogue, with analysis showing the students' habits of interpretation, action, and belief in their everyday transactions with the games. This section discusses the findings to provide answers for the research questions.

8.4.1 Aspects of games that students identified as supporting their learning

The storylines that emerged from the analysis of students' conversations echoed those in the literature. These storylines gave insights into the common experiences of students through game-based learning. These common experiences included problem-solving and completing challenges. The challenges and problem-solving experiences reflected the students' cognitive engagement and application of knowledge and skills.

They are examples of habits of action that students recognised when learning with games. From the student dialogue in my study, the reasons for these games being motivating were as diverse as the games themselves. In general, students anticipated and were prepared to meet the challenges set within the game, even if they could not predict exactly what that challenge would be. They perceived a challenge in the game as different to other challenges faced in the classroom.

In addition to cognitive engagement, participants considered fun and enjoyment positive aspects of games as pedagogy. Studies of how students emotionally engaged in science learning by Kayumova and Tippins (2016) affirmed positive affective practices as fruitful for the students in science education. The empirical data I have presented deepens the understanding of how affective practices may help students to be aware of their own agentive actions in game-based learning experiences. The aspects that students valued included fun and cognitive challenge, while encompassing connections between knowledge domains and peers.

Students referred to the games being fun in their PMM maps and interviews; however, the students referred more often to the varied cognitive challenges they experienced with the game. It may be that this cognitive engagement was an important aspect of the game-based learning experiences offered in classrooms. Students seemed to relish the unknown nature of the challenges that the games presented. This was a different challenge to 'guessing what is in the teacher's head'. Students understood that the challenges posed by the game would be solvable. Such anticipation of challenge explains the motivation alluded to in studies since Malone (1981). This section considers the possible reasons for the motivational value of cognitive challenge for students.

For students, this sense of fun can be just one component of the teleoaffective space offered by games. By looking beyond fun, other influences on teleoaffective experience can be teased out. The students mentioned the challenges they anticipated and the pride they had in completing them. They provided ample evidence of their agency in making meaning about their learning in the knowledge domains and the application of wider skills. These similarities across the different game types demonstrate that students could recognise the ontological site the game provided. Students focused on particular aspects of the classroom and game at different times, and while the novice and expert experiences were different, both were valid experiences that the students needed to work through for their learning to progress. Perhaps in this way, game-based experiences can be an equitable pedagogy, providing a differentiated experience that supports all learners towards success.

Interestingly, the students spoke of their learning actions and reflected on their learning, but they did not credit the game with teaching them. This may be because of the shift to student-centred activities where the learning goals were clear but the teacher pedagogy may not have been visible to the students. It may be because the students felt the traditional role of the teacher explicitly explaining knowledge to the whole class was not as visible as when activity-based learning was used. Either way, it was not a detraction from their learning. This observation from the students' discourse evidences a repositioning of what teaching and learning may look like when students are agentive. The student perception of the role of the game may include it as an interlocutor, part of their discursive interaction with the domain knowledge, able to give feedback to track progress. The agency a student must exhibit to make meaning about their progress and articulate their emerging understandings becomes the focus of the student's discussion. Using the games in this way seems to put the student in the driver's seat of their own learning journey.

The theme of challenge was repeated through the dataset. This repetition across the different ways games were employed in classrooms resonated with the patterns found in the literature that students will predict and persist with challenges as presented in the game. Students can manage their learning behaviours in the game to repeat steps and meet challenges set. In my dataset, the students never saw the game as too hard, and they welcomed challenges. This may be seen as a limitation of the data set presented in this thesis as there were no discrepant cases evident, or it may be seen as a positive aspect of the use of these types of games in classrooms, as they have differentiated options to support more students to feel they are progressing in their learning. In this way, the game offered an opportunity to expect and predict the challenges and work through meeting them.

When faced with a challenge, students implemented habits of action through specific actions and routines, which the games supported. Students saw these actions as clear progress towards learning outcomes. When interacting with the game, the learning experiences became a shared curriculum-making event, with the game positioned as an interlocutor in dialogue with the student. This interaction has perhaps been hard to define as it is different to the traditional idea of teaching and learning. The learning here was experienced through the game and tied to the students' actions during play.

This leads to conceptualising learning as both a process and a product. In education, there is a tendency to have students produce concrete products to evidence learning. The game space may provide a pathway to help students understand their progression of learning through a process, involving challenges and multiple attempts, and see a product at the end of the game, for example, a full bingo card or a working robot. The game-based learning experience may influence student perception of reaching a learning outcome and being successful in the task. Game-based learning activities may lead to the development of a learner identity. Students' conversations with the game, with peers, and with teachers may support the student to develop an awareness of their agency in these learning moments. Having this awareness of agency I feel may be an important part of developing a learner identity in the moment and possibly beyond.

While the theme of anticipated future use did not form its own storyline, it does have implications for the value students put on using game-based learning experiences as part of their classroom work. The students' anticipation of retention and transfer of knowledge and skills was insightful, giving a different definition of these terms than is found commonly in the academic literature. Some specific examples of this include the students' retention and transfer of mathematics skills and knowledge, like estimation and addition, while in the literature, retention is often interpreted to mean the retaining of student numbers in tertiary courses. There is also context-based recall, when in other settings students may not realise the transfer of specific skills to new situations or questions. This study captured the students' reflections and provided evidence of the future affective and moral value of the students' day-to-day work.

Through game-based learning activities, the students were required to enact their agency and were well aware of the learning intentions of the game. Students readily provided evidence from the game and their actions within the game to share their meaning-making process. Teachers validated this process when they engaged in conversations with the students about their learning and the game. In both written and verbal descriptions of learning, the students articulated the transfer of content skills, connected to domain knowledge, and projected future use of the skills and content used in the game. This provided an understanding for the teacher about the teleoaffective nature the game offered students as a site for learning. Students valued the experience as an authentic expression of learning, and it may have affected their discursive production of meaning as a learner in a school setting.

8.4.2 How students identified and described their experience of learning through games

Across the three different game types, the students' experiences of games aligned as a site of practice. This section shows this alignment visually, through the theoretical frameworks that support the analysis of students' learning experiences through practice theory. This is followed by a discussion of the site ontology of games, as disclosed through my research.

The practice site provided by the iPad mathematics applications was influenced by the cognitive, teleoaffective, and moral actions of the Grade 1 students (Figure 57). The local moral order of the classroom included the students' understanding of their own agency as learners and acceptance of the game as a legitimate learning activity. The explicit teaching of the teacher before gameplay supported the beginning cognitive understanding of mathematical operations for the students. During the independent learning time, students used parallel play as they worked alongside each other to practise their mathematical operations with their choice of game.

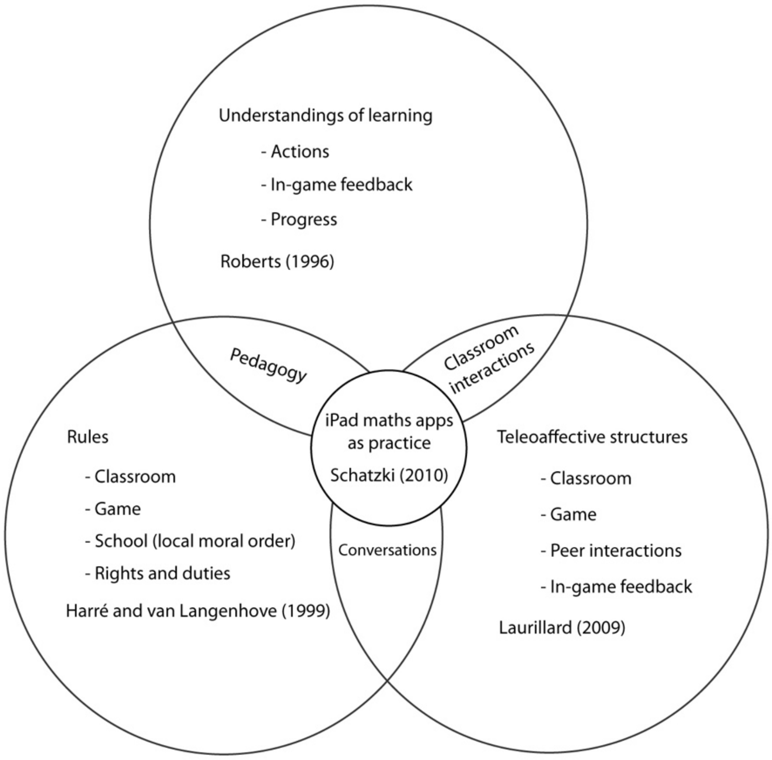

Figure 57: iPad mathematics applications as practice. The Grade 1 students' experiences were influenced by their learner agency and recognition of their cognitive, teleoaffective, and moral actions.

Grade 3 students used the Lego Robotics as a collaborative group. The students' grouping influenced the way students expressed their agency and supported each other as learners. As a site of practice, the Lego Robotics exemplified an opportunity for students to recognise their own application of knowledge domains, development of new knowledge, collaborate and problem-solve with peers, and live out their understandings of equity (Figure 58). Students drew on their previous knowledge to successfully complete and program the robots as a collaborative group. The students' dialogue, actions, and behaviours directly influenced the teleoaffective nature of the experience and used collaboration and problem-solving examples to express their learning.

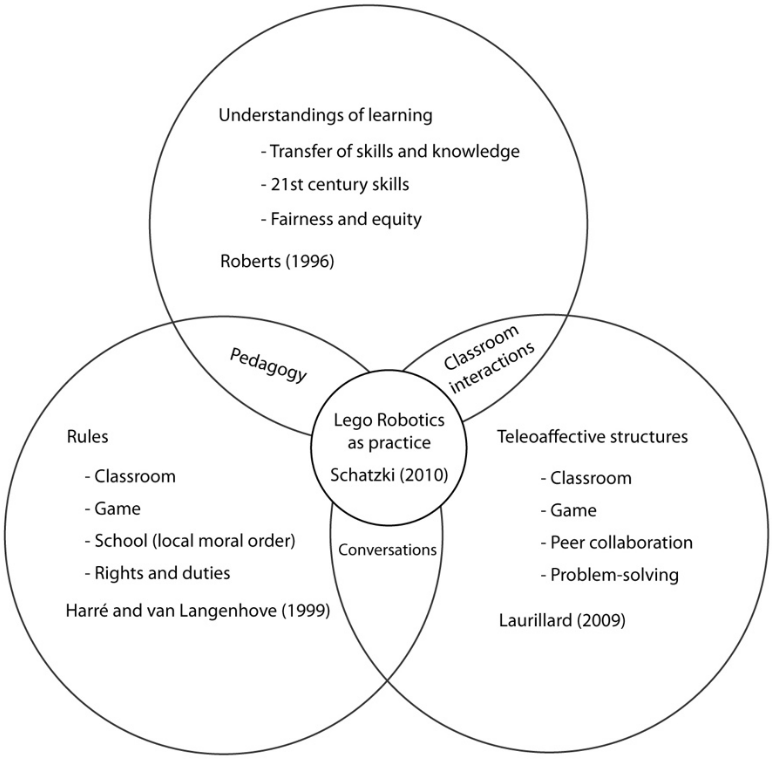

Figure 58: Lego Robotics as practice. The Grade 3 students' experiences were influenced by their learner agency and recognition of their cognitive, teleoaffective, and moral actions.

Forest Springs promoted its academic curriculum. As a practice site, the GameMaker: Studio project provided a series of novel challenges that required the Year 9 students to be agentive in their interactions and reflexive in design and coding of their digital game (Figure 59). The co-constructed dialogue focused on the mechanics of building the game in GameMaker: Studio as it was a novel experience for all three students. They described this novelty as challenging, which influenced the teleoaffective experience as they worked towards their game as a product of their learning. The local moral order of this classroom project aligned with the students' timely thinking about subject choices and career options. The project served multiple purposes for students in this context, including learning to code a digital game, problem-solving unfamiliar challenges, and developing a vision of their future self who would make use of coding.

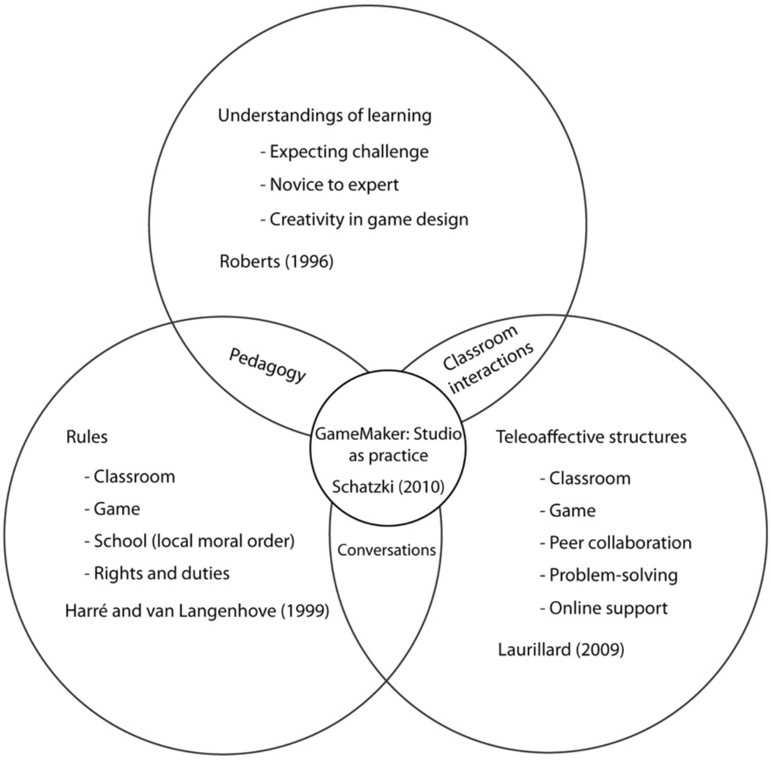

Figure 59: GameMaker: Studio as practice. The Year 9 students' experiences were influenced by their learner agency and recognition of their cognitive, teleoaffective, and moral actions.

Using games as a practice site associates an opportunity for students to take their learning from procedural and routine to be connected to wider social practices, becoming visible through the game (Hakkarainen, Engeström, & Paavola, 2009). The students' meaning making encompassed and identity shift to acknowledge themselves as game designers.

By becoming attuned to the wider variety of knowledge practices that may be accessed through games as a practice site, teachers and students seemed to recognise learning beyond the cognitive domain and find authentic ways to assess the wider affective and moral dimensions through discursive actions.

The student reflections in this thesis support game-based learning experiences as a semiotic tool in their classroom interactions. Certain features of the cultural space that games provide have already been documented in the literature. The way games were implemented in these case studies shows that the semiotic space the students experienced supported my recognition of agentive learning behaviours in students. What is added by the case studies here is that the students were aware of their actions as learners when using games. The students were invited into a curriculum-making experience when they were engaged in games, and this involved students developing a better understanding of content and making personal links to wider skills. The learning goals of these experiences were well understood by the students. The next step for educators is to understand that students value games and that games may have power to take students beyond content and make links to better understand themselves as learners, within and beyond the classroom. A possible reason for this is that the practice site afforded by games leads students to better navigate the requirements for success through their undisputed agency as a player of the game.

8.5 Games as a Curriculum-Making Practice

Game-based learning experiences are a tool for students to recognise their own agency through specific cognitive, affective, and moral learning actions. This is partly due to the innate recognition of play and games as a cultural tool. Within the site of practice, they understand their learning through the evidence provided within the game and through peer interactions. Through the provision of evidence, the site of practice offered by games may include the opportunity for students to be active in their own curriculum making. This is discussed next as the role of the game in the practice site (site ontology) is explored.

8.5.1 How game-based learning experiences contributed to student perception of self as a learner

As explained throughout this thesis, teachers need to enable student agency through pedagogy. Teachers' pedagogy when implementing games is influenced by a range of tacit and explicit understandings of learning, including their recognition of student agency. Teachers understand the games as providing a shared language and opportunities for the students to make meaning about content and skills through their actions in the games. By providing these experiences, teachers acknowledge student agency in the classroom setting and support students to build their own perceptions of themselves as agentive learners. Game-based learning experiences may help students to develop their own narratives about themselves as learners. I believe that this use of game-based learning experiences is an example of curriculum making.

When the students were offered the dynamic transactions afforded by game-based learning experiences, they understood that they were engaged in more than meaning making about the domain knowledge. The game-based learning experience offered additional sociocultural and teleoaffective experiences that supported the ontological site where students and teachers shared in language and meaning making beyond the knowledge domain. The practice site of the game offered the students a rich experience through which they could see their own agency and capacity as learners.

The game-based learning experiences seemed to allow for student investment in ownership of the learning process and product. The students' narratives across the year levels did not mention the game as teaching them anything; instead, the game provided concrete moments for them to show their learning actions (process) and knowledge (product). The students' perspectives were consistently of themselves as learners, providing further support for viewing games as an enabler of student perceptions of themselves as learners. Such an understanding of self as a learner through the game space may support the usefulness of game-based learning experiences as a way of empowering student agency in a classroom.

By implementing game-based learning experiences, these teachers were supporting their students with an opportunity to recognise their own agency as learners. Such pedagogy can be seen to assist students to develop a narrative of themselves as learners and so be an opportunity for curriculum making (Huber et al., 2011). Through the concept of curriculum making, students are involved in their own actions of the lived curriculum. Huber et al. (2011) described the shift in Canadian schools from teacher-generated pedagogy to a shared active space of curriculum development between teachers and students. The narratives shared in my thesis resonate with this shift of curriculum being focused on the teacher's do and say to the student's do and say, which is enabled by the game-based learning experience.

The psychological discursive space offered through the agentive use of game-based learning experiences may support students to become aware of their complex meaning-making actions. Meaning making is theorised here to transcend the cognitive domain and encompass a lived curriculum-making narrative. To build a curriculum-making narrative, students need to be invited into the learning activity and to believe they can be successful. The learning community in the school also needs to include developing a local moral order and culture of supporting the student to understand that they have learner agency (say) and can enact learner agency (do) in the classroom.

It may be that the students recognised that games as a learning tool offered more than they normally perceived in other classroom activities. When a game-based learning experience was offered, students saw an opportunity for more than fun, more than practise of cognitive skills, more than collaboration, and more than challenge. The game represented authentic actions, which peers and teachers understood as ways of being an agentive learner in the classroom setting. They positioned the game as an interlocutor that they could make mistakes with and that would give feedback on their progress in real time. The game also represented a site in which students could rehearse their cognitive, affective, and sociocultural self, contributing do (actions) and say (voice) to the classroom. Games provided a discursive interaction that supported curriculum making amongst students and teachers. Games may be a structure that enables agency for more students in our classrooms.

The game-based learning experience became an invitation to develop a curriculum-making narrative from the students' direct experiences; it allowed them in turn to implement their habits of interpretation about their own learning and self as learners. In further discursive interactions with the game or others, the students may become aware of their agency as a learner when using games, further contributing to the teleoaffective space and learning cycle for them and their teachers.

8.6 Game-Based Learning as an Opportunity for Students' Discursive Production of Meaning

The methodological contribution of this study includes the use of three theoretical frameworks—the epistemic authority of teachers (Roberts, 1996), the sociocultural nature of the teleoaffective classroom, (Laurillard, 2009), and the psychological discursive moral space (Harré & van Langenhove, 1999)—I offered a way of understanding games as a discursive practice site through practice theory (Schatzki, 2010). The research protocols and tools offered in the research methods were developed to access the student and teachers perceptions of learning with game-based experiences.

Teachers and students valued the contribution games made to the classroom. Teachers conveyed an understanding of the layered ways games could help students connect to content and wider skills. Students approached games with a sense of being able to meet the challenges posed and reach the goals set within the game. When the game was considered a practice site, the students' reflections disclosed a complex series of interactions including the cognitive, affective, and moral actions that students valued as evidence of their learning. This in turn led to the student actively identifying their agency in the game-based learning experience.

The representations of school classrooms have shifted from Robert's (1996) conception of a mostly passive meaning-making experience through explicit teaching. Laurillard's (2009) model of a sociocultural classroom is a more dynamic presentation of classrooms today, with student-centred activities and a collaborative atmosphere. Through these sociocultural exchanges, students are invited to discursively produce a learner version of themselves. These exchanges support the students to engage in the game space and reflect on themselves as learners. Effectively, the game-based learning experience is an example of curriculum making, where students are invited to be agential in their own learning and reflective meaning-making practice.

As a cultural tool, games offer a practical site for students to identify their perception of agentive actions as learners. The varied transactions with the game-based learning experiences documented in this thesis supported students and teachers to make meaning about knowledge domains and wider skills. Through our conversations, the students positioned the game as an interlocutor that provided feedback and information on their moment-to-moment progress in the game.

The students' habits of interpretation, habits of action, and habits of belief about themselves as learners in the game-based experience gave insights into their complete experience of learning, not restricted to the knowledge domain. The site that games offered to students was reflexive and dialogical. Students perceived games in classroom settings as a teleoaffective structure that supported them to make meaning within the knowledge domain, by making clear connections between other knowledge domains and 21c skills. They were also able to demonstrate their actions as agentive learners within game transactions, particularly when faced with challenges. Students were also able to articulate the ways in which games supported the moral domain of their learning. Students' true beliefs of themselves as agentive and successful in their game-based learning experiences permeated their activity. They conveyed habits of belief that the game would be fun, provide achievable challenges, and result in their visible learning progression towards a teleoaffective endpoint.

The relationship between the student and the game needs to be further interrogated. The use of discursive psychological methodologies may be a way to do this. Using co-constructed conversations, I was able to glimpse the relationship that exists between the student and the game. This thesis contributes the first steps in understanding how students and games form sites of practice in classrooms. The final chapter explores the implications of this thesis for further research, teaching, and learning.

Chapter 9: Site Ontology of Game-based Learning Experiences

9.1 Introduction to the Conclusion Chapter

Through this thesis, I aimed to contribute knowledge to the field of educational research to improve understanding of game-based learning experiences in school settings. In this conclusion, I offer the following contributions: (1) a theoretical framework and method that attend to students and teachers as agentive co-contributors within research and (2) an understanding of game-based learning pedagogy as a site ontology from the student's perspective, through an empirical application of positioning theory (Harré & van Langenhove, 1999) and practice theory (Schatzki, 2010). In this conclusion chapter, I attend to both of these areas, providing theoretical and practical implications for research and practice.

Students were engaged in dynamic interactions when using games as a learning tool. These interactions with the game supported students to be cognitively, affectively, and morally involved in the experience and encouraged students' awareness of their agency in the moment. The students' habits of interpretation and habits of action when interacting with game-based learning experiences helped them to make meaning about their learning in the moment. This learning was enhanced through discursive reflection on the game. These game-based learning experiences were discussed as a form of curriculum making. To enhance the possibilities for students to engage with curriculum making, there is a need to recognise and develop opportunities for discursive reflection during and after the game-based learning experience.

The cover story of games being fun and motivational learning activities is a part of the storyline teachers and students offer when reflecting on using games as a learning tool. Games are considered to have something special to offer students, and I believe this may be explained when we consider the game as an ontological site. When teachers implement game-based learning experiences, the lived experience of the students is acknowledged and validated. As a cultural tool, games may offer more accessible forms of meaning making for more students. Game-based learning experiences provide differentiated and adaptive learning opportunities for students. Students understand these opportunities and they accept their agential role in curriculum making when using games in the classroom.

The findings contribute to the field, explaining how and why students and teachers find games a compelling pedagogy, with the support of empirical data. The findings also provide a theoretical framework to support an understanding of the success of other student-centred pedagogies in the classroom. In our reflective co-constructed dialogue, teachers and students described complex experiences of teaching and learning through games. Their reflections gave insight into the cognitive, teleoaffective, and moral dimensions of their experiences when using a game-based learning tool.

The theoretical frameworks of Roberts (1996), Laurillard (2009), Harré and van Langenhove (1999), and Schatzki (2010) show the range of influences on classroom teaching and learning. I used these frameworks to structure the research methods and data analysis for this thesis. By accounting for the social and structural impacts on the discursive psychological space experienced by students during game-based learning experiences, I provided an account of the ontological space that would not be available through survey or test data alone.

Analysis of the dataset resonated with existing literature, including an endorsement of the learning actions and routines supported by games. In addition, students discussed feedback from the game as informing their learning actions, their implementation of 21c skills (collaboration, creativity, and problem-solving), possible future uses of knowledge and skills, and being able to meet challenges set within the experience. Their game-based experiences supported them to make meaning, as a learner, through their own discursive process.

Students positioned the game as an interlocutor. It provided feedback and adaptive challenges for students to measure their own progress. This feedback formed part of both the rules and the teleoaffective space offered by the game. Such features of the game supported students to provide concrete evidence of their learning, using the meaning-making processes of the game.

When students used games as a practice site, they were active in curriculum making. The teachers were instrumental in the explicit planning and teaching before, during, and after game use. The pedagogy used by the teachers was one that enabled students to feel in control of their learning actions with the game. In implementing this complex pedagogy, teachers were fulfilling their professional rights and duties while validating the rights and duties of their students.

The game as an ontological site did not arise spontaneously. The teachers were aware of, and made time for, the development of relationships between the students and the knowledge domain, and this was reinforced by the use of games as a site of practice. These games provided structure that students engaged with in agential ways. Teachers were cognisant of offering a variety of learning experiences to support the skills and knowledge of students, so that when students used the game, they were confident to apply their learning to new contexts. The following section attends to the theoretical implications of the research, followed by the implications of understanding the game-based learning experiences as an ontological site for teaching and learning.

9.2 Theoretical Implications

Games are defined in this thesis as a cultural tool and validated as a positive support for student learning through the literature and teachers' praxis at the time of the research. Within this empirical study, the students and teachers described the game-based learning experiences as a way of traversing the space between cognition and culture. The semiotic space that developed between the students and the game was understood by both the teachers and the students. By attending to Roberts' (1996) and Laurillard's (2009) conceptions of classroom practice, students positioned the games as an interlocutor with a clear contribution to the discursive spaces that support learners to evidence their meaning making.

This thesis began with a definition of play and games as ways children make meaning about their culture. In understanding the game as an ontological site, this definition of play as the work of children was further validated. The practice site offered by games needs to be recognised as also supporting the success of games as a curriculum-making pedagogy. I demonstrated that this success is made possible through the local moral order of the school environment, the teachers' pedagogy for the knowledge domain, and the teleoaffective space offered in the classroom. The discursive space of the classroom may also contribute to the perceived effectiveness of game-based learning experiences.

The methodology I developed attended to the cognitive, teleoaffective, and moral dimensions of the classroom experience. These dimensions were necessarily different for the teachers and students involved; however, the rights and duties of both parties were intertwined. The educational and discursive psychological frameworks I implemented were instrumental in understanding the teachers' praxis and students' agency in the classroom. These theoretical models supported a deeper understanding of the game as an ontological site when used as a tool for curriculum making. In seeking to understand educational praxis for students and teachers, there is a place for discursive psychology in classroom research.

The use of discursive psychology in this classroom research supported students to reflect on the ways they defined and understood their own meaning-making relationship with games. I feel this approach to research is important in acknowledging that the classroom is an authentic lived space for students. As adults, we often diminish the work of children in school as a watered-down version of the world beyond school. However, the co-generated data in this study showed that the students saw games as a legitimate form of work, with value in their everyday life in the classroom. This real-life action, in their lived world of the classroom, supported students to build biographies about themselves as learners, through their actions and evidence within the game. My analysis of these biographies gave insight into the agentive actions of the students.

Implications for future research include the need for further use of the discursive psychological theoretical framework in other classroom settings to investigate learning using other tools and praxis. This would enable a body of work that attends to the agency of students as learners to develop, and perhaps will further validate the student-centred pedagogies of teachers. There would also be opportunity to investigate different types of digital and analogue games to discern if the site ontology is similar or different to that found for these digital game types. The implications of this thesis for teaching and learning at the school and classroom level are now put forward.

9.3 Implications for Teaching and Learning

The following implications for teaching and learning arose from the discussion of the findings; each is followed by actions for teachers to further enable student agency when using games in curriculum making.

Schools and teachers need to be aware of the power of game-based learning for students, beyond the cover story of the game being motivational and fun. The myth of games as a ‘stealth learning tool’ that can ‘sneak in learning’ also needs to be actively dispelled. Instead, the use of games as a cultural tool that may enhance students’ recognition of their own learning in the moment needs to be promoted as best practice. In challenging this myth, the knowledge and skills of the teacher and student as active agents in the classroom curriculum making should become the focus of the interactions with games. In understanding the game as an ontological site, the game becomes a valued medium for students to recognise their learner actions in their own curriculum-making narrative. Teachers may be able to highlight moments where students are enacting their agency in positive ways with games.

Game use in my study was not an abdication of the teacher’s responsibility or role. To clarify this point, the game was not a replacement for a teacher. The students did not perceive the games as a replacement teacher but as a responsive interlocutor. There is a need to further interrogate the relationship that develops between the game and the student; however, my thesis supports that a relationship does exist and that it is valued by the student in their discursive reflection. Insights into the relationship may be gleaned through dialogue as the games are played and perhaps through video and close observational data of student action in the moment. Such discursive reflection is similar to the ‘pupil voice strategy’ used with students in the research by Flutter (2007) of student action in democratic classrooms. Games may also be used to empower students’ voice as a shared experience and language between teacher and student (Bibby, 2009; Flutter, 2007).

Game-based learning pedagogies as a lived practice should be developed more explicitly for teachers to understand the importance of the discursive relationship the student may develop with the game. In my study the implemented game types developed students' skills and application of knowledge progressively from rote-learning games in mathematics to learning programming with Lego Robotics and then designing a digital game with GameMaker: Studio. A teacher will need to select game types that are suited to the cognitive, affective, and moral learning needs of their student group, taking into account their age, present domain knowledge, and game type to reflect the learning outcomes anticipated.

Depending on the game type, teachers may need to invest class time for students to become familiar with the game-based learning tool; for example, explicit teaching may be needed for students to learn to navigate the GameMaker: Studio software and understand the interface and tools. The game is unlikely to 'teach' the student any new content knowledge; instead, games seem to be well received and understood by students as a practical application and rehearsal space.

When games were implemented as a learning tool, students seemed to enact a site-based knowledge and skills set, which were analysed as habits of action. To measure the development of student skills and knowledge, teachers may find dialogue with the student helpful. While it may be possible to review a student's game metrics collected by a digital game, these metrics may not give the whole picture of a student's learning experience. For example, when a student is using a specific game for the first time, they may focus on the mechanics of the game (putting the pieces in the right place, clicking the buttons) rather than applying their content knowledge. There needs to be time allocated for students to explore the game-based learning experience before formative assessment of content and skills.

The offering of games as a form of pedagogy assisted these students to engage with the intentions of the teacher. The use of games provided a common language for both teachers and students to share progress and make meaning. There was a sense of a shared purpose of the learning journey for the teachers and students as the students used the language of the game, its feedback, and progress indicators to engage in domain knowledge discussions with peers and teachers. This may lead to a cycle of game use in classrooms, as both teachers and students value the ways learning becomes visible during the game.

Game-based learning experiences may be an ideal student-centred activity. The students applied habits of action to the game and developed habits of beliefs about themselves as learners through the game interactions. By discussing the students' progress using the shared language of the game, teachers validated the students' meaning making, leveraging the students in game actions and thinking to meet existing learning outcomes. Such validation of student knowledge and action may also affect a student's perception of self as an agentive learner.

Perhaps it is important *how* game-based learning experiences are used as a form of pedagogy, where the teacher is not present as the disseminator of information, and the students are allowed to work autonomously and believe they can complete the task independently. The local moral order of the school may also be key to helping students to be aware of learning goals and navigate their own learner actions. While the teacher is absent from micromanaging the game-based learning experience, students feel excited and empowered about their opportunity to take the reins and work with peers.

To get the most out of game-based learning experiences, teachers and other adults in the setting should be made aware of their own possible biases about the potential of games as a learning tool in the classroom. Professional development opportunities are needed to support teachers to engage with praxis to uncover the potential of the shared meaning-making language that games offer in educational spaces. Teachers also need to be aware of their own agency in providing student-centred opportunities that enable students to be agential in the lived curriculum of the classroom.

My thesis advocates the use of games as a form of pedagogy that enables students to recognise their own learning. However, while powerful and enabling for students, I am cautious about turning every classroom interaction into a game. As an experienced teacher, my true belief is that varied pedagogy, appropriate to the knowledge domain, be sought and applied. Sometimes, this will be a game-based learning experience, and often, other learning experiences will engage and connect learners to the domain knowledge. Teachers should seek to incorporate games into the classroom when they are pedagogically appropriate.

When students identify their learning, they are exhibiting their agency; their awareness of their own ability to act, interact, and transact to learn. Within the game site, the student's dialogue with the game, with peers, and with teachers supports the discursive meaning-making space for the student as a learner. These game-based experiences become a vehicle for students and teachers to position a shared language of learning. It is set in an experience that has value for students using a cultural tool. This is something we know historically to be effective and valued.

As noted in previous chapters, the ability of students to show agency through game-based learning activities depends strongly upon the willingness of schools and teachers to provide infrastructure to enable digital games as a form of pedagogy in classrooms. It seems the timing for this study was right, as these structures and the cultures of the schools were supportive of this pedagogy for the students. Once schools have access to game-based learning experiences, there is an additional opportunity for students to be agentive in their learning. Teachers and students may realise the benefits of games to show their knowledge and skills in authentic ways.

In summary, the implications for teaching and learning become clear when the game was viewed as an ontological site, empowering students and teachers as agential in the discursive lived curriculum of the classroom. The game-based learning experience supports a relationship and a dialogue within the game space and with peers, through shared meaning making in a knowledge domain. Teachers and schools need to be active in providing the infrastructure, cultural environment, and affective supports for students to develop skills as agentive learners using different tools.

9.4 Implications for Students and Their Learning

Students valued the games in the immediate classroom, positioning games as a form of sociocultural capital and part of the meaning-making language validated in the classroom. In this way, the students' learner identities were realised through their discursive reflections upon actions, feedback, and progress, providing evidence that students had applied their domain knowledge and made progress in their learning. They had not waited for a test paper to be returned; they were supported by the immediate feedback of the game. For students, the game-based learning experience represented a meaningful engagement with curriculum. For example, games represented a low risk of failure and a high chance of success. They saw games as a way of building and displaying their knowledge and skills as a learner.

The students clearly identified the content and skills they experienced through the game-based learning experience. Students discussed specific learning behaviours, 21c skills (collaboration, creativity, and problem-solving), projecting future use of knowledge and skills, and meeting challenges within the experience. These agentive actions of applying their domain knowledge supported students to make clear connections and meaning for their own self-production as learners.

In this study, the games were a vehicle for students to experience learning in a new frame and be aware of success as learners. By analysing these learner experiences the agency of the students was evident. The students used the cognitive process of meaning making in the knowledge domain as evidence of learning. Students were also aware through our conversation that they were making meaning about themselves as successful learners in the game space. They did not wait for the teacher to tell them as they could see their progress for themselves. This awareness of progress, understanding what learning looks like for them, may link to confidence in themselves, in this moment, in this context. The content meaning making with the iPad mathematics applications, Lego Robotics, and game design was different for each group. The uniting experience for the students was recognition of themselves as successful learners through agentive participation in real experiences of classroom work.

Future use of game-based learning experiences in classrooms should be supported with discussions of failure as part of learning. This may assist students to apply their agency in other classroom activities. By drawing out the process and products evidenced as learning during game play, students may be able to recognise and transfer their learner agency to other classroom tasks.

9.5 Games as a Site Ontology That Contribute to Student Recognition of Agency as a Learner

The cognitive, affective, and moral dimensions of the classroom setting supported the students to enact agency as learners when they were engaged with game-based learning experiences. Teachers who implemented the games had an intuitive understanding of the pedagogy that would support students as agentive learners when using games, and the discursive co-generation of data helped to illuminate these tacit practices through the teachers' professional and moral domains. The site of learning shifted from the teachers' do and say to the students' do and say in response to the game and the teacher. The game provided a structure and the opportunity for the student to enact agency.

The game also offered a way of clarifying the tacit teacher intentions of the lesson. This led to the game being understood as a way of curriculum making for students and teachers. By recognising the game as an ontological site, teachers should approach using games in classrooms with more confidence of the potential for games to provide opportunities for students to locate themselves as active learners. This may extend to helping students to identify their own agentive behaviours. There is a need to shift from teachers and researchers attributing agency to students, towards explicit development of student skills to recognise and define their actions as agentive learners.

There is a need to use the methodology and theoretical frameworks in other classroom research of game-based learning, and other cultural tools. This would develop a body of work that could be responsive to implementation of newer technologies to classrooms and recognise the new relationships students may develop to support themselves as agential learners.

My research could be extended through a larger scale study of game-based learning experiences to see if themes are consistent across a wider demographic. The same research tools could be implemented to explore different game types and different tools as they become available to classrooms. Again, how these tools form a practice site that supports student agency and identification of learning should be central to the research.

Teachers could use the research tools I have developed in their own classrooms to document their praxis as part of explicit teaching and student debriefing to better understand their own learners. Using the research tools as a way of co-generating data with their students would be a visible teaching practice that could inform future pedagogy.

Such actions would provide evidence to meet the professional teaching standards in Australian schools.

I argue that we need to look at games as a form of pedagogy in a new way. By involving students as co-generators of dialogue, I gained an understanding of why students found learning with games compelling. Using discursive psychology, I was able to share the complexity of student activity in classrooms and disclose that their experience of agency as a learner when using game-based learning supports them to be part of their own curriculum-making experience. Helping students to realise, recognise and enact their agency in classrooms could be the next steps in pedagogical development for teachers.

My contribution to research is that the power of game-based learning experiences noted by teachers, anecdotally and in the literature, may be understood when we look at game-based learning experiences as a practice site that provides a dialogical interaction positioning the student as an agent in their own learning. My thesis also contributes to everyday teaching practice by providing insight into the ways students value games as a learning tool. Teacher choice of games as pedagogy needs to attend to the cognitive, affective, and moral environment of the classroom experienced by students. When game-based learning experiences are used in school settings, they may offer an opportunity for students to recognise their learner actions and claim their agency.

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Appendix 1: Sample of Transcript Analysis

= N Grammar
= R + Duties
= creative
= order of PMM Map

Transcript 2c

Interview 2 with Grade 3-4 students. Lily and Brian (Pseudonyms) - dice interviews - kids took turns with the same dice to answer questions ☺

Fiona: we are just taping like last week, no video. and what I want to start with is the lego dice. ANd I will get each of you to have a turn at rolling that, and we will talk about whatever question comes up as we go. There are sentence starters on there.

Brian: I found the lego challenging so I tried and tried to think of what I could do to make it work better. — R+D learner "duty" to think about it. ownership of solution to bird?

Fiona: Good, and nice and quick. Lily, do you want to do the lego one first, then we will do the other one.

Lily: Ummm, I show I am a learner when I, um when we work together, like um. When we work as a team because if you just do it by yourself, like it will be slower, and if you work together it will make better stuff. — 21st C Skill. R+D - to learn about working in the real world. Collaboration

Fiona: Fair enough, so team work helps you to create things faster.

Brian: I found the lego interesting because I got to like, build different things, design and stuff. — his R+D. Active Learning + application

Fiona: Yeah.

Pronoun shift

Lily: I found lego challenging so I um, so we had to go to a different step. This way didn't work, that the computer showed us, then we had to use our own way. — R+D - Learners in action - Unexpected challenge (followed the instructions)

Fiona: Yeah, good.

Brian: I already had that one.

Fiona: Spin it again, and again (laugh) Yay...different one.

Brian: I show I am a learner when I am using lego and finding out new things. — Actions + R+D of learner. Towards new knowledge for him?

Fiona: Really, good.

- surprise - challenge

Lily: I was surprised when like we finished doing the programming and when we actually programmed it, it didn't really work, and it broke into pieces. — Should work but didn't. R+D not met as expected

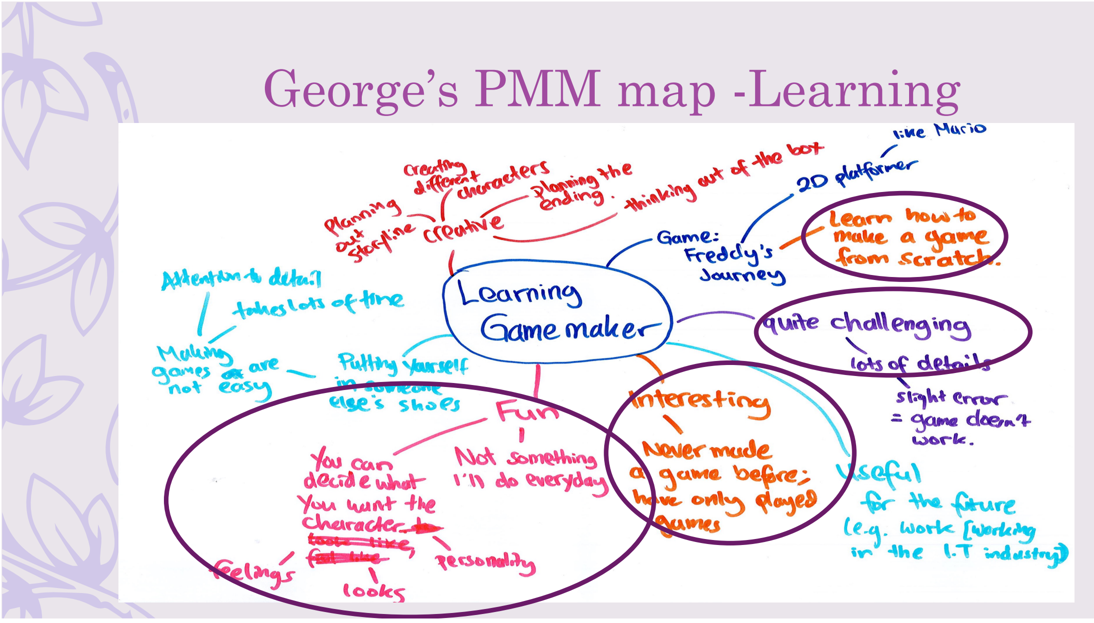
Fiona: That was a little disappointing, wasn't it. Now have a look around the dice, if there is something else you want to talk about on that one. Then we will start the other one. (2.31) You want to do that one, Ok, read it out.

Brian: I show I am a learner when I can use minecraft and find my golum. → (Learning Transfer) outside school context. challenge by choice

Fiona: Is that because it's fun for you?

Brian: It's fun for me and my cousins, they are into it as well. — Shared fun.

Appendix 2: Sample analysis by theme of PMM map and interview

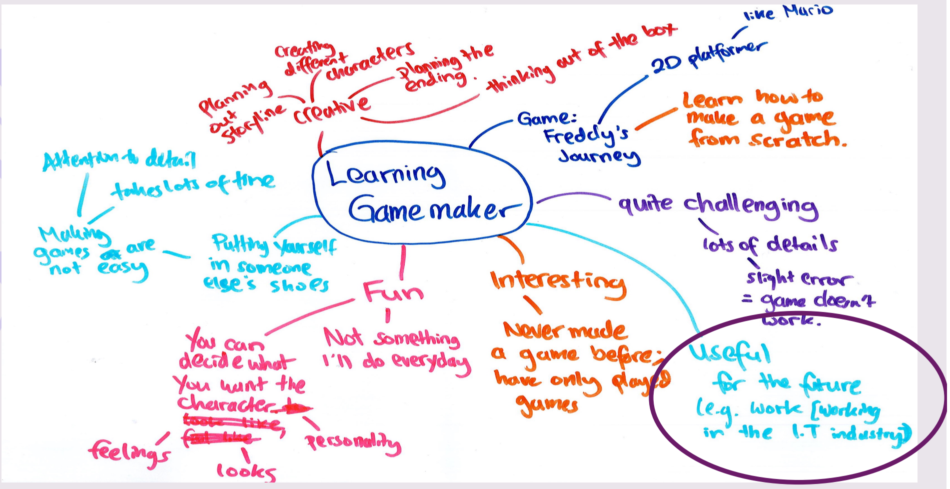


Three follow up interview questions:

I found GameMaker: Studio interesting because...	*I was surprised when.....*
George: **I** found GameMaker: Studio interesting because... there is just so much stuff about it. There are like lots of stages to create a single game, and it's just well, it's kind of hard, but hard in like a good way. So **you** learn lots of stuff, lot's of things like doing GameMaker: Studio. So that's what **I** found interesting. (Line 40- 45) (**Pronoun Grammar** + Challenge)	George: Well, **I** was surprised when, well, again, **Obi-Wan** has said it, or **Phoebe**, um how long it takes. Yeah, 'cause **you** imagine, oh, it's like a simple game and it wont take that long, but when in fact it took like four weeks, it's pretty surprising. (line 117 -120) (**Pronoun Grammar** + Challenge)

The best thing about this topic was when I....
George: ...basically the final product. It was like a sense of achievement. Oh, yeah, **you've** done this and um, **you** feel like happy, just **you've** created a game that works, and yeah. (Line 101) (**Pronoun grammar** + **Motivation**)

George's PMM map- Transfer



Two follow up interview questions- transfer

The skills from GameMaker: Studio will come in handy when…

*George: Um, the skills **I** used from GameMaker: Studio will come in handy when, well again, in the future if **I** decide to become a software engineer or something, **it** will come in handy. And **I** guess **it** will also be come in handy like during the holidays, like if **I** am bored. (line 199-202)*

Pronoun Grammar + evidence of transfer

The knowledge from GameMaker: Studio will come in handy when…

*George: Um, the knowledge **I** used in this topic will come in handy when, well, again it's like the skills question, so maybe like in the future, it depends on what work, the job **I** will get. **It** might be handy then. But then, another perspective like, **you** know, the details, nitty gritty detail **you** have, it might be handy to have like, **you** know, like wood maybe, like measuring something or **you** know. (Line 258 – 262)*

Pronoun Grammar + evidence of transfer