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Morales, Gemma Alejandra

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Technology and Bilingual Education: Helping Yolŋu Students Crack the Alphabetic Code

Gemma Alejandra Morales

<https://orcid.org/0000-0003-1123-0330>

Ph.D. Arts Candidate

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School of Languages and Linguistics

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ABSTRACT

Phonological awareness and letter knowledge have a significant and causal relationship with early reading for readers of alphabetic languages. While the existing research regarding the emergent reading skills of mainstream Western populations is vast, little is known about the development of literacy skills among children coming from cultures transmitted primarily through oral tradition. This study examined the emergent literacy skills of students attending a remote bilingual Indigenous school in the Northern Territory, Australia. The study included all Transition (kindergarten) to Grade 4 students enrolled at the participating school. This thesis proposes that phonological awareness, letter knowledge, and early word reading are closely related for children learning to read in Dhuwaya and that phonological awareness training can facilitate the acquisition of early reading ability in Dhuwaya. A Dhuwaya language game-like iPad application software was used as a phonological awareness intervention tool. This Intervention App was specifically designed and created for this thesis project. The Intervention App includes 24 levels that progressively increase in difficulty. Each level consists of a sound segmentation activity, a letter knowledge activity, and a sound blending activity. Letter knowledge, phonological awareness (at both the syllable and phoneme level), and word recognition skills were measured at three separate testing times: immediately before the start of the intervention, immediately after the intervention ended, and six months after the intervention ended. This study investigated the different patterns and relationships found amongst the participants' performance across the various measures assessed. This study also examined the relationship between student age and assessment performance.

The study also investigated the intervention effects, if any, on phonological awareness, letter knowledge, and early word reading. The results indicate that phonological awareness, particularly at the phoneme level, is significantly related to early word recognition in Dhuwaya. Results also suggest that letter knowledge mastery is crucial to early word recognition in Dhuwaya. However, the participants' letter knowledge, phonemic awareness, and word recognition skills were delayed when compared to the benchmarks proposed in existing research. Phonemic awareness and word recognition scores were particularly low across all three testing times. Post-intervention scores suggest that the Intervention App did not have a significant impact on syllable awareness and letter knowledge skills. However, post-intervention scores suggest that the Intervention App was moderately successful in increasing phonemic awareness skills and that increased phonemic awareness skills may have led to increased word recognition skills. The theoretical and practical implications of the results are discussed in this thesis, as well as suggestions for creating more effective Dhuwaya language emergent literacy IT resources.

DECLARATIONS

I, Gemma Alejandra Morales, the degree candidate, hereby declare that this thesis is entirely comprised of my original work towards the Doctor of Philosophy (Arts) degree except where indicated in the preface. All sources of information referred to in this work are acknowledged with reference to the respective authors. This thesis contains fewer than the maximum word limit of 100,000 words exclusive of tables, figures, bibliographies, and appendices.

PREFACE

This thesis includes a few excerpts from a published book chapter authored by myself, Gemma Alejandra Morales. Research conducted for this Ph.D. thesis was used to author the book chapter. I am the first author of the book chapter. Jill Vaughan and Merrkiyawuy Ganambarr-Stubbs are the second and third author, respectively. The citation for the book chapter in question is:

Morales, G., Vaughan, J., & Ganambarr-Stubbs, M. (2018). From home to school in multilingual Arnhem Land: The development of Yirrkala school's bilingual curriculum. In G. Wigglesworth, J. Simpson, & J. Vaughan (Eds.), *Language practices of Indigenous children and youth: The transition from home to school* (pp.69-98). London, UK: Palgrave Macmillan.

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I extend my deep gratitude to my family and friends whose constant support, encouragement, and belief in me and my ability to succeed kept me motivated throughout the process. I am eternally grateful to my parents who have provided me with countless opportunities which have allowed me to explore my passions and further my education. I would also like to thank my brother Choompy who is my best friend and my greatest confidant. I thank my extended family for being loving and the Lendorians for being amazing friends. I thank my labmates Dani and Josh for helping me maintain my sanity throughout this process. They understood life’s challenges as a PhD researcher and made me feel that I was not alone. Finally, I would like to thank Adam for helping me day-to-day so that I could get my work done and for pushing me even when I was tired.

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GLOSSARY

The following is a list of the key terminology used in this thesis.

- **Assessment App:** The letter knowledge and phonological awareness assessment iPad app created for this thesis project is named Indigenous Languages Early Literacy 1 (iLe1). However, it is also referred to as the Assessment App throughout this thesis to avoid confusion as the Intervention App is closely named Indigenous Languages Early Literacy 2 (iLe2). ‘Assessment App’ and ‘iLe1’ are used interchangeably; they both refer to the same iPad app.
- **Automatic Word Identification (“automatically read”):** the process of going straight from a word’s orthographic spelling to its’ pronunciation. Readers are not utilizing letter-sound knowledge when identifying words automatically. Instead, readers are identifying words automatically when they link the word as a whole to its pronunciation.
- **Code-Related Skills:** The critical skills involved in the utilization of the alphabetic code. Specifically, letter knowledge and phonological awareness.
- **First Language:** The terms ‘first language’ and ‘home language’ are used interchangeably in this thesis.
- **Home Language:** the language that a child learns through immersion at home; the language most commonly spoken by the members of the child’s family at home and in their immediate community. This language tends to be the child’s primary language before they enter the schooling system. The terms ‘home language’ and ‘first language’ are used interchangeably in this thesis.

- **Indigenous Languages Early Literacy 1 (iLe11):** The letter knowledge and phonological awareness assessment iPad app created for this thesis project.
- **Indigenous Languages Early Literacy 2 (iLe12):** The game-like phonological awareness training iPad app created for this thesis project.
- **Intervention App:** The game-like phonological awareness training iPad app created for this thesis project is named Indigenous Languages Early Literacy 2 (iLe12). However, it is also referred to as the Intervention App throughout the thesis to avoid confusion as the Assessment App is closely named Indigenous Languages Early Literacy 1 (iLe11). ‘Intervention App’ and ‘iLe12’ are used interchangeably; they both refer to the same iPad app.
- **Intervention App Training:** is used to refer to the intervention phase of this thesis project which consisted of student participation with the Intervention App.
- **Language-Minority Student:** A student whose primary or home language differs from the dominant language of the community where the school is located.
- **Mainstream:** The prevailing or dominant culture held in a society. The culture held within the largest group of people in a wider society.
- **Reading:** unless specified, ‘reading’ refers to simple word level reading, it does not refer to text comprehension.
- **Phonological Awareness:** the understanding that spoken words are composed of discrete sound units such as syllables and phonemes. Phonological awareness also involves the ability to consciously think about and to manipulate these discrete units of sound. For example, children can display phonological awareness by orally segmenting a word into its constituent phonemes.

- **Phonemic Awareness:** the awareness that words (and syllables) can be broken down into discrete phonemes.
- **Stimulus:** Each individual occurrence of a task in any given iLeL2 activity. For example, there are six syllable blending questions in each iLeL2 level. Each of these questions counts as one stimulus.
- **Student Cohort:** a group of children enrolled in the same school year level at a particular school; e.g. all Grade 4 students enrolled at the same school.
- **Syllable Awareness:** the awareness that words can be broken down into discrete syllables.
- **Task Items:** ‘Task items’ is used throughout this thesis to refer to the specific sound or word being targeted in any given question or task. For example, /m/ is the task item for the question “Which word begins with the /m/ sound: map, car, or hat?” Map is the task item for the question “What do you get when you put /m/.../æ/.../p/ together?”
- **Transition:** term used for kindergarten, the school year before Grade 1, in the Northern Territory, Australia.
- **Typically Developing Children:** Children who achieve developmental milestones (cognitive, physical, social, etc.) age appropriately. In contrast, children display atypical development if they are not achieving developmental milestones within appropriate age periods.
- **Word Decoding:** the process of using letter-sound correspondences to sound out words and reach their pronunciations.
- **Word Recognition:** The ability to recognize individual words on a page; the

process of accurately linking printed words to their corresponding pronunciations and meanings; i.e., linking a written word to its corresponding spoken word. The term ‘word recognition’ is inclusive of any strategy used to identify a printed word. Decoding and automatic word reading are both word recognition strategies.

Note that the pronoun ‘her’ is used throughout Chapter Five, Chapter Six, and Chapter Seven regardless of the gender of the participant under analysis. This was done to help keep the participant’s identity anonymous.

CHAPTER ONE

1.0 INTRODUCTION

Literacy events pervade our lives. Proficient reading is not only the crux of academic achievement but also the key to the wealth of information made available through written language. Reading ability bolsters scholastic success as it grants children access to all of the academic subject material found in texts (Papen, 2016). Scholastic success, in turn, leads to employment opportunities. Higher educational levels lead to higher employment and income rates (U.S. Bureau of Labor Statistics, 2018). Moreover, reading skills allow a child to live a more fulfilled life in that literacy events¹ are ubiquitous in today's literate society. Gaining access to information made available through newspapers, journals and the internet requires reading ability. Reading skills are also requisite for communicating via email and instant messaging. Furthermore, reading books, magazines, billboards, shopping lists, ingredient lists, directions, instructions, road signs, food labels, etc. all require adequate literacy skills. Early literacy development is therefore a critical research topic considering that literacy is such an essential tool in our society.

However, literacy skills are not readily acquired by all children. Evidence shows that many children struggle to acquire proficient reading skills (Moats, 2007). Moats argues that only 60% of children are born with all the "wiring" required for reading and will develop sufficient reading skills regardless of the teaching methods used in their reading education. The other 40% of children, who are not born with the required "wiring," will struggle to develop proficient literacy skills and are at risk of reading failure. This percentage is even higher for children coming from families with minority or

¹ Literacy events refers to any activity that involves literacy (Heath, 1982).

low socioeconomic status. The reading achievement of these at-risk children is crucially dependent on the quality of the reading instruction provided to them, who are only likely to succeed in their literacy pursuits if they are identified early on, and are provided with effective scientifically based reading programs (Moats, 2007).

The effectiveness of varying emergent literacy programs has long been studied and a growing body of research suggests that phonological awareness and letter knowledge are at the heart of successful early literacy programs (National Institute of Child Health and Human Development (NICHD), 2000). These two skills seem to play an important role in converting text into linguistically meaningful information (Powell & Diamond, 2012). This thesis examines the development of phonological awareness and letter knowledge skills in a particular population of at-risk children. Special focus is given to the relationship between these two skills and early word reading ability. The following section contains a brief discussion on phonological awareness, letter knowledge, and early word recognition. Section 1.2 introduces the population of children under study. Section 1.3 is a brief overview of the thesis project while section 1.4 reviews the structure of the thesis paper.

1.1. EMERGENT LITERACY

Orthographic systems use a set of symbols to systematically represent the words or sounds of a language (McDougall, Brunswick, & de Mornay Davies 2010). In alphabetic languages, letters (or graphemes) are used to represent individual sounds (or phonemes). These letters are strung together to create written words, which in turn are strung together

to create written sentences and paragraphs. This written code cannot be directly processed by the brain's language module (Shaywitz, 2003) meaning that readers must convert written code into something linguistically meaningful so that it can be processed (Goswami, 2005; Shaywitz, 2003). The alphabetic code is a highly effective tool that readers of alphabetic languages can use to convert written code into linguistic code.

The *alphabetic code* (or *alphabetic principle*) involves the understanding that words can be broken up into smaller sounds and that these sounds are systematically, to varying degrees, represented by the letters of the alphabet (Schuele & Boudreau, 2008; Fellowes & Oakley, 2014). The alphabetic code also entails an understanding of how to apply this knowledge to word reading (Ball, 1993). The process of decoding, or using the alphabetic code to convert written code into linguistic code, involves converting letters into sounds and then blending these sounds together in order to access a word's pronunciation. This first step, converting letters into sounds, is highly dependent on a child's ability to develop sound-to-letter (phoneme-to-grapheme) correspondences (Nicholson, 2005). Knowledge of the names, sounds, and orthographic (written) shapes of the letters of one's alphabet is referred to as letter knowledge (Piasta, Phillips, Williams, Bowles, & Anthony, 2016). Learners must develop proficient letter knowledge in order to successfully utilize the alphabetic code for reading (Hulme, Snowling, Caravolas, & Carroll, 2005).

Learners must also develop proficient phonological awareness. Phonological awareness is the ability to attend to and manipulate the phonological (sound) structure of one's language (Snow, Burns, & Griffin, 1998; Moats, 2005; Fellowes and Oakley, 2014). It involves the ability to attend to the abstract sound structure of a word as

opposed to the meaning of a word. In other words, this means recognizing that the word ‘caterpillar’ is longer than the word ‘snake’ even though snakes tend to be much longer than caterpillars (Snow et al., 1998). Phonological awareness allows children to penetrate the phonological structure of a word giving them the ability to analyze the specific sequence of sounds of the word (Schuele & Boudreau, 2008). It is phonological awareness that enables children to blend disparate sounds together to form word pronunciations.

Phonological awareness is an umbrella term for an array of skills developing along a continuum (Gillon, 2004). Easier skills such as rhyming and alliteration tend to develop before more difficult skills such as separating words into their constituent sounds, blending isolated sounds together to create a word, or substituting a sound in a word with a different sound to create a new word. Children can demonstrate their particular phonological awareness skill level by completing any task that requires thinking about and possibly manipulating the sound units of a word (Moats, 2005). An array of tasks has been created for the specific purpose of measuring children’s phonological awareness levels. The different tasks all tap into the same underlying construct of phonological awareness, albeit at different levels of awareness. For example, a child may be asked to segment a word into syllables or they may be asked to segment a word into individual sounds. The different tasks also vary in terms of the operations required to complete the task. In a segmentation activity, children are asked to break up words into disparate sounds. In a blending activity, children are asked to blend disparate sounds together to create a word.

A large body of research has been dedicated to comparing students' performance on phonological awareness tasks to their word reading skills. The research suggests that phonological awareness has a significant and causal relationship with early reading ability (Gillon, 2004) and that it is one of the strongest predictors for later reading². Young children with highly developed phonological awareness skills tend to become skilled readers while children experiencing phonological awareness difficulty often go on to demonstrate later reading difficulties. In regards to children already reading, good readers tend to perform well on phonological awareness measures while poor readers tend to perform poorly on phonological awareness measures. Therefore, some reading experts believe that phonological awareness development is one of the first obstacles encountered by emergent readers (Adams, 1990; Moats, 1999; O'Connor, Notari-Syverson, & Vadasy, 1996).

While some students are able to develop phonological awareness simply from being in stimulating classroom and home environments (Schuele & Boudreau, 2008), many others need explicit and systematic training (International Reading Association, 1998; McBride-Chang, 2004). Fortunately, research indicates that phonological awareness can be trained and that this training, in turn, facilitates reading acquisition (NICHD, 2000; Perez, 2008). Phonological awareness interventions have been successful in facilitating the acquisition of reading skills in typically developing children, in preventing future reading difficulties for at-risk children, and in helping children with reading disorders catch up to their typically developing peers (NICHD; 2000).

² Adams, 1990; Blachman, 1991; Ehri et al., 2001; Lonigan, Burgess, & Anthony, 2000; National Early Literacy Panel, 2008; NICHD, 2000; Perez, 2008; Snow, Burns, & Griffin, 1998; Snowling, Adams, Bishop, & Stothard, 2001; Stanovich, 1986

Various phonological awareness intervention programs have been created. These interventions differ in regards to the content, duration, sequence, and delivery of the training as well as in the characteristics of the participating students (Bus & IJzendoorn, 1999). Fortunately, research indicates that most variations in phonological awareness interventions are effective and produce positive results (Gillon, 2004; National Early Literacy Panel (NELP), 2008; NICHD, 2000), although some interventions are more effective than others and researchers have not yet reached an agreement in regards to which training characteristics most effectively facilitate reading acquisition (McKenna, Walpole, & Conradi, 2010). In particular, research is unclear in regards to which specific phonological awareness tasks contribute most robustly to early reading (Chafouleas, Lewandowski, Smith, & Blachman, 1997; Dickinson & Neuman, 2006). Moreover, existing research suggests that the relative usefulness of the different tasks may be language specific to an extent (Caravolas & Bruck, 1993). Consequently, there are no clear standards for how to create the most effective intervention programs possible.

1.2. LITERACY IN REMOTE INDIGENOUS AUSTRALIA

In order to create effective interventions, programs must be tailored to the specific needs of the children undergoing intervention. However, the majority of existing reading research is conducted on children coming from predominantly literate cultures and is based on commonly spoken languages. As previously mentioned, existing evidence suggests that phonological awareness skills may be language specific to some extent (Caravolas & Bruck, 1993). Emergent literacy benchmarks may also be different for

children with varying cultural backgrounds. Indigenous Australian children living in remote communities are unique in that many speak traditional Indigenous languages at home and come from cultures primarily transmitted through oral tradition. Studies focusing on the emergent literacy skills of remote Indigenous Australian children are limited and the existing research generally focuses on English literacy attainment. This lack of specialized research is disadvantageous considering that this particular population of children tends to be in great need of literacy support. Throughout the country, many Indigenous Australian children living in remote communities underperform in comparison to their non-indigenous peers in school (Harris, 1990; Moses & Wigglesworth, 2008; Reeders, 2008).

Many educators, politicians, and researchers use the National Assessment Program – Literacy and Numeracy (NAPLAN) literacy scores to highlight the ever-widening literacy gap between Indigenous and non-Indigenous students. The NAPLAN test has been administered annually to every child at school in Australia at Grades 3, 5, 7, and 9 from 2008. NAPLAN scores do suggest an alarming disparity between non-Indigenous and Indigenous students' English language literacy rates. In 2015, 78.7% of Indigenous students reached at or above the national minimum standard for Grade 3 reading benchmarks compared to 95.6% for non-Indigenous students (Australian Curriculum, Assessment and Reporting Authority [ACARA], 2015). The gap is even wider for Northern Territory students with only 42.5% of Indigenous Northern Territorian students achieving at or above the national minimum standard compared to 92.4% of non-Indigenous Northern Territorian students. The gap is widened even further

by remoteness with only 27.4% of Indigenous students living in very remote areas³ of the Northern Territory achieving at or above the national minimum standard for Grade 3 reading benchmarks. This rate stands out when compared to their non-Indigenous peers living in very remote Northern Territory, of which 90.3% attained at or above national minimum standard score (ACARA, 2015). While these numbers are alarming, they do not show what Indigenous children can do in their home language, which, in remote communities is not English, but a traditional Indigenous language, or a creole (known as Kriol in Australia) or a dialect known as Aboriginal English.

A few Northern Territory schools have adopted bilingual programs, using both a traditional Indigenous language and English for instruction. Bilingual programs give Indigenous children the opportunity to learn how to read in the language they know best. A large body of research highlights the considerable benefits of first language literacy instruction for language-minority students (Cummins, 2000; Genessee, 1994). However, a limited effort has gone into examining the home language literacy skills of Indigenous children attending bilingual schools. This study seeks to fill this gap in the knowledge base by examining the home language emergent literacy skills of Australian Indigenous children living in a very remote community and attending a bilingual school. The current project offers unique insight as it examines the development of early literacy skills in Dhuwaya speakers. At the time of this study, no one, to the best of my knowledge, had conducted a study that focuses on the development of home language alphabetic and early word reading skills in native Dhuwaya speakers.

³ The Accessibility/Remoteness Index of Australia (ARIA) is a standard classification system which labels areas/locations in Australia by their level of remoteness. 'Very remote' is a specific label indicating a more extreme level of remoteness than the "remote" label. 'Very remote' is characterized by having "very little accessibility of goods, services, and opportunities for social interaction" (Commonwealth Department of Health and Aged Care, 2001).

1.3. CURRENT STUDY

This thesis applies existing phonological awareness research to the investigation of emergent literacy skills in native Dhuwaya-speaking children living in a very remote Indigenous community in the Northern Territory, Australia. All participants are students at a bilingual school where literacy is initially introduced in Dhuwaya. This context allows for the examination of early literacy acquisition in Dhuwaya, thus providing the opportunity to show what the children can do in their home language. The overarching aim of the thesis is to provide a clearer picture of the alphabetic code-related skills (phonological awareness and letter knowledge) of Dhuwaya-speaking children and to examine the relationship between these skills and early word reading in Dhuwaya. The first major aim of the thesis is to investigate the various patterns and relationships found amongst the Dhuwaya-speaking children's performance on measures of letter knowledge, phonological awareness, and word recognition (in their home language). The second major aim is to investigate what effects, if any, a researcher designed Dhuwaya phonological awareness training program has on the development of phonological awareness, letter knowledge, and early word reading skills. Varied research methods were used to achieve these aims.

Quantitative data was collected to achieve the first research aim.

Phonological awareness, letter knowledge, and word recognition assessments were administered to all Transition (kindergarten) to Grade 4 students. Trends in the students' assessment outcomes were analyzed. An age of mastery was determined for each skill

measured⁴. Setting benchmarks is valuable because it can help identify students who may be at risk for reading failure. Patterns in the participants' assessment data were also analyzed to shed light on the relative difficulty of the various phonological awareness skills assessed. This knowledge is critical as it allows educators to create assessments and intervention programs that progress in a sequential order, allowing students to move from easier to more difficult tasks. A correlational method was used to investigate the relationships between the various skills measured. Specifically, the study examines the relationship between phonological awareness and word recognition, the relationship between letter knowledge and word recognition, and the relationship between phonological awareness and letter knowledge. This is a growing area of research as it provides an opportunity to ascertain which elements have the most facilitative effect on early reading acquisition.

A quasi-experimental pre-test/post-test method was used to achieve the second major aim of the thesis. I designed a Dhuwaya phonological awareness and letter knowledge training program that was delivered via a game-like iPad application (app). The participants interacted with the training app over the course of one school term. Phonological awareness, letter knowledge, and word recognition assessments were administered to the participants immediately before they started the training and again immediately after they finished the training. The participants' pre-test and post-test scores were compared to examine whether the training program was successful in increasing phonological awareness and letter knowledge, the skills explicitly taught in the training program. Changes in pre-test/post-test phonological awareness and letter knowledge

⁴ In this thesis, "the age of mastery" refers to the age at which children are able to obtain scores of 90% or higher on any given measure.

scores were then compared to changes in word recognition scores. The purpose of this comparison was to investigate whether phonological awareness training has a facilitating effect on the development of early word reading skills in Dhuwaya speakers.

The findings of this study will contribute to society considering that academic achievement plays such an important role in today's society. Indigenous children living in remote communities need to succeed in a formal Western school system in order to gain "power and independence" in the wider Australian community (Harris, 1990, p.5). This thesis will contribute to the growing body of literature focused on the academic needs of this particular group of children. Specifically, it will shed light on the development of early literacy skills in native Dhuwaya speakers. The findings will help researchers and educators create more effective home language literacy programs by highlighting the skills that make the biggest effects on early reading development in this specific language. This in turn, may help Dhuwaya speakers acquire home language literacy skills more effectively.

1.4. THESIS OVERVIEW

Six chapters follow this introduction. Chapter Two introduces the context in which this study takes place and highlights the unique situation of the current project's participants. The chapter begins with a description of the community and the school in which the current project takes place. It then looks at various factors critically affecting the early education of students in this particular context. Chapter Three describes the reading process and then hones in on the phonological awareness literature. Chapter Four

describes the methodology used in this thesis project. Chapter Five presents the results relevant to the first aim of the project, and thus discusses the various patterns and relationships found amongst the participants' performance on measures of letter knowledge, phonological awareness, and word recognition. Chapter Six looks at the results relevant to the second aim of the project. The effectiveness of the researcher designed Dhuwaya phonological awareness training program is discussed in this chapter. The thesis concludes with Chapter Seven which provides a general discussion of the findings. The similarities and differences between the current findings and previous research are discussed. The theoretical and practical implications of the findings are also discussed. This final chapter also addresses the limitations of the study and provides a window into future research.

CHAPTER TWO

2.0 ISSUES IN INDIGENOUS AUSTRALIAN CHILD EDUCATION:

A FOCUS ON YIRRKALA COMMUNITY SCHOOL

The purpose of this chapter is to introduce the context in which this study takes place and to highlight the unique situation of the current project's participants. The mechanics involved in the process of learning how to read are similar across cultures. However, contextual nuances in the children's lives cannot be dismissed when investigating how to best help a community of students learn how to read. This chapter begins, in section 2.1, with a description of the community and the school in which the current project took place. Then, four different circumstances affecting the early education of students in this particular context are discussed.

Section 2.2 focuses on the participant's language status and provides a thorough discussion on the history and importance of bilingual and bi-literate education for Yolŋu children. The section begins with a discussion on the benefits and grounding of bilingual education and why, if implemented correctly, it can be used as a tool to help facilitate the acquisition of first and second language literacy skills. This is followed by a brief history of the Northern Territory's bilingual education policy and Yirrkala community's response to the debate on bilingual education. This section closes with a short summary highlighting the implications for the current study. Section 2.3 focuses on the participants' home literacy environment and how it affects their early education. The chapter then moves into section 2.4 which covers attendance issues faced at Yirrkala

School. The next section addresses the shortage of qualified Indigenous staff. The chapter closes with a summary of the contextual issues mentioned.

2.1 PROJECT SITE⁵

This project takes place in a very remote Indigenous community in Northeast Arnhem Land, a region located in the Northern Territory.

2.1.1 Yolŋu People

Arnhem Land is a region located in the northern tip of the Northern Territory, Australia (Morales, Vaughan, & Ganambarr, 2018). The Indigenous people inhabiting the north east of this region are known as Yolŋu. Yolŋu continue to follow the belief systems and *rom* ‘ceremonial law/custom’ that were passed down to them by their early ancestors. They use a complex system of society-wide relationships, including a classificatory kinship system. Everyone and everything in the Yolŋu world is allocated to one of two moieties: Dhuwa and Yirritja. Dhuwa people belong to Dhuwa land, speak Dhuwa languages and perform Dhuwa ceremonies; Yirritja people are responsible for Yirritja land, speak Yirritja languages, and perform Yirritja ceremonies. Dhuwa and Yirritja are two halves of one whole; they connect to create one holistic group. For example, Yolŋu must marry a member of the opposite moiety. The moiety groups are further divided into smaller family groups called clans. Each clan has its own language, homeland, totem,

⁵ Parts of sections 2.1.1., 2.1.2, 2.1.3, 2.2.3 and 2.2.5 are published in Morales, Vaughan & Ganambarr-Stubbs 2018.

traditions, ceremonies, songs, creation stories, and dances. Yolŋu inherit their clan and moiety from their father.

It is critical to know one's place in this complex system, as membership in these groups governs how Yolŋu relate to one another and to the rest of the world. For example, when a Yolŋu passes away, their mother's mother's clan is responsible for carrying out specific ceremonies. As another example, any woman's child is also considered her sisters' children. Therefore, a Yolŋu child will call both his biological mother and all of her sisters *ngāṇḍi*, the Yolŋu term for 'mother', and a child's biological mother and her sisters will all call the child *waku*, the Yolŋu term for 'my child'. Each Yolŋu child must understand this rich and complex system of cultural knowledge, rights, and responsibilities to be a fully functioning member of the community. An individual's social position within this cultural matrix is not merely ideological: it is lived and actively negotiated every day. Language is fundamental to these processes, as both the means and an end goal of socialization processes (Ochs & Schieffelin 2011). The Yolŋu assistant principal of Yirrkala Community School, who was also born and raised in Yirrkala states that "without our language, everything is meaningless" (Ganambarr-Stubbs, 2016).

2.1.2 Yirrkala Community and Language

Yirrkala is a very remote Indigenous community in Northeast Arnhem Land in the Northern Territory; 25 km south-east of the mining town of Nhulunbuy and 700km east of Darwin, the territory's capital. The Methodist church established Yirrkala mission in 1935 bringing together different clans of Indigenous people from the Yolŋu block. The

different clans were compelled to live together by the missionaries but each clan originally lived on its own lands, now known as a clan's homeland. In the mid 1970s, a homelands movement began where clans moved back to their original lands to live in smaller communities (Yirrkala Literature Production Centre (Yirrkala LPC), 1991). Currently, the population of Yirrkala ebbs and flows as people live partly in the community and partly in their original homelands. However, if all members were present at one time, the population would be around 800.

Yolŋu Matha is a pan-dialectal cover term encapsulating approximately 30 language varieties spoken by Indigenous people in north eastern Arnhem Land. *Yolŋu* refers to the people while *matha* means 'tongue/language'. Each clan has its own variety of Yolŋu Matha, with many named after the proximal demonstrative, i.e. the clan-specific word for 'this' or 'here.' Although the different varieties of Yolŋu Matha might in linguistic terms be considered dialects of the same language, the social reality for speakers is that these are separate languages. The different clan languages are mutually intelligible, distinguished largely by grammatical morphology and some minor lexical differences (Amery 1993, p. 47). Although there are two different branches of Yolŋu Matha languages, shared features, as well as consistent contact between speakers of different clan languages, ensure mutual understanding between their speaker communities.

The result of this bringing together of different clans is that many distinct varieties of Yolŋu Matha are spoken in Yirrkala, with speakers of at least 18 different

Yolŋu Matha clan languages currently residing in the community⁶. In Yirrkala, Gumatj and Djapu have the largest speaker communities among these clanlects, and another four have more than 20 speakers. The rest have between one and five speakers, with several others no longer spoken. There is a further Yolŋu Matha dialect, Dhuwaya, spoken by all community members, regardless of clan affiliations (see discussion below). Although English is not a daily language, many Yirrkala community members have some proficiency due to the schooling system and the community's close proximity to Nhulunbuy; competence levels vary from very limited to relatively high.

Traditionally, children learn their mother's and grandmother's languages at a young age. As they become young adults, they begin learning their father's language, which is their own clan language. Learning one's esoteric clanlect is a crucial step in becoming strong in Yolŋu identity; it is through the acquisition of this language that Yolŋu learn about their rom and culture. They learn about their songs, their land, their ceremonies, and cultural responsibilities. Through their language they learn how they are connected to different clans and different lands: "It was not until I spoke in my own language, Rirratjinu, that my view of the Yolŋu world became more meaningful" (Marika, 2000). Yolŋu also learn to identify an interlocutor's clan affiliation by their speech, which allows them to determine their relationship with one another (Yirrkala LPC, 1991).

Currently, however, all children are acquiring Dhuwaya among their main languages and many continue to speak it during adulthood. Dhuwaya is different from the rest of the Yolŋu Matha varieties in that it has no clan affiliation: it is spoken by members

⁶ Dätiwuy, Djapu, Dhuḍi-Djapu, Djambarrpuyŋu, Marrakulu, Narranŋu, Gumatj, Gupapuyŋu, Maṅgalili, Munyuku, Maḍarrpa, Dhaḷwaŋu, Rirratjinu, Gälpu, Wangurri, Golumala, Djanu Warramiri, and Daymil

of all clans. It is a koiné language – a variety that has emerged from prolonged contact between speakers of different dialects⁷ of the same language, and in this case originating at least in part from community baby-talk registers (Amery 1993, p. 55). All of the varieties contributing to the emergence of Dhuwaya are Yolŋu Matha languages, and hence Dhuwaya comprises features from the different contributing clanlects. The process of koineization tends to involve various processes of simplification (Siegel, 1985) and Dhuwaya is indeed somewhat simplified (or, arguably, regularized (see Amery, 1993, p. 53-55)) in comparison to the clan languages (e.g. compare Dhuwaya’s four verb conjugation classes to Gumatj’s eight and Dhangu’s nine).

Dhuwaya is widely referred to as a *lingua franca*, as it was originally used as a common language in the community. Amery (1985) objects to the use of this terminology as the term *lingua franca* designates a variety needed for successful communication between speakers of different languages. He argues that Dhuwaya was never needed to facilitate communication amongst different clans since the Yolŋu Matha languages are mutually intelligible. Instead, Dhuwaya was created out of a social need “to stress solidarity within the peer group” (Amery 1985, p. 128). As such, he prefers the term ‘*communilect*’, as Dhuwaya is only spoken in Yirrkala and its surrounding homelands.

Community members are therefore typically multilingual. Language choice in any given situation is dependent on a complex of factors, including interlocutor, domain, and activity. Speakers may choose to speak their own language with everybody, although clanlects are most often spoken at home and with other members of the clan. Yolŋu also acquire the clan languages of other family members (certainly of their mother and

⁷ Recall that the different Yolŋu Matha varieties, while socially considered different languages, can be considered dialects in linguistic terms.

grandmothers, but frequently also others) and will use them accordingly. While most Yirrkala community members continue to practice multilingual traditions, many younger Yolŋu are shifting towards more frequent use of Dhuwaya, and the age at which people acquire their own clanlect is rising.

2.1.3 Yirrkala School Today

Yirrkala School runs a Two-Way program, incorporating both Yolŋu and Western language and knowledge systems throughout the curriculum. Community elders use *gaṇma* as a metaphor for the program: a place where a current of water from the sea (non-Indigenous knowledge) meets a current of water from the land (Yolŋu knowledge). At this place, the two “currents engulf each other, flowing into a common lagoon and becoming one” (Marika 2000, p. 47).

The school currently encompasses a FAFT program,⁸ preschool, primary school, and secondary program. It also offers extensive support to the nine homeland schools in the surrounding area. Around 100 students are enrolled across three classes in the primary school (Transition/Grade 1, Grades 2 – 4, and Grades 4 – 6) and a further 90 in three secondary classes (Grades 7/8, Grades 8/9, and Grades 10 – 12)⁹. This structure changes depending on the school’s needs, students’ attendance, the progression of students, and staff changes (Yirrkala LPC, 1991).

⁸ Families As First Teachers – a government program offered in remote communities to help parents support the early development of children aged 2 – 4.

⁹ The school does not have the resources or enrollment numbers to have individual class groups for each student grade level. Instead, students from different grade levels are grouped together into joined classes. Grade levels separated by a / or a – signify that those grade level cohorts are all placed together in the same class (e.g. Grade 2, Grade 3, and lower achieving Grade 4 students are placed in the same class).

Yirrkala School aims to follow a bilingual step model where there is a high emphasis on Dhuwaya instruction in the early years that decreases incrementally over time. Conversely, English instruction increases as students progress through their educational journey. While literacy is initially introduced in Dhuwaya, beyond Grade 9 instruction is given largely in English. Figure 2.1 offers a diagram of the bilingual step model that focuses on the estimated amount of time allocated to each language for each student grade level. Implementation of the step model is affected by: class groupings (different student grade levels in one class) and team teacher¹⁰ attendance (sometimes low due to cultural events and community obligations).

At present, the preschool is led by a qualified Indigenous teacher who is able to deliver both the English and Yolŋu program. Oftentimes, pre-schoolers' parents come to school to support their children. All primary classrooms have both a Yolŋu team teacher and a non-Indigenous classroom teacher who provides support in delivering the Dhuwaya program. Team teachers in turn support the classroom teacher by facilitating communication when needed (Yirrkala LPC, 2014). A Yolŋu team teacher delivers the primary school art program. Secondary classrooms do not have Yolŋu team teachers, partly due to limited funding, but also because of the transitional step-model nature of the program. However, a Yolŋu secondary tutor splits her time between the Grades 7/8 and Grades 8/9 classrooms, teaching Yolŋu Matha literacy (at least two hours a week) and maths in each classroom. The Grades 10 – 12 class does not have an allocated Yolŋu teacher but Yolŋu Matha activities are included in their curriculum as much as possible. Grade 10 – 12 students also participate in a three day clan language workshop every school term.

¹⁰ 'Team teachers' are Yolŋu teacher aides.

	Lessons in Yolŋu Matha	Conversion to hrs/mins	Lessons in English	Conversion to hrs/mins
Year 7	20%	1 hour 5 mins	80%	4 hours 15 mins
per day				
per week		5 hrs 25 mins		21 hrs 15 mins
Year 6	20%	1 hour 5 mins	80%	4 hours 15 mins
per day				
per week		5 hrs 25 mins		21 hrs 15 mins
Year 5	20%	1 hour 5 mins	80%	4 hours 15 mins
per day				
per week		5 hrs 25 mins		21 hrs 15 mins
Year 4	50%	2 hours 40 mins	50%	2 hours 40 mins
per day				
per week		13 hrs 20 mins		13 hrs 20 mins
Year 3	60%	3 hours 10 mins	40%	2 hours 10 mins
per day				
per week		15 hrs 50 mins		10 hrs 50 mins
Year 2	70%	3 hrs 50 mins	30%	1 hour 30 mins
per day				
per week		19 hrs 10 mins		7 hrs 30 mins
Year 1	80%	4 hours 15 mins	20%	1 hour 5 mins
per day				
per week		21 hrs 15 mins		5 hrs 25 mins
Transition	90%	4 hours 50 mins	10%	30 mins
per day				
per week		24 hrs 10 mins		2 hrs 30 mins
Preschool	95%	3 hours 50 mins	5%	10 mins
per day				
per week		19 hrs 10 mins		50 mins

Figure 2.1 – Bilingual education model at Yirrkala School (Morales et al., 2018)

The Two-Way curriculum incorporates a number of innovative programs developed by Yirrkala Community School. *Galtha*¹¹ Rom lessons focus on vital cultural and developmental knowledge, and are delivered by elders in language¹² in a more traditional setting (e.g. hunting, collecting paper bark). The *Garma*¹³ Maths curriculum has been developed to incorporate both Yolŋu knowledge systems and Western concepts (Marika, 2000; Durruwutthun, 1991; Watson-Verran, 1992). The Yolŋu section of the

¹¹ *Galtha* refers to the process of working together to reach an agreement.

¹² The phrase “in language” is used to signify that a speaker is using a variety of Yolŋu Matha as opposed to using English.

¹³ ‘Garma’ refers to a ceremony/place where different people join to make decisions together.

program encompasses two aspects: *gurrutu*, the complex systems of kinship that connect individuals and clans to each other; and *djalkiri* ('foot/footprint'), an individual's connections to the lands and waters their ancestors passed down to their clan. In the *Garma* curriculum, *gurrutu* is connected to maths (namely expressions of recursion), while *djalkiri* is connected to space/location.

All classroom resources required to run the Two-Way curriculum are produced by Yirrkala School's Literature Production Centre (LPC). Available literacy resources include ordered readers, storybooks, story sequencing cards, vocabulary cards, and school newspapers. School staff and myself are in the process of creating iPad literacy training apps and iBooks in Dhuwaya. Classrooms are colorfully decorated and equipped with a wide range of Dhuwaya resources including alphabet wall cards, informative posters, and *gurrutu* (kinship system) charts. Literacy worker staff positions are crucially filled by native Yolŋu speakers.

Yolŋu continue to take control within the school. The 2016 staff list includes 19 Yolŋu staff members, the same number as non-Indigenous staff members. Yolŋu fill all kinds of staff positions: teaching, linguistic, administrative, clerical, ancillary, and janitorial. A Yolŋu principal in training works alongside a non-Indigenous principal. The teacher-linguist is a senior Indigenous woman who works closely with Yolŋu teaching staff on the curriculum delivery. A Yolŋu senior cultural advisor ensures correct cultural protocols are followed for any events occurring at the school and acts as a family representative in the school. The Yolŋu Action Group continues to meet weekly to discuss day-to-day matters of the school and the Yambirrpa School Council meets each term to oversee all major decisions, with the intention of ensuring that schooling respects

Yolŋu beliefs and is in line with Yolŋu aspirations (both of these groups are strictly Yolŋu only).

It is clear that language plays a big role in Yirrkala School's curriculum, with equal importance assigned to both English and Dhuwaya instruction. Research suggests that bilingual programs are not only effective, but also rightful and beneficial for language-minority students (Baker, 2011; Brisk, 2006; Wigglesworth & Simpson, 2018). All Indigenous children have the right to be taught in their home language as acknowledged by the UN Committee on the Rights of the Child (Skutnabb-Kangas, 2015; Zmyvalova, 2015). At the same time, English schooling is critical considering that it is necessary if Indigenous children are to gain access to the wider Australian community. The following section details the language status of the students and on how to make the best use of the children's existing language skills at school.

2.2 LANGUAGE STATUS

The term 'majority language' is used to refer to the language spoken by the "socially and culturally dominant group" of a particular location (Eisenchlas, Schalley, & Guillemin, 2013). Majority languages generally "carry more prestige" (Dijkstra, Kuiken, Jorna, & Klinkenberg, 2014) and tend to be the language used in formal schooling. Students whose home language is the same as the majority language are referred to as language-majority students while students encountering a different language (any language other than the majority language) at home are termed language-minority speakers (August & Hakuta, 1997).

English is the majority language in Australia, and therefore academic success in Australia is highly dependent on Standard Australian English oral language and literacy proficiency. However, the participants in this study live in a remote Indigenous community where English is like a foreign language. As previously mentioned, Yirkala Community members acquire one or multiple varieties of Yolŋu Matha at home. Throughout the community, Yolŋu Matha is the daily language used by the Indigenous community. Therefore, the majority of Yolŋu children do not generally encounter English until their first day at school.

The need for minority children to achieve academic success in a dominant language is ubiquitous. However, it has been noted throughout the literature that differences in home and school language put children at risk for academic failure (August & Shanahan, 2006; Jones, Ostojic, Menard, Picard, & Miller, 2017; McKenna, Walpole, & Conradi, 2010). Thus, researchers have invested a lot of energy into determining how to best educate language-minority students. One innovative program model, bilingual education, has time and again proven to ameliorate the disparity between home and school language (Baker, 2011; Barnett, Yarosz, Thomas, Jung, & Blanco, 2007; Cummins, 2000; Farver, Lonigan, & Eppe, 2009; Ramírez, Yuen, & Ramey, 1991).

Yirkala community members have gone through great efforts to run a bilingual program at their school and they believe that using their language at school not only helps students understand curriculum material but also allows students to build a strong sense of identity. Although community members and school staff have put in prodigious efforts to run a successful bilingual program, reading outcomes are still falling short. Low Indigenous student outcomes have caused the Northern Territory government to try and

abolish bilingual education. However, a look at the vast research on bilingual education and on the history of Northern Territory government support suggests that the failure of Indigenous bilingual programs may be due to a lack of resources rather than a lack of time spent on English language literacy.

We now turn to a brief discussion on bilingual education. The research on bilingual education is vast. The next section will focus on bilingual education for language-minority students as it fits the scope of the present study.

2.2.1 Bilingual Education for Language-Minority Students: A Brief Overview

Children typically begin schooling with knowledge of their first language and developing cognitive abilities, and when these skills match those required in a school setting, children tend to be more successful. The linguistic and conceptual skills parents pass on to their children are culturally specific and serve as a scaffold for future learning (Schieffelin & Ochs, 1986). Typically, when children from mainstream homes enter mainstream schools, they build upon previous experiences refining existing skills fostered at home. For example, when parents model narratives to conform to school expectations children will have an easier time participating in classroom story time (Reeders, 2008). Building on children's previous language experiences strengthens their cognitive abilities and allows for deeper, more abstract thinking (Thomas & Collier, 1997).

For some students coming from different cultural backgrounds, skills acquired at home do not conform to those needed in a formal classroom and the skills these children

bring with them may not facilitate their transition into school. Instead of cultivating their existing abilities, they must begin acquiring new skills that align with those used at school. Furthermore, children can cultivate negative feelings towards their cultural background or gain animosity towards the school language when they are placed in English-only classrooms where their first language is replaced by a dominant language (Genesee, 1994). In order to ameliorate this disunion between young students' home and school language and cultural backgrounds, schools around the world have implemented bilingual programs.

2.2.1.1 Bilingual Education

There is no clear-cut definition for 'bilingual education.' Ovando, Combs, and Collier (2006) state that bilingual education does not refer to one uniform model of education, instead, it is a cover term used for a vast variable group of educational programs that function in more than one language. However, bilingual education is different from learning a language as a subject in school (Lotherington, 2000). Likewise, mainstream classrooms are not considered bilingual just because they have a large number of language-minority students (Baker, 2011). Bilingual education means learning through two languages; using two languages as mediums of teaching curriculum content (Garcia, 2009; Lotherington, 2000). Colin Baker (2011) adds that often, the term 'bilingual education' is used for programs using more than two languages for instruction. Ultimately, 'bilingual education' "is a simplistic label for a complex phenomenon" in

which more than one language is used as a teaching medium at school (Baker, 2011, p. 213).

2.2.1.2 Program Styles

There are many different types of bilingual education programs. There is no one-size-fits-all approach. Each community will have different needs and goals that determine how bilingual education is implemented in schools. A good bilingual program is well designed for the community of students it serves. Thus, good bilingual programs can have very different structures (Lotherington, 2000). This section discusses some of the most commonly described types of programs used to educate language-minority students. Most programs, however, do not fit neatly into any program type description (Baker, 2011). Additionally, programs labelled under the same name vary greatly in how they are implemented (August & Shanahan, 2006). However, in order to understand the research findings, it is necessary to have background knowledge on various types of educational models used for language-minority students and the terms used to describe them. Garcia states:

“The descriptions that follow are in themselves theoretical. In practice, all bilingual education types look different from the way in which they are described by scholars and teachers, as schools adapt them to the sociolinguistic landscape in which they exist, the diverse wishes of communities and parents, the realities of the teaching force, of

instructional material, and of the children's social and age situations.”

(Garcia, 2009, p. 123)

There are a few variations of non-bilingual educational programs for language-minority children. **Mainstreaming** occurs when language-minority children are placed in English-only mainstream classrooms alongside language-majority students without receiving any first language support. This is also called submersion education as language-minority children are placed in a sink-or-swim situation. Similarly, children placed in **Structured Immersion** programs do not receive any first language support. The difference from mainstreaming is that all students in a structured immersion classroom are language-minority students. In structured immersion classrooms, teachers do not use the children's home language but they do use simplified versions of the majority language in an attempt to make it easier for language-minority students to understand (Baker, 2011).

In some mainstream classrooms, language-minority students are pulled-out for part of the day to receive English as a Second Language (ESL) support. Some **ESL pullout** programs are geared towards acquiring English oral language proficiency through studying vocabulary, grammar and conversation (form). Others use **Content-based ESL**, which focuses on teaching English through using English to teach parts of the curriculum (function). Teachers make use of non-verbal communication such as gestures and visuals in order to help students understand the material. Teachers use slow, simple and repetitive speech to bolster understanding (Baker, 2011).

Transitional bilingual programs are weak versions of bilingual education (Baker, 2011). Transitional programs use the home language in the early years to facilitate content learning and second language acquisition. The home language is only used as a tool until students have gained control of the second language. As soon as students appear to have a grasp on the second language, all learning is done through the second language. The goal of transitional programs is dominant language monolingualism. The language-minority status of the child is seen as a problem that needs to be fixed by acquiring the majority language and assimilating to the dominant culture (Baker, 2011; Ruiz, 1984; Thomas & Collier, 1997).

Transitional programs are “weak versions” of bilingual education because they foster subtractive bilingualism which occurs when a child’s first language is replaced by a second language. The child’s first language ceases to be developed; it is subtracted as the second language is added (Garcia, 2009). Subtractive bilingualism can result in a child’s inability to acquire full mastery in either language (Ovando et al., 2006). Conversely, strong versions of bilingual education programs support ‘additive bilingualism.’ Additive bilingualism occurs when a second language is added to a person’s repertoire at no cost to the home language. The home language continues to be developed while students simultaneously acquire the second language (Garcia, 2009). The home language of the student is seen as a resource and a right (Ruiz, 1984). The goals of enriched educational programs are bilingualism, biliteracy and biculturalism.

Maintenance programs (also called developmental programs) foster additive bilingualism. Children’s’ home language continues to be a focus in school even after the majority language is acquired. Each language is used as a medium of instruction for

specified amounts of time each day. **Dual-language/Two-way** programs also keep both home and majority language central to the curriculum throughout the students' schooling. They differ from maintenance programs in that they are designed to cater to both language-majority and language-minority students. Schools try to create classrooms in which half of the students speak language A at home and the other half of the students speak language B at home. Although the home language is different amongst students, all students are immersed in an additional language part of the time and taught in the home language for the remaining time. In some programs the minority language is used 90% of the time in the first few years and then decrease incrementally, while the dominant language increases, as students progress through the school grade levels. In other programs, each of the two languages is used 50% of the time from the beginning to the end of schooling. Dual language programs are mainstream classrooms because there are students in the class who speak the majority language at home (Baker, 2011).

As previously mentioned, there does not exist a specific bilingual program design that can be regarded as the best model for all situations. The label of the program style is not as important as the characteristics of the program or of the characteristics of the students the program is geared towards (Cummins, 2000; Thomas & Collier, 1997). A good bilingual program caters to its students' needs and the wishes of their parents and is well planned and implemented (Baker, 2011; Cummins, 2000; Lotherington, 2000). Successful bilingual programs crucially support the development of both languages at school (Lotherington, 2000). Yirrkala Community School's step model can be likened to a maintenance program in which English is added to the students' repertoire at no expense to their home language, the development of both languages is promoted. The

goal of the curriculum at Yirrkala School is to foster additive bilingualism and biculturalism.

2.2.1.3 Debate, Research, and Rationale

Bilingual education is a controversial issue in many places as can be seen through policies such as California's Proposition 227¹⁴ and the Northern Territory's First Four Hours policy (discussed in section 2.2.3). Although supporters tend to be academics and opponents tend to be politicians, there are some academics that advocate English-only instruction (Cummins, 2000 and personal conversation with members of the University of Melbourne's Graduate School of Education). Opponents of bilingual education are driven by the time-on-task (or maximum exposure) hypothesis. Porter states:

“The evidence of direct correlation between early, intensive second-language learning and high level of competence in the second language is inescapable, as is the on-task principle – that is, the more time spent learning a language, the better you do in it, all other factors being equal.”

(Porter, 1990, p. 119)

However, international empirical evidence suggests bilingual education does not have any adverse effects on language-minority students' mainstream education and may even be beneficial for language-minority children (Cummins, 2000; Genesee, 1994). In

¹⁴ Proposition 227, passed in 1998, requires all public-school instruction to be conducted in English. Children who are not fluent in English may be placed in an intensive structured English immersion program for no more than one year. (Matas & Rodríguez, 2014).

fact, many studies show that minority students in bilingual programs tend to outperform their minority student peers in English-only schools (Ramírez et al., 1991). Furthermore, bilingual education gives children the opportunity to acquire grade level (or higher) proficiency in two languages (Barnett et al., 2007; Farver et al., 2009).

Bilingual education gives minority children the same opportunity mainstream children receive of enriching their first language and culture, which in turn fosters higher levels of cognitive growth (Thomas & Collier, 1997). Thomas and Collier (1997) found that the more first/home language (L1) academic and cognitive instruction a language-minority student receives, the better their second/non-home language (L2) academic and cognitive outcomes will be (given that they are also receiving substantial L2 support). The authors understand these results to be based on the fact that language is intertwined with academic and cognitive development. Children begin their cognitive growth as babies in the home in their home language. Students are able to think more profoundly and understand academic material better in their home language. Students' cognitive growth is truncated if they can only function in a second language when they start school because they are unable to think as deeply as they would be able to in their home language. This can be detrimental as it stunts English language learners' (ELLs) cognitive and academic growth making it even harder to catch up with their constantly advancing native English-speaking peers.

It can take many years for a language-minority student to acquire the level of L2 proficiency needed to understand academic content. Therefore, language-minority students in English-only programs may miss out on years of curriculum content. In an attempt to address the question regarding how much language proficiency is needed to

follow classroom instruction, Cummins (2000) proposed a distinction between basic interpersonal communicative skills (BICS, or conversational language) and cognitive academic language proficiency (CALP, or academic language). Conversational proficiency, or BICS, is acquired through every day interaction with community members outside of school. Academic language, or CALP, on the other hand is the academic school register and is cultivated through schooling. Conversational language skills tend to be acquired by immigrant second language learners relatively quickly because they are supported by contextual and interpersonal cues (such as pointing, head nods, eye glances, hand gestures, etc.) and are not cognitively demanding. Academic language skills, on the other hand, are harder and thus take longer to acquire as they are not supported by contextual or interpersonal cues and require cognitively demanding thinking.

While conversational L2 oral proficiency typically reaches age-level norms within two years of learning, academic L2 proficiency typically takes five to seven years (Cummins, 2000). This distinction was based on studies highlighting the fact that while students seemed to be fluent speakers of the L2, they were still performing poorly on academic aspects of the L2 (Skutnabb-Kangas & Toukomaa, 1976; Cummins, 1981b). The BICS/CALP distinction is supported by research. Based on evidence from a study examining the linguistic skills of language-minority students in the San Francisco Bay area, Hakuta, Butler, and Witt (2000) argued that it takes three to five years to develop conversational language skills while it takes four to seven years to develop academic language skills. Bilingual education gives language-minority students the advantage of

developing academic skills in their home language while they simultaneously develop academic language skills in the dominant language.

Bilingual school programs also allow minority students to maintain their cultural identity and positive self-esteem. A child's first language is appreciated and enriched while they add a second language to their repertoire. It is important for a school to have a positive attitude towards its students' culture because it instils confidence which is beneficial to student achievement (Baker, 2011). Home language usage also encourages parental involvement in a child's schooling and research indicates that parental involvement is important for student success (see section 2.3) (Cole, 2011). Social benefits of bilingualism also include cultural enrichment, improved intercultural communication, and enhanced employment and career prospects (Lotherington, 2000; Simpson, Caffery & McConvell, 2009).

There is evidence that bilingualism leads to various cognitive benefits as well. Bilinguals already have experience with learning an additional language, and therefore they tend to be better able at acquiring subsequent languages than monolinguals are (Baker, 2011; Garcia, 2009). Other cognitive benefits such as heightened metalinguistic awareness¹⁵ and flexible thinking have also been discussed in the literature. Bilingual children tend to grasp the abstract and arbitrary nature of language quicker than their monolingual peers do as a result of learning how to express the same meaning in different languages. Form and meaning are more separated for bilingual children giving them more flexibility with language (Garcia, 2009). Bilingual children have been found to have greater word awareness and faster semantic development. Bilinguals have also been

¹⁵ "Metalinguistic awareness is the ability to treat language as an object of thought" (Garcia, 2009 p. 95). It is the ability to think of the structure and form of language as opposed to its meaning.

shown to be better at sentence construction and grammaticality judgements (Bialystok, 1987).

Studies also give evidence of bilinguals having more divergent thinking than monolinguals (Baker, 1988). Each language has a different way of describing the world. Bilinguals are equipped with different ways of expressing themselves and the world around them, which allows for a more flexible understanding of the world around them (Garcia, 2009). Divergent thinking tests usually involve asking participants to create solutions to problems or to make a list of uses for certain objects (Garcia, 2009). May, Hill, and Tiakiwai's (2004) instructed participants to think of a paper clip and list all the things they could do with it. Bilinguals generated longer lists with more creative, unique and unusual responses.

2.2.2 BILINGUAL EDUCATION: FOCUS ON LITERACY

Learning how to convert written code into linguistic code is a universal aspect of literacy acquisition. All literacy learners, regardless of language, must learn how to map written symbols or letters to sounds (Sampson, 1985). However, L2 literacy has the added obstacle of understanding the spoken language, a prerequisite for mastering the association between the written and spoken forms of a language (August & Shanahan, 2006). Thus, oral language proficiency is an important component in literacy attainment. As a result, many researchers argue that students perform better when they learn to read in the language they know best (August & Shanahan, 2006; Ovando et al., 1996; Thomas & Collier, 1997; Verhoeven, 1991).

The principal advantage of learning how to read in the home language is that children begin acquiring pre-literacy skills in their home language and come to school on the first day of class equipped with these essential skills. As Devlin (2007, p.6) notes, by the time English-speaking students enter the classroom they have already acquired the following pre-literacy skills: “they know the sounds of English, have an understanding of the grammar of English, have an extensive English vocabulary, know a lot about the cultural context and patterns English speakers use when they are talking and usually know a lot about reading books and other kinds of print.” Indigenous children living in remote areas have very limited (or no) experience with these English pre-literacy skills. With the exception of being familiar with books and other kinds of print, Indigenous children have the same knowledge but in their own home language (Devlin, 2007, p.6). Learning to read in their home language would allow Indigenous children to draw on these previously developed pre-literacy skills.

If English is not the primary language spoken at home, and a child has never been immersed in an English-speaking setting by the time they are entering kindergarten, then the child could benefit from being placed in a bilingual program that introduces literacy through their first language and later (or simultaneously) adds English literacy (Brisk, 2006; Feinauer, Hall-Kenyon, & Davison, 2013). This would give language-minority children the opportunity to acquire and develop literacy skills through the language they have most command of. Children can transfer their previously acquired literacy skills to a second language once they have acquired a firm grasp on the concepts involved in literacy (August & Shanahan, 2006; Cummins, 2000; Feinauer, Hall-Kenyon, & Davison, 2013).

Cummins (1981a) Common Underlying Proficiency (CUP) model states that there is one central processing unit responsible for all of a bilingual's academic and cognitive functioning. All the information entered through both the minority language channel and the majority language channel gets fed into the same central processor (Cummins, 1981a). A person can obtain information from an unlimited number of channels. The only requisite is that the language is developed enough to process complex cognitive information (Baker, 2011).

A corollary of the CUP model is that information taught in one language does not need to be taught in the other. For example, if children have already learned to multiply in Spanish, they do not need to relearn how to multiply in English. English math vocabulary would need to be acquired but the cognitively demanding aspects required for multiplication are already intact. Cognitive functioning and academic concepts transfer between a bilingual's languages (Baker, 2011; Cummins, 1981a, 2000; Thomas & Collier, 1997). The Interdependence Hypothesis (Cummins) expresses this concept:

“To the extent that instruction in L_x is effective in promoting proficiency in L_x, transfer of this proficiency to L_y will occur provided there is adequate exposure to L_y (either in school or environment) and adequate motivation to learn L_y.” (Cummins, 1981a, p. 29)

The Interdependence Hypothesis explains the transfer of literacy skills between a bilingual's languages. Many of the skills needed to develop literacy in a second language are the same as those used in first language reading even when the languages do not share

a writing system: phonological awareness, scanning, skimming, understanding that written language represents spoken language, contextual guessing to words, skipping unknown words, tolerating ambiguity, reading for meaning, making inferences, monitoring, recognizing the structure of text, using previous learning, using background knowledge about the text, knowledge of text structure, rhetorical devices, sensorimotor skills, visual-perceptual training, cognitive functions, and many reading readiness skills (Baker, 2011; Ovando et al., 2006). The transfer of literacy skills is even more accessible when the two languages share writing systems (August & Shanahan, 2006) as is the case for English and Yolŋu Matha, both linked to alphabetic writing systems. The understanding of the alphabetic principle can be transferred between languages.

It is important to note that while many of the skills used in L1 reading transfer to L2 reading, they are not sufficient on their own and distinct skills particular to the L2 must also be learned. Some aspects of reading are language specific (Frost, 2005) because languages differ in their phonological and morphological structures and because languages use different writing systems that vary in the way they represent speech (Seymour, 2005). Logographic systems, such as Chinese, use signs to represent morphemes or words while syllabaries, such as Japanese kana, use symbols to represent the existing syllables of the language. Abjads (consonantal alphabets), such as Arabic, use letters to represent consonant sounds and leave readers to apply the appropriate vowels while alphabets, such as English and Yolŋu Matha, use letters to represent the consonant and vowel sounds that make up syllables and words (Borgwaldt & Joyce, 2013). See Borgwaldt and Joyce (2013) for a more thorough description of the different

writing systems used by literate societies today. Variation is also found within each writing system type (Miller, 2019).

Alphabetic orthographies vary in the degree of consistency found between grapheme-to-phoneme correspondences (Miller, 2019; Seymour, 2005). The correspondence between letters (graphemes) and sounds (phonemes) is highly regular, consistent, and transparent in some languages yet variable, inconsistent, and sometimes arbitrary in other languages (Seymour, 2005). That is, there is a one-to-one mapping between letter and sound in some languages while there are many-to-one and one-to-many correspondences in other languages (Goswami, 2005). There are differences between learning how to read in a language with a highly regular orthography and in a language with a highly irregular orthography as is the case with Yolŋu Matha and English (these differences will be discussed in chapter 4). However, L1 literacy benefits are not inhibited by orthographic differences. As previously mentioned, there are many universal literacy skills, such as print awareness, that can be learned in an L1 and later transferred to an L2.

Many researchers have investigated the effects that home language literacy has on L2 literacy attainment and they have not found any negative effects. On the contrary, research suggests that language-minority children taught to read in their home language tend to outperform their English-only taught peers on literacy tests (Farver, Lonigan, & Eppe, 2009; Greene, 1997; Ramirez, Yuen & Ramey, 1991; Slavin & Cheung, 2005; Thomas & Collier, 1997; Verhoeven, 1991).

Hancock's study (2002) suggests that children can better acquire the skills necessary for reading if they are doing so in a language that they are proficient in and

also provides evidence for the cross-linguistic transfer of these skills. The study tested the effects of first language books on pre-literacy skill development on 52 native Spanish-speaking five year olds and 25 native English-speaking five year olds. The parents of all the children were responsible for reading Families Reading Every Day (FRED) books to their children. Twenty-six of the native Spanish-speaking families were given Spanish FRED books, the parents of the remaining twenty-six Spanish-speaking families as well as the parents of monolingual English-speaking families were given English FRED books. These parents were tested to ensure that they could read, and they were also responsible for keeping a log of their readings. At the end of the semester, all students were tested for pre-literacy skills in English.

The Spanish-speaking students who were read to in Spanish (their first language) significantly outperformed the Spanish-speaking students read to in English on measures of pre-literacy skills. This outcome supports the claim that language-minority children could benefit from learning how to read in their first language. The Spanish-speaking group that was read Spanish FRED books performed at the same level as the native English-speaking group, demonstrating that home language literacy acquisition did not leave language-minority students at a disadvantage when compared to their monolingual English-speaking peers. On the contrary, the data suggests that the native Spanish speakers (read to in Spanish) were able to transfer pre-literacy skills acquired in their home language to pre-literacy tasks conducted in English and this resulted in them developing English pre-literacy skills at the same rate as native English speakers read to in English.

First language literacy plays an important role in the development of second language literacy because it allows children to develop literacy in the language they know best. However, first language literacy is not sufficient on its own; L2 oral proficiency must also be acquired. Students need L2 vocabulary knowledge in order to understand what they are reading. Furthermore, studies suggest that first language literacy skills can only be transferred to an L2 if a certain level of second language oral proficiency has been acquired (Bossers, 1991; Carrell, 1991; Clarke, 1980). Language-minority students could benefit from receiving intensive English oral language instruction while simultaneously acquiring first language literacy skills.

Another functional rationale of home language literacy instruction for Indigenous children is that the sounds used in Indigenous languages are easier to perceive (than English) even when hearing has been damaged. Otitis media (OM), inflammation and infection in the middle ear caused by bacteria or viral infection (Galloway, 2008), is pervasive in Indigenous populations with up to 67% of Indigenous people experiencing at least one type of OM in their life time (Butcher, 2013). OM causes temporary and permanent hearing loss in varying degrees. Australian languages have adjusted to this hearing loss by making use of coronal sounds, which are acoustically easier to perceive for people with OM-related hearing loss. Some of the sounds in the English language (peripheral sounds for example) are more difficult to hear for people experiencing OM-related hearing loss. Home language literacy instruction is acoustically advantageous for Indigenous children suffering from hearing loss. This advantage is important seeing that accurate speech perception is needed to correctly match letters to their corresponding sounds (Law, Vandermosten, Ghesquiere, & Wouters, 2014).

Another advantage of bilingual literacy programs is that they tend to include culturally relevant books, which helps to bolster reading comprehension for language-minority students (August & Shanahan, 2006; Baker, 2011). Droop & Verhoeven (1998) tested the reading efficiency and reading comprehension of Turkish and Moroccan language-minority children and native Dutch speakers all being taught in Dutch. All students were given different reading passages with content that was culturally familiar in either Turkish, Moroccan, or Dutch. All children scored higher on both reading efficiency and comprehension on the texts that were culturally familiar to them.

Various practical benefits of bilingual education have been discussed. It gives language-minority children the opportunity to learn how to read in the language they know best without hindering their ability to develop second language literacy. Home language literacy instruction is specifically beneficial for Indigenous Australian children because it reduces the risk of hearing loss playing an adverse role in literacy acquisition. Home language literacy programs also help increase the availability of culturally relevant books as they call for the creation of Indigenous language reading materials. Bi-literacy programs also have many social benefits for Indigenous children: they foster confidence and a positive sense of identity, they increase parental involvement and help at home, and they create opportunities to sustain language, culture and tradition. Minority language literacy instruction essentially gives the language increased status, function, and motivation (Baker, 2011).

It is clear that bilingual education has beneficial results when properly implemented. However, students at Yirrkala Community School are still achieving very low levels of literacy in both languages. The low achievement of these students must be

attributed to a lack of resources and support, not to bilingual education per se. We now look at Northern Territory policy on bilingual education.

2.2.3 Indigenous Australian Schooling and Northern Territory Policy

As previously mentioned, many Indigenous Australian children living in remote areas learn how to speak a traditional Indigenous language, a creole, a mixed language, or Aboriginal English at home. When they enter the formal Australian school system they are exposed to Standard Australian English, the language of education. For many Indigenous children, this is their first experience with the English language. Therefore, many Indigenous communities request that their languages be used at school alongside English.

The majority of Indigenous schools in the Northern Territory ran English-Only programs prior to 1973¹⁶ even though international support for the use of vernacular languages in formal schooling had been gaining momentum since the early 1950s. The advantages of vernacular language use are highlighted in the now-famous 1953 UNESCO report on *The Use of Vernacular Languages in Education* which argues that “pupils should begin their schooling through the medium of the mother tongue” and that “it is important that every effort be made to provide education in the mother tongue” (UNESCO, 1953 p.47-48). Many enlightened policy-makers, teachers, linguists, and missionaries working in the Northern Territory also advocated the use of Indigenous Australian languages in schooling (Gale, 1997). However, the Commonwealth

¹⁶ A small number of Indigenous schools used vernacular languages in the classroom; e.g., Hermannsburg Lutheran Mission (Nicholls, 2005).

Government, which had accepted the responsibility for the education of Aboriginal children in the Northern Territory in 1950, encouraged mission schools to adopt English-only programs in line with their assimilationist policies¹⁷ (Devlin, 2017a; Gale, 1990; 1997). Mission schools adhered to these recommendations because the schools accepted subsidies from the Commonwealth Office of Education on the condition that assistance would only be given to schools using English as the language of instruction (Gale, 1990; 1997).

The Minister of State for Territories, Paul Hasluck, commissioned a team of two to investigate the curriculum and teaching methods used in Indigenous schools in 1963 (Watts & Gallacher, 1964). This investigation, led by Betty Watts (then Lecturer of Education at The University of Queensland) and Jim Gallacher (then Inspector of Schools, Welfare Branch, Northern Territory Administration), resulted in the influential 1964 Watts-Gallacher report. The report acknowledged the diversity of language and culture found amongst Indigenous people stating that “heterogeneity is a salient characteristic of each Aboriginal group” (p. 8), highlighted the differences between ‘tribal beliefs’ and ‘European ways’, outlined principles that should underlie Indigenous schooling, and made recommendations on how to improve Indigenous student outcomes. Watts and Gallacher (1964) advocated bilingual education as the ideal approach to teaching Indigenous children in Northern Territory schools, stating that “it cannot be doubted that the language which should be used as the medium of instruction in the early years of schooling is their own vernacular language” (p.57). Still, they concluded that this approach was not feasible in Northern Territory schools for practical purposes such as

¹⁷ The 1937 Commonwealth Government policy on Indigenous people promoted assimilation and asserted that “any attempt at assimilation would have to be preceded by some system of education for the Aboriginal people” (Watts & Gallacher, 1964, p.26).

there being too many languages spoken in the area and too few vernacular primers and textbooks in existence.

In 1968, Joy Kinslow-Harris wrote an influential paper emphasizing the value of vernacular education and arguing that bilingual education was indeed achievable in some Indigenous schools. Kinslow-Harris (1968) convincingly disproved the concerns discussed in the 1964 Watts-Gallacher report and she outlined practical suggestions on how to implement vernacular literacy programs in Indigenous schools. She recommended using a 'team teaching' approach which would give Indigenous teachers the opportunity to teach in their vernacular language while working closely with a qualified non-Indigenous teacher. Her proposal was picked up by policy-makers and tabled at a National Workshop on Aboriginal Education organized by Betty Watts herself. The report from the National Workshop supported Kinslow-Harris's suggestions, claiming that "the majority of participants were strongly in favour of implementing such programmes as soon as possible, beginning with pilot studies in selected areas" (Watts, 1971, p. 207). The report ultimately made its way to the Labor Party and on December 14th, 1972 newly elected Prime Minister Gough Whitlam declared that: "The Federal Government will launch a campaign to have Aboriginal children living in distinctive Aboriginal communities given their primary education in Aboriginal languages" (Whitlam, 1972).

An Advisory Group was appointed by Kim Beazley Snr., the Minister for Education under the Whitlam Government, to make recommendations for the implementation and development of bilingual programs in Indigenous schools (Watts, McGrath, & Tandy, 1973a). The three-person Advisory Group on Teaching in Aboriginal

languages in Schools in Aboriginal Communities in the Northern Territory (the Watts Committee) consisted of Betty Watts, W.J. McGrath (Inspector of Schools, Aboriginal Education Branch), and J.L. Tandy (Department of Education, Canberra). The Advisory group convened in January and February of 1973. They visited potential schools and then wrote a report detailing their findings and recommendations (Devlin, 2017a).

The Advisory Group's report suggested that pilot bilingual programs be implemented in schools "where there is a single Aboriginal language acceptable to the community and where linguistic analysis and recording of that language are sufficiently advanced"¹⁸ (Watts et al., 1973a, p.50). The implementation of bilingual programs also depended on available school staff. Watts et al. (1973b) recommended that each classroom be allocated a teaching team. The team should include one Indigenous teaching assistant capable of delivering lessons taught in the vernacular language and one fully qualified non-Indigenous teacher who is both capable of delivering lessons taught in English and enthusiastic about supporting and training the Indigenous assistant¹⁹. The Advisory Group proposed that bilingual education be piloted in five communities that fulfilled these requirements: Angurugu (in Anindilyakwa and English), Areyonga (in Pitjantjatjara and English), Hermannsburg (in Western Aranda and English), Milingimbi (in Gupapuyngu and English), and Waruwi, Goulburn Island (in Maung and English). The program model recommended was a bilingual step model and the following principles were listed. The step model uses the vernacular language as the language of

¹⁸ Some missionary linguists had been studying the vernacular languages spoken by Indigenous people in their mission settlements. These missionary linguists tended to create orthographies for the vernacular language based off the Roman alphabet (Gale, 1997). See section 2.2.5.

¹⁹ This recommendation was proposed for the initial stages of the bilingual program. The Advisory Group noted that these circumstances could change as Indigenous teachers achieved full professional teaching qualifications. They noted that it might be possible for fully qualified Indigenous teachers to provide instruction in English (Watts et al., 1973b).

instruction and literacy in the early years while English is being taught as a second language. English literacy instruction would commence once the students mastered home language literacy skills and acquired English oral language proficiency. Classroom instruction would gradually transition to English for many parts of the curriculum as the students' English oracy and literacy skills improved. Language Arts in the Indigenous language and Indigenous studies classes would continue to be taught in the Indigenous language through the entire duration of the program (Watts et al., 1973a). The Advisory Group's report was unanimously approved by Parliament in March of 1973 and bilingual programs were implemented in the five pilot communities that same year (Devlin, 2017a; Gale, 1990; 1997).

The Advisory Group stressed the importance of recognizing and respecting the students' Indigenous culture, stating that "the school should be the agent of cultural continuity rather than of cultural discontinuity" (p. 47). Bilingual schools were to foster both biliteracy and biculturalism. This aim reflects the change that was occurring in the political sphere at the time. Government trends were moving away from assimilationist policies and moving towards 'self-determination' policies. As Nicholls (2005, p. 161) states:

"it is no accident that the year that the bilingual education programmes were introduced also marked the official abandonment of the Australian Federal Government's earlier policy of Assimilation of Aboriginal people".

'Self-determination' policies encouraged Indigenous participation and control in local community affairs and this included taking some authority over their children's education (Australian Law Reform Commission, 1986 (updated 2010); Nicholls, 2005). This

paradigm shift in government norms is reflected in Whitlam's bilingual education campaign.

The early years of the Bilingual Program (henceforth referred to as the Bilingual Program)²⁰ were characterized by intense enthusiasm and rapid expansion (Collins, 1999, p.121). By 1974, bilingual programs were underway in 11 Indigenous schools (Department of Education, 1974, p.5). A group of head advisors, later known as 'the Bilingual Unit', was appointed by the NT Department of Education in 1974 to navigate the development of a centralized program (Disbray, 2013). The School of Australian Linguistics (SAL), now the Centre for Australian Languages and Linguistics, was duly established in 1974 for the purpose of training Indigenous people as linguists and literacy helpers, therefore providing "much needed support to bilingual education programs" (Department of Education, 1974, p.9). The Indigenous teacher training program was expanded and relocated from Kormilda College in Darwin to the Vocational Training Centre at Batchelor College (now Batchelor Institute for Indigenous Tertiary Education (BIITE) where it could better accommodate the large intake of trainees enrolled in the 1974 school year (Kormilda College Yearbook, 1973; Uibo, 1993). A three-year teacher training course was offered for the first time²¹. Prominent linguists Geoff O'Grady and Ken Hale were invited to survey the newly established bilingual programs in June of 1974. In their report of their visit they stated that they were "extremely impressed with the Northern Territory Bilingual Program – so much so that we are inclined to assert that

²⁰ 'Bilingual Program' spelled with uppercase letters is used to refer to the consolidated Northern Territory Bilingual Education Program which encompassed all bilingual schools in the territory. The same words spelled with lowercase letters (bilingual program) are used to refer to individual school programs.

²¹ Prior to 1974, the two-year course was the most in depth course offered in the Indigenous teacher training program. The three-year course commenced in 1974 at Darwin City College but it was later moved to Batchelor in April of 1975 (Uibo, 1993).

this program constitutes one of the most exciting educational events in the modern world” (O’Grady & Hale, 1974, p.1).

The Bilingual Program initially received support from the Department of Education but their support quickly began to waver as the government’s attitude towards the use of Indigenous languages changed (Devlin, 1995; Disbray 2016). A period of consolidation was initiated as early as 1976 by a group of senior government administrators who felt that the rapid expansion was too difficult to sustain due to a lack of resources and skilled staff (Gale, 1997; Northern Territory Education Department, 1976, p.8). James Eedle, then Director, Northern Territory Division, Australian Department of Education, requested that “further expansion be limited and existing programs be consolidated and evaluated prior to an eventual decision as to which should be maintained indefinitely” (Eedle, 1976, p.2). Nevertheless, the Bilingual Program continued to grow owing to efforts put forth by local community members, school staff, and informed academics (such as S. Harris who advocated bilingual education) (Gale, 1997). Formally accredited bilingual programs were implemented in 20 schools across the Northern Territory by 1996 (Collins 1999; Gale, 1997).

The different aims for bilingual education listed by the Australian Department of Education in 1975 and then in 1982 highlight the government’s waning support for Indigenous language development. In 1975, the first aim listed was: ‘to help each child to believe in himself and be proud of his heritage by the regular use of the Aboriginal language in school and by learning about Aboriginal culture’ (Australian Department of Education, 1975, p.1). In 1982, the first aim listed was: ‘to develop competency in English (reading and writing) and in mathematics to the level required on leaving school

to function without disadvantage in the wider Australian community' (Northern Territory Department of Education, 1980, p.2). Criticism aimed at bilingual education began to grow. Opponents were concerned with the cost (for specialized teachers and Indigenous language materials) and the effectiveness of using Indigenous languages in school (Devlin, 2017b; Freeman & Staley, 2018).

In December of 1998, two government officials announced that the Northern Territory Government was withdrawing its support for bilingual education (Adamson, 1998; Reid, 1998). The decision to dismantle bilingual programs was based on the recommendations of an Education Review Task Group. The task group comprised four government appointees that did not have any direct ties with the communities and schools affected by this top-down decision (Devlin, 2017b; Nicholls, 2005). The Task Group claimed that their recommendations were based on conversations with Indigenous people who supposedly voiced concerns over the operation of bilingual programs in their communities. However, many Indigenous people expressed their frustration over the government making this decision without consulting members of the affected communities, many of who had worked hard to operate their bilingual programs (Nicholls, 2005). Another main reason given for the policy change was the alleged poor performance of students in bilingual schools when compared to their peers enrolled in English-only schools. Peter Adamson, then Minister of Education, told the *Alice Springs New* that "we looked at the statistics and bilingual communities, on average, are performing worse overall, and certainly in terms of numeracy and literacy specifically, compared to non-bilingual schools" (Chlanda, 1999). However, administrators never released any figures or statistical data to support this claim (Nicholls, 2005). Government

administrators claimed that a significant amount of money would be saved by phasing out specific funding for bilingual programs and that these savings could then be redirected more equitably into the development of English language programs (Devlin, 2017b; Reid, 1998). The government did not offer any advice in regard to what specific curriculum models should be used to replace the bilingual programs.

Many community members, teachers, educators, and linguists protested in defense of bilingual education (Devlin, 2017b). Many letters challenging the appropriateness of the decision were sent to the government from academics and organizations all around the world. This outcry was based on the lack of support for Indigenous languages in the classroom and not on the prioritization of English per se. Indigenous people expressed a desire for their children to learn English but not at the expense of their own Indigenous languages (Collins, 1999, p.121). The 1998 decision was characterized as an unlawful denial of human rights (Devlin, 2017b). A petition supporting the retention of the Bilingual Program was sent to Parliament on April 20th, 1999 with 2,443 signatures. This debate led to a government commissioned review of Indigenous education in the Northern Territory. The review was conducted by former senator Bob Collins and a small team of government officers (Collins, 1999). The aim of the review was to explore how the 1998 policy change could be implemented based on a detailed consultation with the schools and communities affected by the decision. Their terms of reference were to investigate the views and educational aspirations of Indigenous parents and community member in relation to their children's schooling, to provide an assessment of the main issues affecting educational outcomes for Aboriginal children, and to propose supportable actions for educational outcome improvements (Collins, 1999, p.1). The review's results

were presented in a report formally titled *Learning Lessons* (also known as the Collins report).

Learning Lessons called for the continuation of bilingual education attesting to community support. The authors explained that they received many written submissions and verbal opinions on the topic of bilingual education and that “with few exceptions, the submissions supported the retention of the bilingual program (Collins, 1999, p.120). The authors also claimed that “outcomes in bilingual schools clearly show positive outcomes compared with benchmark non-bilingual schools (p.122). The report recommended increased training and support for teachers, stressing the need for qualified TESL/TEFL teachers and more in depth research into Indigenous student pedagogy and learning outcomes. (Collins, 1999, p. 125). It also recommended a ‘rebranding’ of the program to be called ‘Two-Way Learning’. To this name change the government acquiesced, but to nothing further. Indeed, a number of programs were shut down during this period (Simpson *et al.* 2009). Furthermore, the programs that remained were now mostly ‘transitional’ programs rather than genuinely ‘Two-Way’.

The protest over the closure of the Bilingual Program was discussed in a report by the Human Rights and Equal Opportunity Commission (HREOC, 2000). HREOC (2000) maintained that the closure of bilingual programs touched on many human rights issues. They stated that both the failure to offer Indigenous students proper education and the disregard for Indigenous languages in school were in direct violation of human rights. HREOC pointed out the lack of Indigenous participation involved in the decision, and called it a violation of Australia’s commitment to respect self-determination rights. They argued that “the decision of the Northern Territory government to phase out bilingual education programs in government schools in Aboriginal communities amounted to a denial of their right to choose the mode of education for their children and threatens the viability of remaining languages (HREOC, 2000). The HREOC also pointed out how unfair it was to provide immigrant students with funding for ESL support while Indigenous children were not being offered any kind of language acquisition support.

The Northern Territory government backed down in its attempt to abolish bilingual education and 16 of the 20 programs²² survived the attack (Devlin, 2017b). Still, the government failed to implement any of the recommendations made in the Collins Report and it neglected to improve school conditions for Indigenous children. Support for ESL teacher training dwindled, resulting in a decline in the number of teachers qualified to teach English to second language learners. Opportunities for Indigenous teacher training also decreased, leaving the territory with a shortage of Indigenous teachers qualified to teach literacy in their own Indigenous language²³. The lack of qualified Indigenous teachers destroyed links between the formal school system and the communities leaving parents with less motivation to send their children to school (Simpson, Caffery & McConvell, 2009).

Criticism aimed at bilingual education continued to grow. The 2003 Ramsey report argued against the effectiveness of bilingual education in developing English language skills, claimed Indigenous language literacy was futile, and argued that Indigenous language revival was not a school responsibility (Ramsey, 2003). In 2007 an influential Indigenous leader, Noel Pearson, argued that the focus in formal schooling should be on obtaining mainstream Western education and that Indigenous languages and cultures should be taught in a separate domain (Pearson, 2007). He also argued that children needed to be exposed to English at an early age in order to become bilingual and that teaching in the home language in the early years was detrimental to their acquisition of English. Soon after, the Minister of Indigenous Affairs, Mal Brough, stated that

²² Refers to the Indigenous bilingual school programs operating at the time.

²³ This was in large part due to a reduction in Indigenous training from the Batchelor Institute for Indigenous Tertiary Education (BIITE) who previously provided in-community training and support. See Morales, Vaughan, & Ganambarr-Stubbs (2018) for more information.

children were not acquiring English because communities refused to learn English in favor of using Indigenous languages only (Simpson, Caffery, & McConvell, 2009). While these unsupported claims against bilingual education were gaining media attention, the researched reports drawing attention to the lack of resources in Indigenous schools were being ignored.

In 2007, the Wild-Anderson report on child abuse in the Northern Territory (formally titled *Ampe akelyernemane meke mekarle: Little children are sacred*) attributed children's poor performance in school to being taught in a language they did not understand (Wild & Anderson, 2007). The report urged the government to implement the recommendations made in the Collins Report/*Learning Lessons*, which called for the use of home language instruction in school alongside a focus on teaching English oral language proficiency. The Northern Territory government overlooked these recommendations. In the same year, the Australian Education Union released a report emphasizing the importance of bilingual education (Kronemann, 2007). The report, titled *Education is the Key*, also stressed the importance of properly teaching English oral language and attributed the failure of Indigenous schools to a lack of qualified teachers and resources. Like previous pro-bilingual reviews, this report did not gain much public attention and its recommendations were ignored by the Northern Territory government.

Shortly after, the economist Helen Hughes released an anti-bilingual education paper that did gain significant media attention (Hughes, 2008). Without providing any evidence or citing research, the Hughes paper asserted that bilingual education was detrimental to Indigenous students' scholastic outcomes. Hughes argued that bilingual education overlooks the fact that children lose the ability to learn a second language with

age. Hughes also inaccurately stated that all Indigenous children were being taught in their home language.

A few weeks later, Minister Marion Scrymgour announced a new direction for Indigenous education that focused on improving attendance rates and on increasing the number of teachers (Scrymgour, 2008b). The Minister was sure conditions would improve and called for the scores of the first National Assessment Program – Literacy and Numeracy (NAPLAN) tests to be posted on the Department of Education, Employment, and Training's website.

In 2006, the Australian Government decided to administer the NAPLAN tests to all children in Grades 3, 5, 7 and 9. Standardized tests, such as the NAPLAN tests, are used to create benchmarks that indicate the typical level of progress made by children at specific ages. The Literacy component of the NAPLAN test is designed to assess reading, writing and language conventions, specifically grammar, spelling, and punctuation (Wigglesworth, Simpson, & Loakes, 2011). The aim of NAPLAN testing is to collect data that could help educators and politicians identify schools and students in need of intervention and support. In order to fulfil this purpose, tests need to be made for the specific students being tested on. However, the same tests are administered to all children in formal Australian classrooms.

Second language learners of English should not be expected to reach the same benchmarks as monolingual English speakers. Longitudinal studies have shown that it can take five to ten years for English language learners to achieve grade-level norms on tests that measure English academic language development (Cummins, 2000; Thomas & Collier, 1997). Indigenous children are set up for failure when they are forced to take the

same test as their monolingual peers considering that English may be their second, or third, or fourth (and so on) language (Wigglesworth, Simpson & Loakes, 2011). Moreover, the expected cultural knowledge embedded in the exam may be foreign to Indigenous children living in remote communities. Nonetheless, all students are administered the same version of NAPLAN test regardless of linguistic and cultural background.

The results of the first NAPLAN tests, administered in May of 2008, were released on September 12th 2008 (ACARA, 2008). The results for Indigenous children were alarmingly low which galvanized politicians to focus their attention on this particular population of students. Indigenous children living in remote communities performed more poorly than Indigenous children living in rural communities who in turn performed more poorly than Indigenous children living in urban communities. The Northern Territory had the lowest scores of all the states.

On October 14th 2008, Marion Scrymgour, the Northern Territory Minister for Employment, Education and Training announced a first four hours in English initiative which became a de facto anti-bilingual education policy. She claimed her intention was to lift Indigenous students' English oral acquisition, literacy and numeracy levels:

“...the first four hours of education in all Northern Territory schools will be conducted in English. I am absolutely committed to making the changes needed to improve attendance rates and lift the literacy and numeracy results in our remote Indigenous schools” (Scrymgour, 2008a).

The announcement was made without consultation with any of the communities affected by the policy. Policy-makers did not provide any scientific research or evidence to support the idea that English-only education would be beneficial for Indigenous students. Upon closer look, there were only nine schools running bilingual programs in the Northern Territory at the time when the first four hours in English initiative was made. Not surprisingly, Indigenous students attending these nine bilingual schools slightly outperformed their Indigenous peers attending English-only programs (Simpson, Caffery & McConvell, 2009). The majority of these bilingual programs were dismantled with no advice on how to transition to English-only based instruction. In 2012, the first four hours in English policy was quietly removed from the Northern Territory Department of Education and Training's website. However, government support for bilingual education is still lacking across the territory.

This section served as a brief history of bilingual education in the Northern Territory showing that government policy has both created space for, and firmly excluded Indigenous languages from the schooling system. While in the seventies and eighties such top-down approaches empowered the classroom as a site for fostering community language use, the tendency in recent years has been towards the explicit or indirect dismantling of existing bilingual programs and the continued privileging of English-language instruction; as Nicholls (2005) describes it, 'death by a thousand cuts'.

2.2.4 The Fight for Bilingual Education at Yirrkala Community School

Yirrkala Community School was established as a mission school in 1939. At first, Yirrkala School was English-only²⁴: the use of children's home languages was banned at school (Marika, 2000). For many in the community, this linguistic barrier undermined existing local epistemologies and prevented real community engagement in the school program.

“[T]he missionaries didn't realise that when they stopped us speaking Yolŋu language in the school, they were stopping our way of thinking.”
(Marika-Munungiritj et al., 1990, p. 37)

Moreover, the use of English made it difficult for Yolŋu children to understand what was happening in school. Prior to the arrival of the missionaries, the Yolŋu people had had minimal contact with Europeans, and hence little exposure to English (Amery, 1985).

The missionaries did however introduce alphabetic Yolŋu Matha written language to the community²⁵. Joyce Ross, a missionary linguist, had been translating bible literature and hymns into Gumatj²⁶ in the early 1970s. Thus, when the bilingual education initiative was launched, Yirrkala School stood out as a feasible location to initiate a

²⁴ Amery (1985: 8) notes that early attempts were made to incorporate Yolŋu Matha in the curriculum, but these were stymied at the time due to the lack of an adequate orthography.

²⁵ The information on this process, and the early days of bilingual education, presented in this section was largely provided in personal interviews in November 2015 and February 2016 with Beth Graham, a former teacher at Yirrkala who was appointed bilingual coordinator when the bilingual program was being created. Where information is sourced elsewhere, this will be acknowledged.

²⁶ Gumatj is a clan-lect of Yolŋu Matha.

bilingual program: an orthography existed, the language had already been written down in church literature, a local linguist was available, and community leaders were supportive of the idea. As a result, a team of linguists, educators, and community members made a concerted effort to develop the bilingual program.

A major early challenge involved choosing which of the Yolŋu Matha varieties would be the language of instruction. Gumatj emerged as the best choice for the bilingual program for both practical and political reasons: Gumatj had already been studied and used in writing, and most members of the community understood the language. Moreover, the Gumatj were the traditional landowners of much of the surrounding area, and among the most populous and powerful clans in the community (Yirrkala LPC, 1991). The community understanding was that literacy skills in Gumatj would be easily transferable to other clanlects (Amery, 1985, p. 10).

Gumatj literacy and curriculum materials then needed to be created, but this task proved challenging due to a lack of resources. The Literature Production Centre did not yet exist, and there were perhaps only two Yolŋu people literate in his or her own language at the time. Furthermore, there was the significant challenge of harmoniously integrating the two languages' distinct ways of talking about and classifying the world into one curriculum, and expressing orally-transmitted stories into a written format. For the Yolŋu teachers this was a brand new experience:

“When we started biling. Ed (sic) the teachers found it hard to understand enriching first language. They had all been taught in a second language and teachers taught about another world. It took a while before they realised

what we were on about - a completely new concept but once they caught on they loved it.” (*Beth Graham email correspondence*, February, 2016)

As a result, the process of formulating well-written resources reflecting natural language use, and reshaping the curriculum to incorporate Gumatj, took the better part of the following decade. It was made possible only through constant cooperation between Yolŋu and non-Indigenous teachers, and support from Yolŋu elders.

The use of Gumatj at the school, however, had always been contentious for both political and linguistic reasons. Children learn culture and law through their own language, their mother’s language, and their grandmother’s language; language is a core aspect of Yolŋu identity. While parents for the most part consented to their children speaking Gumatj, many were concerned about it threatening the use of other clanlects.

“[A] lot of the people who live here are not Gumatj, and so when you start to tease it out, they could accept that Gumatj was used but they didn’t want it sort of replacing their own language.” (*Leon White interview*, November 2015)

And yet since Yirrkala had always been a community in which multiple related languages co-existed in a complex language ecology, Gumatj’s new status as a school language did not override entirely the existing dynamics of multilingual repertoires in contact. As a result, issues also arose due to the differences between the language used in the Gumatj readers and the language that children, and sometimes even teachers, were using. Reports

soon emerged that children were experiencing difficulties with the language differences, particularly with the suffixes, and so while the school continued printing materials in Gumatj, teachers informally used Dhuwaya in the classroom, especially in the early years (Amery, 1985).

In the mid-1980s, linguist Rob Amery came to Yirrkala to study and document Dhuwaya as a particularly linguistically interesting result of contact phenomena. In his interview, Leon White recalls how Amery's work encouraged the community to talk about what the children were actually doing with language (i.e. developing Dhuwaya as a primary/first language) and to consider this variety as legitimate and worthy of attention. Moreover, by this time classroom teachers, who had been reporting that the Gumatj stories were not always succeeding in engaging the students' attention, began to request more literacy resources in the variety they were all using everyday (Morales, Vaughn, & Ganambarr-Stubbs, 2018).

Dhuwaya was then presented as a good alternative for the bilingual program. It was a 'neutral' language in that it did not belong to a specific clan, and its use corresponded with the principle that children should be initially educated in the language they know best (Amery, 1985). It was also believed that using Dhuwaya at school would prevent further language change, as the variety would be subject to further codification and standardization processes. Since Dhuwaya was understood to be "the closest to [...] the baby talk, the lingua franca that the kids had sort of developed", many feared that it was a transitional stage towards "further creolization of Yolŋu Matha" (*Leon White interview*, November 2015), seen as an unfavorable outcome (Amery, 1993, notes that this concern is unfounded).

Thus in 1987 Dhuwaya was established as the language of instruction (Yirrkala LPC, 1991). Contention remains, however, over the use of Dhuwaya at school. Many Yolŋu still worry that the younger generation will not acquire their own clan language, and for some, Dhuwaya feels inappropriate for an academic setting:

“That was one of my *nhawi*²⁷, arguments, because they have changed it to Dhuwaya and when I went to school everything was full-on Gumatj and it was more...how can I explain it? It was more, you had more challenging. [...] [Gumatj] is strong and it’s more sort of...I think the way it’s structured, in a way it’s more of an academic way of language speaking. [...] [I]t was more powerful than Dhuwaya...[Gumatj] is more like Standard Academic English.” (*Banbapuy Whitehead* ²⁸*Interview*, November, 2015)

For some teachers and community members the ideal outcome would be the introduction of multiple clan languages to the classroom (*Banbapuy Whitehead interview*, December 2015).

2.2.4.1 Yirrkala Community School’s Response to First Four Hours

As previously mentioned, the 2008 decree that “the first four hours of education in all Northern Territory schools will be conducted in English” (Scrymgour, 2008a) led to the closure of most extant bilingual programs across the Northern Territory (Morales,

²⁷ *Nhawi* is a Yolŋu term meaning ‘whatchamacallit’.

²⁸ Banbapuy Whitehead is a Dätiwuy woman who is currently a senior teacher at Yirrkala.

Vaughan, & Ganambarr-Stubbs, 2018). The bilingual program at Yirrkala is unique because it continued to run in the wake of the 2008 first four hours policy. While government funding was not pulled entirely, the Department of Education actively pushed English-only literacy tests, strategies, and programs in the wake of this policy. This was met with great disappointment and frustration in Yirrkala community:

“[W]e, the old people, would be saddened by such an approach because our language comes from within the very essence of our being. It makes us who we are.” (*Going Back to Lajamanu - Interview with D. Marika*²⁹, 2009).

“Language is the key to our education. It’s us, it’s a mirror of our soul and when you look into a mirror it’s you, so that’s what language is.” (*Banbapuy Whitehead interview*, November 2015)

Nevertheless, in what had rapidly become a hostile policy context, the bilingual program at Yirrkala continued to run. The government revoked all personnel and resource support for the school’s bilingual program, and yet the school remained steadfast in their goal of educating Yolŋu children to be strong in their language and culture, through Yolŋu Matha language as well as the English language. The importance of English instruction was not undervalued, but the Yolŋu people did not want Western culture to replace Yolŋu culture in an assimilationist manner, and for some community members the First Four Hours

²⁹ D. Marika, now deceased, was the former chairman of the Yambirrp School Council.

Policy was understood to be merely the latest instantiation of a larger project to westernize Indigenous people:

“They want to try to westernize Yolŋu people. They want to leave us in a mainstream culture like a white man. That is a difficult part for us. We don’t want to live in that. We want to live in two worlds that we are comfortable and that’s one things our government are trying to close the gap to bringing us into a mainstream culture, into a mainstream world. And that is important that we as Yolŋu people need to be very strong in our own right identities.” (*Going Back to Lajamanu - Interview with D. Marika*³⁰, 2009)

School and staff members argued that the policy would hinder children’s scholastic success because of their unfamiliarity with the English language. “[I]t’s important for children to be able to understand and compare because children, if we teach them in one language all the time, English, the children will be bored and children will never get attention to that. The language is very strange to them” (*ibid*). In a letter to Scrymgour, one Yolŋu teacher wrote:

“We have been told we are not to use our students’ first language, only English. Well, I already know that the children won’t understand what I’m saying, they will laugh at me, and they may even misbehave because

³⁰ D. Marika, now deceased, was the former chairman of the Yambirrp School Council.

they'll be bored and won't know what the lesson is about. So perhaps I will cheat and use some Yolŋu Matha – what will happen then? Will I have my mouth washed out with soap like in the mission times? Or will I have to stand on one leg outside the classroom? Or perhaps I will lose my job?" (Y. Yunupingu, 2010)

The First Four Hours policy was finally dismantled in 2012, but this has not brought much relief for many who work tirelessly to defend bilingual education:

“One of the obstacles I’ve experienced in the continual politics that stands between bilingual programs, it brings me so much trauma and stress, and adds more strains and more pains. So often, our energy goes into defending the programs rather than improving them. I am an advocate for bilingual programs and I believe they are a good method to teach. They encounter Both Ways learning and shift the power balance and can empower Yolŋu teachers to contribute their knowledge.” (*Yunupingu, December 2015 presentation*)

Indeed, the policy threat to bilingual education remains. The 2014 government-commissioned Wilson report advocates English-only instruction, and recommends that all secondary students be sent to boarding schools in regional centers, further evidence that in attempting to ‘close the gap’, the government risks further undermining local community priorities and language maintenance.

Yirrkala community members have worked hard to keep their language at school, and yet government budget cuts have time and time again resulted in the loss of vital staff members. The school lacks resources critical to the successful full implementation of a bilingual program; this is in large part attributable to the continuing debate about the effectiveness of bilingual schooling, which is persistently deaf to academic research findings that demonstrate the efficacy and necessity of such programs (Morales, Vaughan, & Ganambarr-Stubbs, 2018).

2.2.5 A History of Writing in Yolŋu

As previously mentioned, Yolŋu culture is traditionally preserved and transmitted orally from one generation to another, the transfer of knowledge and culture is not dependent on written language. Thus, literacy was not a central part of Yolŋu life until non-Indigenous people invaded their land. The arrival of the first missionary linguists in the 1800s marked the beginning of writing practices in Indigenous languages. Some missionaries developed orthographies based on the Roman alphabet for the purpose of representing various Indigenous languages (Gale, 1997). Yolŋu literacy practices were originally forced on Yolŋu people by non-Indigenous people who were trying to use written language to ‘Christianize and educate’ them. It wasn’t until the end of the 20th century that Yolŋu people started using literacy to fulfil Yolŋu aspirations.

Gale (1997) distinguishes three historical phases in the development of writing in Indigenous languages in Australia: the Christianizing phase, the educating phase, and the Aboriginalization phase. Each phase directly contributed to the following phase and therefore the phases do not represent discrete points in time. The three phases are

differentiated by the types of products created and the different motivating factors behind their production (Gale, 1997, p.212). What follows is a synopsis of Gale's (1997) seminal work on the history of writing in Indigenous languages. Yirrkala is the primary case-study community discussed in Gale's book. Her work covers the history of vernacular writing in Yirrkala from the creation of Yolŋu orthography up until the 1990s. Personal observations about current literacy exposure are discussed at the end of this section.

The Christianizing Phase

The Christianizing phase covers the missionary era, beginning with the first arrival of missionary linguists (Gale, 1997). Missionary work centered around promoting Christianity and preaching the gospel with the ultimate goal of converting non-believers. The main goal of the mission settlements was to 'save souls' by 'Christianizing' and 'civilizing' the 'heathens' (p.53 & p.56). Attitudes towards the use of Indigenous languages varied among the different missionary societies. Many mission groups prohibited the use of vernacular languages in their teachings of Christian values. However, mission staff in other settlements made an effort to learn the local language because they saw the benefit of using Indigenous languages to communicate with Indigenous people and to spread the Christian message. Orthographies were created by missionaries to represent the vernacular language for the ultimate purpose of translating religious works. Missionaries also taught Indigenous people how to read and write in their vernacular languages so that Indigenous people could 'benefit from' the translated religious texts. Therefore, materials for teaching reading were also produced during the

Christianizing phase. A number of missionaries also created works typically created for language documentation such as word lists and grammars, mainly for non-Indigenous academic purposes. The key contributors of the Christianizing phase were missionaries and Indigenous ‘informants’, ‘language helpers’ and ‘co-translators’.

The Christianizing phase began in Arnhem Land in 1916 when the Methodist Overseas Mission began establishing mission settlements across the northern coast of Arnhem Land. Yolŋu literacy development began in one of these mission settlements, Milingimbi, when the Reverend Theodor Webb arrived as superintendent in 1926. Reverend Webb studied Indigenous culture and language and firmly believed that the Gospel needed to be delivered in a language that the Indigenous people could understand. He attempted to translate scripture into Gupapuyŋu, which was one of the various YM language varieties spoken in Milingimbi (Gale, 1997, p.86). However, Webb struggled because he did not have any linguistic training nor did he have staff that could help. Thus, little progress was made until Beulah Lowe arrived in Milingimbi in 1951.

Lowe was the first trained teacher appointed to the mission school. She had a flair for languages and was interested in learning the local language. Lowe began studying Gupapuyŋu as soon as she boarded the mission boat heading to Milingimbi and she continued to do so until her departure in 1977. She developed an orthography (described in section 4.2) and created various language lessons for non-Indigenous people including 60 grammar lessons, alphabet and pronunciation lessons, and a conversational course. Lowe initially focused on providing Gupapuyŋu language lessons to non-Indigenous mission staff members. She started translating the bible later on with the help of Indigenous language helpers, specifically. Together they translated 60 hymns and

choruses, ‘responsive prayers’, The Gospel of St. Mark, selections of the Old and New Testaments, and a Gupapuynu dictionary.

Joyce Ross, a mission school teacher, developed Yolŋu literacy in Yirrkala after her arrival in 1963. Ross did not begin official language study until 1966 when she began working in adult education (recall that mission schools in the NT were English-only at this time). She began studying the vernacular language with Yolŋu adults. Ross focused on Gumatj, one of the more common YM language varieties spoken in Yirrkala. She investigated the differences between Gupapuynu and Gumatj using Lowe’s work as a point of reference. Lowe’s Yolŋu orthography was used to create literacy works in Gumatj. Another mission teacher, Felicity Field, joined Ross in conducting Gumatj literacy lessons for adults. Ross created five Gumatj primers following the Gudschinsky method. The Gudschinsky method is a phonics based approach developed by SIL³¹ literacy expert Dr. Sarah Gudschinsky for the purpose of teaching adult literacy. Gumatj booklets were created in the adult literacy classes. Gale (1997) states that “all early Gumatj booklets that I have seen are of a religious nature” (p.95). The booklets recapitulate bible stories or describe actual religious experiences, and tend to teach moral lessons. Gale further states that themes in these early booklets reflect “the Christianising motives of Ross and Field in the running of their adult education classes” (p.96).

Ross and Field also spent nearly 15 years translating scripture into Gumatj, with the help of various Yolŋu people. They helped produce a Gumatj New Testament which was published in 1985. Gumatj renditions of Old Testament stories were also created during the Christianizing phase using blanks provided by the Bible Society. An SIL blank

³¹ SIL stands for the Summer Institute of Linguistics. This Christian organization works primarily in the field of Linguistics and bible translation. A specialized ‘Australian Aborigines Branch’ was formed in 1961 (Oates, 1999).

was used to reproduce Gumatj bible stories in comic-strip form. Moralistic stories were also translated into Gumatj using a Wycliffe Bible Translators blank.

The Educating Phase

The educating phase began when bilingual education was launched in the NT. Creating vernacular literacy materials was a critical step for the implementation of bilingual programs. The motivating factor during this phase was to ‘educate’ Indigenous people so that they could participate in the wider Australian community. The primary goal of bilingual programs was to help children acquire strong literacy skills in their home language that could later be transferred to learning in English. The main vernacular written works produced during the educating phase were primers, readers, booklets, magazines, and community newspapers. These materials were generally modelled off English curriculum materials used in non-Indigenous schools. These materials were produced in high volume following O’Grady and Hale’s recommendation to ‘flood the place with literature’ in order to encourage ‘rapid and effective attainment of literacy in the vernacular’ (O’Grady & Hale, 1974, p.3). The key contributors of the educating phase were school staff members (both Indigenous and non-Indigenous), especially those working in the LPCs.

As previously discussed, Yirrkala School commenced a bilingual Gumatj-English program in 1974. Bilingual education was largely made possible by Ross and Field’s early linguistic work. Ross’s five Gumatj primers, originally developed for adult education, were used to teach literacy at Yirrkala School. These primers include a series

of lessons that progressively introduce Gumatj phonemes, syllables, and words. Each lesson includes accompanying story texts that strictly use the words taught in previous and current lessons. The story texts associated with each lesson were written by Yolŋu adults but they were limited to words chosen by Ross and they generally followed English word order. Reading material was also provided by Field who gave the school a collection of Gumatj stories she had recorded on cardboard cards in her adult literacy classes. Illustrations were added to the cardboard cards, which were then laminated and used in the classroom. The stories were later used as source materials for printed readers.

The vernacular ‘literature flood’ began in 1976, with the guidance of Mary Fletcher (the first official LPC supervisor) and Beth Graham (the first official teacher-linguist). They were crucially helped by Yolŋu literacy workers such as Djilirma Munungurr and Wurrmitjin Munungurr. Materials produced during this phase were printed on a Gestetner machine or handwritten on cardboard cards. Sight words were originally printed on single sheets of A4 paper with accompanying pictures or on cardboard cards for classroom use. Sight word books were later developed to replace the A4 sheets. Children dictated personal stories to literate Yolŋu teaching assistants who would scribe their stories in personalized ‘language experience books’. LPC staff produced revised primers, sixty ‘supplementary readers’, and sixty phonics based workbooks. Literacy materials created during this time tended to revolve around familiar themes such as hunting trips. Existing English readers were subsequently translated into Gumatj in an attempt to diversify available reading material. Translated books did not turn out to be very helpful because the stories revolved around many foreign concepts and a lot of language play, such as rhyme and alliteration, was lost in translation. A new

set of primers, readers, and sight word books was created in Dhuwaya in the late 1980s when Dhuwaya replaced Gumatj as the YM variety used in school.

Literacy materials were a focal point of the educating phase but vernacular books were also produced to cover other subject areas. Vernacular materials were developed to cover the Indigenous maths program and the Indigenous studies program. Yolŋu literacy workers also produced environmental science booklets including a comprehensive resource book describing local flora and fauna. English texts were translated into Gumatj to be used in a health class. History books detailing Yolŋu people's interactions with the Japanese during WW2 were produced in 1987. A Yolŋu 'law book' was also created in 1987. This 'law book' covered topics such as the creation, totems, and land ownership. The LPC also printed *Yuṯana dhäwu*, the Yirrkala community newspaper. *Yuṯana dhäwu* covered community topics but one of the motivations behind its creation was to get parents and community members involved in literacy practices that could potentially benefit the students' literacy development.

The Aboriginalization Phase

The Aboriginalization phase began when Indigenous people started taking increasing control of local community affairs. This phase is characterized by the production of Indigenous-driven writing that "genuinely meet the needs and aspirations felt by Indigenous people (Gale, 1997, p. 156). This is in stark contrast to the Christianizing phase and the educating phase which were primarily driven by non-Indigenous aspirations. Many written works produced during this phase do not follow the literary

conventions adhered to by literate Western societies. Indigenous people are creating new literary genres leading Gale (1997) to argue that “we need either to redefine ‘literature (to incorporate ephemeral and other emerging vernacular forms) or to change our expectations about what constitutes valid written products...(p.39). The key contributors of this phase are Indigenous community members and Indigenous school staff.

Collaborative Yolŋu initiated writing began as early as 1963 when clan leaders worked together to write the Yirrkala bark petition (discussed below) but the Aboriginalization phase took off in Yirrkala in the 1980s and continues today. In 1984, two groups were created with the intention of finding ways to exert Yolŋu control of the school (Marika-Mununggiritj *et al.* 1990; Stockley *et al. forthcoming*). The first, the Yolŋu Action Group, consisted of all Yolŋu staff at YCS regardless of position: administrative, clerical, ancillary, linguistic and teaching staff (Marika *et al.* 1990). This working body met weekly and made decisions regarding the day-to-day issues of the school (indeed it was at the instigation of this group in 1987 that Gumatj was changed to Dhuwaya as the language of instruction at the school). The second, the Nambarra School Council (now called Yambirrp School Council), was made up of Yolŋu school staff from YCS and all Homeland Schools, as well as community members from all clans. The Council met several times a year and oversaw all major decisions across the schools, with the intention of ensuring schooling respected Yolŋu beliefs and stayed in line with Yolŋu aspirations (Yirrkala LPC, 1991).

Together, these two groups formed an ‘Aboriginalisation Plan’, with the ultimate goal of gaining complete ownership of the school for Yolŋu community members. School staff worked with community elders, writing down their ideas of how the school should

run and what should be included in the school curriculum. In 1987, Mandawuy Yunupingu was appointed as the first Yolŋu principal. By 1988 the School Council's new constitution was officially accepted, marking the formal introduction of 'Two-Way' education. This new paradigm was designed to ensure that community language and epistemologies would take equal centre stage, producing:

Yolŋu students who are balanced in both worlds: strong in their Western knowledge and English and strong in their own identity, cultural knowledge and language.

(Yirrkala LPC & Yolngu Action Group, 2011)

As previously mentioned, Yolŋu-initiated writing can be traced back to 1963. The Yirrkala bark petition was created as a sign of protest against the leasing of their land to a non-Indigenous bauxite mining corporation. The petition was unique in that it was written in diglot form, using both Gupapuyŋu and English, and it was mounted onto two large stringybark boards. The text is surrounded by paintings of totemic figures and other symbols that represent the various clans residing in Yirrkala. These paintings represent the united beliefs of the different clans in regard to rightful land ownership and to the land's spiritual significance for Yolŋu people.

The Aboriginalization of Yirrkala School led to the production of many written works that are uniquely Yolŋu in regard to structure, style, and function. Before this phase, the LPC mainly produced teaching materials that were carefully structured to help children learn about a specific topic. The LPC is now producing publications that record and report lessons that have already been taught both inside and outside of the classroom. *Galtha Rom* lessons (or Indigenous studies lessons) are context-based workshops taught in more traditional settings. For example, the *Biranybirany Galtha Rom* workshop took

place in a homeland center called Biranybirany over the course of a week. Students learned about the cycad palm and about the preparation of its nuts. Only Yolŋu students, teachers, and elders attended the workshop. *Galtha Rom* reports are unique school materials because their main purpose is to record (as opposed to teach) a workshop as a significant event that can later be remembered and reminisced. *Galtha Rom* reports are also unique because of their ephemeral nature. *Galtha Rom* lessons are not fixed parts of the school curriculum. Workshop content is renegotiated by Yolŋu elders every time a session is taught, ensuring that content is specifically relevant for the current time and place.

Production of an adult magazine called *YÄN* commenced in 1991. Gale (1997) argues that “*YÄN* seems to epitomize the aspirations of Yolŋu adults in the community of Yirrkala regarding the purpose of writing and the print media” (p.159). Gale lists six purposes of writing demonstrated in *YÄN*: to disseminate information considered important to the local and wider community, to serve as a forum where local issues can be constructively discussed, to celebrate achievements and events involving Yirrkala community members, to commemorate achievements and events involving the wider Indigenous community, to reminisce about how things were, and to entertain (Gale, 1997, p.159-160). Most articles are produced in diglot form so that they can be read by both Indigenous and non-Indigenous. Articles that are only produced in Yolŋu language signal that they discuss exclusively Yolŋu concerns. The magazine is full of line-drawn illustrations, maps, and photographs of contributors, local people, and familiar locations. Significant recent events are commemorated through colorful illustrations or pictures on the front cover. *Yuṭana dhäwu* is also a largely Yolŋu driven publication reportage in

nature. It differs from *YÄN* in that it features a lot of school and child based material such as *Galtha Rom* reports and school council meeting records. *YÄN* and *Yuṭana dhäwu* both highlight the ephemeral function characteristic of Yolḷu-initiated writing being that current events are the focus of both publications.

Another Yolḷu-initiated purpose for writing is that of ‘maintaining the Dreaming’. Dreaming stories can be likened to Indigenous creation stories – they are used to discuss aspects of Indigenous spiritual beliefs and existence. Traditionally, Yolḷu children learn about the Dreaming by walking through Yolḷu land with elders who use landmarks to interactively reveal a story. The settling of many non-Indigenous people on Yolḷu land has made this difficult. One way Yolḷu have maintained their Dreaming stories is by audio recording clan songs and narratives. Yolḷu literacy workers started recording Dreaming stories in written form to help preserve them for future Yolḷu generations. These publications were produced in diglot form for the purpose of educating non-Indigenous people about Yolḷu culture in the hopes that non-Indigenous people would take better care of Yolḷu land.

Yolḷu also started publishing original stories for entertainment purposes during the Aboriginalization phase. These stories mirror traditional story telling styles in various ways. Many are layered in meaning and touch on Yolḷu cultural practices and beliefs. They also tend to use a lot of direct speech, repetition, and onomatopoeic devices.

Current Literacy Environment

Literacy exposure has come a long way in the past 85 years. Children growing up in Yirrkala today are exposed to a decent amount of written material in English and YM both inside and outside of school. English literacy and curriculum materials are abundant. The vernacular materials created throughout Gale's three phases are still available today and the LPC has produced many more publications and literary works in the 20 years since Gale's book was published. The vernacular written works being produced at school today are reminiscent of both the educating phase and the Aboriginalization phase as Yolngu and non-Indigenous staff continue to work together to deliver the 'Two-Way' program.

Modern technological advances have provided countless reading and writing opportunities in English. Computerized literacy training programs and online books grant children access to a countless amount of reading resources. Children can also use the internet to learn about any topic if they know how to read (to gather information) and write (to search for information) in English. Yirrkala School has a computer lab and every classroom is provided with iPads so students are exposed to all of these literacy resources but typically in English only. Children are also exposed to written English when they watch YouTube videos, TV shows, and movies and when they use phone and iPad apps. YM language IT resources are incredibly scarce, although an effort has been made in the past three or four years to create computerized YM resources. Yolngu staff members are working with non-Indigenous staff members and researchers to create YM literacy training apps and online games. Many vernacular books are being digitized, some

being scanned and archived online and others produced in iBook form. An LPC worker and a few non-Indigenous staff members attended a school funded iBook creation workshop while I was conducting my research. Teachers from Yirrkala School and teachers from some of the surrounding homelands have also shown me YouTube videos they are creating with the students using oral and written YM. Text messages and facebook messages are generally written in YM (this is the only technological use of written language primarily carried out in YM).

Children are exposed to written YM outside of school to a limited degree. Street signs, building signs, and community announcement posted around the community are usually written in YM. Descriptions for art pieces in the famous Yirrkala Art Centre are usually produced in diglot form using both YM varieties and English. Written English is much more common than written YM outside of school. English writing is also used on street signs, building signs, and community announcements. The vast majority of written language in the nearby town of Nhulunbuy is in English. All goods (food, cleaning supplies, magazines, toiletries, etc.) bought in Yirrkala and Nhulunbuy shops are covered with English writing.

2.2.6 Language Status Discussion

It is a well-known fact that language-minority status is a significant risk factor for poor literacy skills (August & Shanahan, 2006). Many schools around the world have adopted bilingual education programs in order to prevent reading failure for language-minority students. The participants in this study fall into this category. Yirrkala Community

members have fought to keep their language, Yolŋu Matha, in the school for two main reasons: a) so that students can better understand curriculum content and b) so that students can develop strong Yolŋu identities as language is a necessary part of Yolŋu culture. Despite this effort, Yirrkala community students continue to develop extremely low literacy levels in both languages. Although NAPLAN testing is not a good indicator of what children can do with language, especially in their home language, I can tell from personal observations and testing that the students' first and second language literacy skills are extremely low (see Chapter Six for first language word recognition skill levels).

The Northern Territory government has attributed remote Indigenous students' low literacy levels to a lack of sufficient English language instruction which has lead them to diminish their support for bilingual education. However, across studies, properly implemented and well-resourced bilingual programs have proven to prevent reading failure and help language-minority students catch up to their native English-speaking peers on literacy measures. Thus, the low academic performance of Indigenous Australian students is not a result of bilingual education per se, but a result of poorly implemented and resourced programs. Furthermore, all children hold the right to be educated in his or her own language, a right acknowledged by the United Nations Committee on the Rights of the Child (Skutnabb-Kangas, 2015). Yirrkala community members have been steadfast in their fight to exercise this right.

Attention should be directed on obtaining research that focuses on how to best support remote bilingual Indigenous programs. In order to investigate how to best support a school, attention must be turned towards the unique characteristics and needs of the student body. Crucially, research must be aimed at uncovering how to best develop

literacy and curriculum content skills in the students' home language. The current project adheres to this need by researching the development of early home language literacy development.

Another unique characteristic of the current participants is that of their home literacy environment and the literature shows that home literacy environment plays a crucial role in a student's academic success. We now turn to a discussion on the home environment of Yolŋu children.

2.3 HOME LITERACY ENVIRONMENT

Children's language development and educational success is greatly impacted by their home and family environment (Cole, 2011; Weinberger, 1996). Academic success, literacy acquisition included, is affected by various family background variables such as socio-economic status, family size, parental education, and parental involvement (Snow, et al., 1998). Of all of these factors, parental involvement is found to have the biggest impact on student outcomes (Cole, 2011). Children begin learning at birth making parents their children's first educators. Moreover, children spend more time with their families and communities than they do in formal school settings (Weinberger, 1996). The Roushdale Metropolitan Borough Council (2006) claims that children spend 85% of their total time with their families, parents, and communities and only 15% of their time at school.

Parental involvement encompasses various different actions, many of which have been found to play a role in children's literacy attainment. For example, parent-child joint

literacy practices, practices such as reading and dissecting story books aloud together, singing the alphabet song aloud together, and working on homework together, have all been found to have positive and significant effects on children's literacy development (Bus, van IJzendoorn, & Pellegrini, 1995, Tam & Chan, 2009; Weinberger, 1996). Studies have also suggested that children's reading book levels are significantly related to the availability of literacy materials in the home (Weinberger, 1996). Parents participate by providing their children with literacy materials such as storybooks and alphabet games. Furthermore, parents contribute to children's interest and attitude towards reading by exhibiting an interest and positive attitude towards education, highlighting the value of reading, and modelling literacy behavior by reading independently in the presence of their children (Phillips, Flynn, Tabulda, Jangra, & Lonigan, 2013; Phillips & Lonigan, 2009; Rowe, 1991). In general, children with more reading experience at home are more likely to independently engage with storybooks at school (Weinberger, 1996).

Parental involvement effects are mediated by culture. Different cultures have different "ways of taking meaning from written sources" (Heath, 1982b, p. 50). Some cultures extract meaning from literacy events in a way that aligns with school practices, other cultures diverge from the mainstream. Children are at an advantage when their home and school literacy practices overlap. Contrastively, difficulties arise when children's home and school literacy practices differ (Heath, 1982b). The children participating in the current thesis project present a unique case study because they come from a community whose early home life does not bolster early literacy acquisition in the same way as mainstream Western children's home life does.

Mainstream Australian parents tend to begin their children's scholastic education at home. They use the same pedagogy, and often times the same language used in school because oftentimes that is the way these parents were taught. The child's home environment thus presents itself as a framework for later learning in the formal schooling system. Furthermore, they come from communities that place a high value on reading ability and as such mainstream Western children are surrounded by reading activities. These children are heavily supported in their quest to acquire literacy skills because they receive help both at home and at school. The same literacy support is not common in Yolŋu homes.

Yolŋu people have a unique worldview and they value knowledge systems very different to mainstream Western knowledge systems. The practice of sending children to formal schools with the sole purpose of acquiring knowledge is novel for many Indigenous people. The formal classroom where children learn about abstract and hypothetical situations is also new. Traditionally, knowledge is passed down to Yolŋu children by their parents and community members through hands on learning.

Bavin (1993) and Christie (1985) argue that traditional Australian Aboriginal cultures³² view children as autonomous independent beings who learn by actively participating in society. Adults do not constantly instruct and reprimand children. Instead, learning happens naturally and informally (Bavin, 1993; Harris, 1990) and takes place through observation and mimicry (Christie, 1985; Harris, 1984). Children learn by watching adults perform daily tasks and then imitating them. Harris (1984) argues that

³² There is a danger in discussing "contemporary Aboriginal culture" as this term is an overgeneralization and each Indigenous community is unique with its own language and culture. In this paper I am speaking about Indigenous communities living in remote areas where contact with mainstream Australians is limited.

children learn through “trial-and-error” rather than through formal learning. For example, choreography for a dance would not typically be taught to an Aboriginal child by demonstrating separate movements which are eventually put together. Instead, the child would perform the entire dance from beginning to end from the very first time, as they try to imitate adults. Moreover, learning is accomplished by repetition. One must repeat a process until he or she accomplishes the task (Harris, 1984).

Yolŋu children are familiarized with this Indigenous pedagogical system at home and they are introduced to themes valuable to Yolŋu traditions, beliefs, and daily life such as ceremony mechanics and hunting. The curriculum content taught in formal schools is not of high value or interest to many Yolŋu parents. Many Yolŋu parents are not familiar or well educated on many of the concepts taught in school. Therefore, many parents do not feel comfortable or simply are not interested in discussing such concepts with their children. It is not common practice for parents to ask their children about what they learned at school or to help them finish their homework.

Furthermore, the children in this study come from a community whose culture has been primarily transmitted through oral language. The use of written language for the transmission and emission of knowledge was only introduced about eighty years ago. Many parents and grandparents have not acquired proficient literacy skills in any language. Therefore, early literacy practices do not tend to be reinforced in the home where the children spend the majority of their time. Many Yolŋu children do not encounter literacy events or partake in literacy practices at home. It is not common practice for parents to read bedtime stories to their children, sing the alphabet song and rhymes, or partake in alphabet games with their children.

Clearly, Yolŋu children's home and school learning environments are very different. The knowledge passed on to Yolŋu children at home by their parents is culturally specific and diverges from the knowledge the students are being taught by their teachers at school. Thus, Yolŋu children come to school with a different set of skills than their mainstream Australian peers. Generally, early literacy skills are not part of the children's existing skills until they enter the schooling system because this is where they tend to be introduced to literacy practices for the first time. It can thus be surmised that needs and benchmarks for these children will be different than the needs and benchmarks for mainstream Western children.

Parental environment is related to the current project in two ways. Firstly, the creation of home language IT resources may help improve the home literacy environment. Children can independently engage in literacy events at home as computerized apps and interactive books talk children through exercises via the software's voice-over. Secondly, this section sheds light on the importance of cultivating home language literacy. Children who learn to read in Yolŋu will become parents proficient and interested in Yolŋu and English literacy. These parents in turn will be better able to help their children in their quest for literacy attainment.

2.4 ATTENDANCE PATTERNS

As mentioned in the previous section, Australian children only spend about 15% of their total time (per year) at school (The Rouchdale Metropolitan Borough Council, 2006). On top of that, attendance rates are very low for remote Indigenous schools meaning that

students spend even less than 15% of their total time at school. Therefore, the amount of time remote Yolŋu children spend on literacy training and activities is minimal.

Average attendance rates for Indigenous students across the Northern Territory are significantly lower than the average attendance rates for non-Indigenous students (Northern Territory Government: Department of Education, 2016). The average attendance rate of Territorian Indigenous students for the second term of the 2016 school year was 67.5% compared to Territorian non-Indigenous students' 89.2% average attendance rate. Furthermore, Indigenous student attendance rates vary significantly by geolocation. Indigenous students attending provincial schools have higher attendance rates than their Indigenous peers in remote schools, who in turn have higher attendance rates than their Indigenous peers in very remote schools. The average attendance rates for Territorian Indigenous students in provincial, remote, and very remote schools for the second term of the 2016 school year were 82.9%, 74.6%, and 59.6%, respectively. Attendance rates also vary by region with the Arnhem Region constantly obtaining the lowest attendance rates (Northern Territory Government: Department of Education, 2016). Compare Arnhem Region's attendance rate of 50.3% for the second term of the 2016 school year to the overall average attendance rate of 67.5% for all Indigenous students across the Northern Territory. Enrolment and attendance data from 2011 onwards is made public on the Department of Education's website. Similar attendance patterns are found across the years highlighting a constant attendance problem in the region where this project takes place (Northern Territory Government: Department of Education, 2016).

Various reasons exist for Arnhem Land students' low attendance rates. Mobility between communities is very high with Yolŋu families constantly travelling between Yirrkala and the Homeland Centers. Additionally, many traditional Yolŋu ceremonies take precedence over school attendance and some of these ceremonies can last weeks or even months. Moreover, student and parental engagement with formal schooling can be low which results in parents allowing their children to constantly stay at home.

As previously mentioned, the practice of sending children to formal classrooms for the purpose of acquiring knowledge is novel for Yolŋu people. The first school was only established eighty years ago and attendance was enforced by non-Indigenous invaders. Moreover, the largest motivator for sending children to school is to help them achieve Western academic success. However, in order for an Indigenous student to attend tertiary education, he or she would have to leave their community which may not sound so appealing to a parent. Another motivator involves gaining career opportunities in the wider Australian community which also demands that a child leave the community. Thus, in many cases the outcome of academic success is leaving the community for further academic or job opportunities.

Yirrkala Community School has made a concerted effort to improve student attendance. Every morning a group of 'Yellow Shirts' (Indigenous community members dressed in yellow shirts) drives around the community knocking on doors encouraging students to come to school. Every Monday at the school assembly, each student with perfect attendance for the previous week is awarded with a certificate and a free treat at lunchtime. At the end of each school year, a \$30 gift voucher for a local store is awarded to every student obtaining a yearly attendance rate of 80% or higher. Children with the

top attendance rates for the year are rewarded with iPads. Additionally, the three families with the highest cumulative attendance scores receive a big prize such as a new refrigerator or washing machine. Despite all these efforts, attendance rates at Yirrkala School remain low. The school's average attendance rate for the fourth term of the 2015 school year, the term in which the experimental phase of this study took place, was 42.0%.

Attendance patterns are relevant to the current study for two reasons. The first reason is concerned with the design of the current project and will be discussed in section 4.3. The second reason pertains to the possible benefits of using a computer-based program for the phonological awareness training program. School funding is dependent on attendance patterns. Low attendance rates mean that the school has limited funding, which in turn curtails the amount of staff that can be hired. As a result, children from various school grade levels are grouped together into one classroom. To add to this, it is common for a student's attendance to be very erratic throughout the school year. Students may be absent for months at a time, which means that they will have missed a significant amount of curriculum instruction by the time they return. Therefore, teachers have the added difficulty of managing classrooms with students at various different levels. Computer-based educational programs allow students to work at their own pace. Delivering a phonological awareness-training program via an iPad app creates the opportunity for each student to receive one-on-one attention at the level that they are at.

Attendance is also problematic for Indigenous teachers as they are required to prioritize cultural ceremonies over work. This is problematic as the number of existing

qualified Indigenous teachers is already dismal due to diminished in-community training. We now address the topic of qualified Indigenous teachers.

2.5 SHORTAGE OF QUALIFIED INDIGENOUS TEACHERS

As mentioned in section 2.2.3, opportunities for Indigenous teacher training have diminished (Morales, Vaughan, & Ganambarr-Stubbs, 2018). In the 1970s and 1980s, the Batchelor Institute for Indigenous Tertiary Education (BIITE) offered a very successful program called the Remote Area Teacher Education Program (RATE). The RATE program offered in-community training; tutors delivered the program lectures onsite so that students would not have to leave their communities in order to earn their teacher qualifications. The program content was adapted for each community, focusing on the “real and immediate classroom and community issues” related to each community school so the course material was immediately applicable (Huijser, Ober, O’Sullivan, McRae-Williams, & Elvin, 2015). Moreover, RATE tutors tended to be community school staff members allowing for a tight relationship between RATE tutors, RATE students, and the community school.

The RATE program was dismantled in the late 1990s due to funding cuts and the difficulty of finding qualified tutors. Batchelor Institute continues to offer Indigenous teacher training on-campus in Batchelor, Northern Territory. Completion rates were high for the RATE program because students could stay close to their families. On-campus programs can be very unappealing because they require Indigenous students to leave their

communities. As a result, the number of qualified Indigenous staff has declined generously over the years.

Because the number of qualified Indigenous teachers in any given community is limited, Indigenous teachers may have to spread their time out in various classrooms. For example, at Yirrkala Community School, the middle years Indigenous tutor splits her time up between two classrooms. On top of the fact that available Indigenous staff is already limited, the Indigenous teachers' school attendance may dwindle due to cultural obligations and ceremonies of higher priority. If Indigenous team teachers are absent, then the Yolŋu curriculum does not get delivered to the students on a daily basis as planned.

The shortage of qualified Indigenous teachers is relevant to this study because it highlights the possible benefits of using a computer-based phonological awareness-training program. Initially, students may need help as they learn to use the program but they should eventually be able to work through the program independently. Students can then continue to develop phonological awareness skills in the absence of an Indigenous teacher.

2.6 CHAPTER DISCUSSION

To summarize, this study investigates the development of home language literacy acquisition among Indigenous Australian students attending a remote bilingual school. Although the mechanics of reading are similar cross culturally, different contextual issues affect children's reading success. These contextual issues must be taken into account

when investigating the development of reading skills of any collective group of students. This chapter has introduced the group of students participating in the current study and has discussed some of the issues that affect their acquisition of literacy skills.

The participants in this study are affected by many other key risk factors for literacy failure such as chronic otitis media. However, these are beyond the scope of this Ph.D. I have only covered the topics that cannot be dismissed when trying to situate and understand the importance of this study. This chapter serves to highlight two major ideas: a) the development of first language (Dhuwaya) literacy needs to be studied and b) interactive IT resources may prove to be specifically beneficial for this particular population of students.

Yolŋu children grow up acquiring one or a few Yolŋu Matha language(s). Many of them do not encounter English until their first day in school. Yirrkala community members have fought to use Yolŋu Matha as a language of instruction at the school in order to help facilitate children's academic success and to raise children with strong Yolŋu identities. Nevertheless, Indigenous students continue to significantly underperform their mainstream Australian peers on national literacy and numeracy assessments. As a result, the Northern Territory Department of Education has removed most of their support for bilingual education despite existing research suggesting that bilingual education does not hurt language-minority students and can even have advantageous results when properly implemented. Furthermore, Indigenous children have a right to be educated in their first language. Instead of dismantling bilingual programs, focus should be placed on investigating the unique situation of remote Indigenous

students and using the findings to develop bilingual programs based on the unique needs of the community.

Cultural differences in home and school ways of knowing have also been highlighted. Traditionally, Yolŋu knowledge and culture has been transmitted orally. Thus, Yolŋu culture does not have a long history of valuing written literacy. It is not common for parents to be proficient readers, which in turn means that it is not commonplace for parents to engage in literacy events at home or for them to introduce literacy practices to their children. Therefore, children's school literacy practices are not reinforced at home. On top of this, attendance rates are severely low for Indigenous children living in remote communities and for Yirrkala School specifically. Attendance rates for Indigenous team teachers are also low. Delivering a phonological awareness training program via an iPad app allows students to independently, without the help of a parent or qualified Indigenous teacher, receive one-on-one attention at the level that they are at. Computerized early literacy resources may then be particularly beneficial to children in these contexts as long as they are able to access these resources³³.

The more a literacy program is adapted to the particular needs of its student cohort, the more successful the program. However, little research has been conducted on Dhuwaya literacy acquisition. This study intends to shed light on the topic by focusing on the emergent literacy skills of Yolŋu children attending Yirrkala Community School where literacy is initially introduced in Dhuwaya. More specifically, this project investigates the relationship between phonological awareness and early word reading in

³³ Computerized resources would not be helpful if students did not have access to computers. Yirrkala School is well equipped with iPads and the school has started distributing iPads to children as prizes for achievements such as exemplary attendance.

Dhuwaya. The next chapter will go into detail on the existing research focused on the relationship between phonological awareness and early reading acquisition.

CHAPTER THREE

3.0 PHONOLOGICAL AWARENESS AND EMERGENT LITERACY

It is imperative that children receive the best possible opportunity to develop proficient reading skills given that reading is such a prominent tool in our society. As mentioned in Chapter One, many children struggle in their endeavor to acquire literacy skills unless they receive organized and systematic reading specific instruction (Moats, 2007). Children who experience reading difficulties at the beginning of their literacy training tend to remain poor readers throughout their school years (Good, Simmons, and Smith, 1998; Juel, 1988; Stanovich, 1986; Torgesen et al., 1999). Early reading difficulties have a domino effect on more complex reading skills (Nicholson, 2005). Young children who do not develop adequate word level reading strategies read significantly less and are exposed to less than half as many words as their typically developing peers (Juel, 1988). Subsequently, children's reading comprehension is severely hindered by their lack of reading fluency and limited vocabulary. Thus, it is crucial that attention be given to children's emergent reading development as early as possible. Research findings indicate that early reading interventions can facilitate the development of reading skills and can even prevent future reading difficulties. The earlier a child is identified as being at risk for reading difficulties, the younger they can begin undergoing reading intervention and the less they fall behind their typically developing peers.

Phonological awareness intervention can be administered to very young children and may have a beneficial effect on their early reading development. Chapter One included a brief discussion on the role of phonological awareness intervention in early

literacy development for readers of alphabetic languages. This chapter includes an in-depth discussion on phonological awareness and its relationship to emergent word reading skills. Other aspects of the alphabetic code are also discussed. Section 3.1 contains a brief description of the reading process. Section 3.2 discusses phonological awareness and the various tasks used to measure and train this skill. The reading wars are introduced in section 3.3. Section 3.4 discusses existing research concerning the relationship between phonological awareness and early reading acquisition. The relationship between letter knowledge and phonological awareness is discussed in section 3.5. Phonological awareness assessment and intervention characteristics are covered in section 3.6. This chapter closes with a general discussion on the relationship between phonological awareness and early reading acquisition.

3.1 BRIEF OVERVIEW OF THE READING PROCESS

Although literacy events vary greatly, most scholars would agree that the main goal of any literacy event is to understand the meaning of the text (Lee & Schallert, 1997; Snow et al., 1998). A reader reads a text in order to obtain information for a specific purpose. This purpose may be for business or for pleasure. Readers may be reading to gain knowledge about a certain topic or simply for their entertainment (NICHD, 2000). Whatever the reason, the reader typically has the intention of understanding the message conveyed in the text and in order to construct meaning out of text (read to learn), one must first learn to read.

Learning how to read is not a straightforward process. The process of reading involves multiple skills working simultaneously. The various factors associated with reading (intelligence, memory, attention, vocabulary, sound awareness, world knowledge, etc.) do not work independently of each other. Rather, they affect each other in unique ways resulting in individual differences amongst children (Snow et al., 1998). Although the different components and skills involved in reading acquisition are dynamic and ever-evolving throughout literacy development (August & Shanahan, 2006), we can examine them by categorizing them into subgroups. Most researchers agree that the following components are crucial for the development of proficient literacy skills in an alphabetic language: phonological awareness, phonics, fluency, vocabulary, and comprehension (Adams, 1990; NICHD, 2000; Santi, Menchetti, & Edwards, 2004; Snow et al., 1998).

Phonological awareness is the ability to think about the phonological structure of words as opposed to the meaning of the word (Trehearne & Healy, 2003). Phonological awareness involves understanding that words can be broken up into smaller units of sound and having the ability to attend to and manipulate these smaller units of sound. For example, a child would not be able to segment 'cat' into its three constituent sounds, /k/ + /æ/ + /t/, if he (or she) did not possess well developed phonological awareness skills. This ability to attend to the individual sounds of one's language(s) is requisite to learning the relationships between letters and sounds (Santi et al., 2004; Schuele & Boudreau, 2008).

Phonics is the explicit instruction of the alphabetic code. Phonics instruction involves teaching letter-sound correspondences and teaching how to use these correspondences to decode words (Gunning, 2000; Nicholson, 2005). Proper utilization of the code for word recognition involves three steps: a) changing letters into sounds, b)

blending these sounds together in order to access a word's pronunciation, and c) scanning one's vocabulary for matching words. The use of the alphabetic code is a robust word recognition strategy because it does not require learners to memorize an orthographic representation for each individual word (Bay Area Reading Task Force, 1997). Instead, children only need to memorize the finite set of letter-sound correspondences in their language's respective alphabet. Children can then apply the alphabetic code to independently sound out words they have never encountered in print (Torgesen et al., 1999).

As children become experienced readers, their word identification skills become automatic (Vacca et al., 2012). Learners begin creating orthographic representations of words that automatically activate a word's pronunciation. When orthographic representations are created, readers no longer need to transform each letter into its corresponding sound or blend the constituent sounds together. Automaticity is a characteristic of individual words. Orthographic representations are only developed after a reader has correctly decoded the word a sufficient number of times. Thus, readers use both alphabetic decoding strategies and automatic word identification routes simultaneously (Li, 2010). Decoding takes precedence when the reader encounters a word for which he or she does not have an orthographic representation. However, overall, the use of orthographic representations takes precedence because it allows a learner to access a word's meaning more rapidly and to read more quickly (Hook & Jones, 2004).

Fluency refers to the ability to read words with speed and accuracy (Vacca et al., 2012). Fluency is necessary because it allows students to reserve their cognitive resources for higher-level thinking (Adams, 1990; August and Shanahan, 2006; NICHD, 2000).

Laborious word recognition consumes a great deal of concentration and memory, which limits one's ability to focus on higher-level processes. In contrast, fluent reading enables one to direct their attention to comprehension strategies, such as making inferences or applying background knowledge (Vacca et al., 2012). Farrall (2012) uses the example of driving a manual vehicle. When one is first learning to drive, it takes their full concentration to properly steer the wheel, work the clutch, press the breaks, and mind other drivers and road signs. The novice driver has difficulty concentrating on directions and holding conversations with passengers. However, once the act of driving becomes automatic, the driver can comfortably drive, attend to directions and road signs, and engage in conversations with passengers. Applied to reading, fluency permits readers to save all of their cognitive resources for more advanced comprehension strategies.

Proficient reading also depends on adequate word knowledge. Word meanings and pronunciations are stored in one's **vocabulary** (Snow et al., 1998). Oral vocabulary helps emergent readers recognize printed words. As children sound out words, they try to match pronunciations with words stored in their vocabularies (NICHD, 2000). If the child is very familiar with the word, they will easily be able to make the connection between the pronunciation and meaning of the word. Proper word decoding strategies are ineffective on their own if the reader is not already familiar with the words they are attempting to read. Furthermore, vocabulary is crucial in text comprehension. Children will have a difficult time understanding the meaning of a text if they are unfamiliar with many of the words in the text (Snow et al., 1998; Vacca et al., 2012).

Reading comprehension, “the essence of reading,” refers to the ability to understand the message intended by the author (Durkin, 1993). Reading comprehension

is the ability to process and comprehend a text as a whole rather than understanding isolated words and sentences, and it involves the amalgamation of various complex skills (Woolley, 2011). Vocabulary, syntactic, and semantic knowledge are needed to grasp the literal meaning of a text (August & Shanahan, 2006). Additionally, background knowledge and various cognitive skills are needed to employ comprehension strategies such as: holding information in memory, identifying main ideas, summarizing and paraphrasing what has already been read, monitoring one's comprehension, making inferences, asking questions, making predictions, and constructing mental pictures (Moats, 2007; NICHD, 2000). As such, texts alone do not provide meaning. Instead, successful comprehension depends on the reader's ability to actively engage with a text: comprehension emerges from a combination of the text's contents and the reader's prior knowledge and mental capacities (Pardo, 2004). Making sense from a text is a complex interactive process.

To summarize, the aim of any reading event is to extract meaning from text. Five skills are thought to be crucial to this process: phonological awareness, phonics instruction, fluency, vocabulary knowledge and reading comprehension. Phonological awareness and phonics instruction help a child learn how to decode familiar and unfamiliar words. Sufficient decoding practice helps develop vocabulary and fluent word reading. Fluent reading allows readers to focus their cognitive abilities on the more complex skills needed for comprehension. While each of these components is necessary for proficient reading, neither is sufficient on its own (Callaghan & Madelaine, 2012). These skills (along with various other factors, such as general intelligence, memory, attention, world knowledge, etc.) work together in a synergistic way (August &

Shanahan, 2006). However, this project focuses on the alphabetic code and the two skills needed to crack the code: letter knowledge and phonological awareness. The remainder of this chapter concentrates on the alphabetic code with a spotlight on phonological awareness.

3.2 PHONOLOGICAL AWARENESS

Phonological awareness is a metalinguistic skill³⁴ that involves a) the understanding that spoken words are composed of discrete sound units and b) the ability to notice and consciously think about these discrete units of sound (Ball, 1997; Li, 2010; Perez, 2008). Any task that requires manipulating the sounds of words requires phonological awareness (Moats, 2005). Examples of such tasks include: isolating the first sound in a word, blending separate sounds into a word, segmenting a word into its individual sounds, adding or deleting sounds from an existing word, or substituting one sound for another (Snow et al., 1998).

Phonological awareness can be thought of as a continuum with differing levels of awareness. A language's phonological structure is hierarchically multi-tiered. Words can be broken down into syllables, which in turn can be broken down into onset and rime, which in turn can be broken down into phonemes. Likewise, there are different levels of phonological awareness that gradually develop (Nicholson, 2005). The different levels of phonological awareness develop in order from larger sound units to smaller sound units (Gillon, 2004; Invernizzi & Tortorelli, 2013). However, the different levels of awareness

³⁴ Metalinguistic awareness is a 'general term used to describe the ability to think about language' (Gillon, 2004, p.10).

develop simultaneously; a child does not need to master one level of awareness before beginning to develop the next (Phillips, Clancy-Menchetti, & Lonigan, 2008).

As children are introduced to texts, they begin to realize that spoken utterances are broken up into words. These separations are represented by spaces on a page. Prior to this realization, children know that there are names for certain objects but they may not necessarily grasp the abstract concept of a word (Snow et al., 1998). Researchers found that some early preschool children did not yet understand the difference between an object and the abstract word used to talk about it (Chaney, 1989; Papandropoulou & Sinclair, 1974; Tunmer, Pratt, & Herriman, 1984). When children were asked which word is long and which is short, ‘snake’ or ‘caterpillar,’ many children said ‘snake’ was long while ‘caterpillar’ was short. In another paper by Stahl (1992), the researcher discusses an interaction with a young girl having difficulty understanding phonics. The researcher asked the young girl if she could say the word ‘coat’ without the /k/ sound and ‘meat’ without the /m/ sound. The young girl responded with ‘jacket’ and ‘chicken,’ respectively. Clearly, the young girl was not yet able to attend to the phonological structure of the words separate from the words’ semantic meanings. Instead, she gave a word for an article of clothing similar to a coat and a word for a type of meat. However, children usually tend to develop word awareness³⁵ before finishing the preschool year.

Syllable awareness is the awareness that words can be broken into syllables. Certain syllabic features help children identify them: syllables all have a vowel or vowel-like sound (the n in button), most languages prefer maximal onset consonant clusters over

³⁵ Word awareness is not typically considered phonological awareness. However, word awareness is a prerequisite for developing phonological awareness skills (Gillon, 2004).

codas and break up accordingly,³⁶ and languages separate consonants into coda and onset of adjacent syllables in order to avoid illegal consonant clusters (nl in English, for example). These linguistic cues facilitate the development of syllable awareness (Gillon, 2004). Therefore, syllable awareness begins to develop early on in the preschool year (Brady & Shankweiler, 1991).

The knowledge that syllables can be broken down into onset and rime is known as onset-rime awareness. The onset of a syllable includes the consonant(s) occurring before the vowel. The rime includes the vowel and following consonant(s). For example, in the word ‘frog,’ /fr/ is the onset while /ɑ:g/ is the rime. Children’s rhymes help children develop onset-rime awareness since they direct attention to the rime in words (Gillon, 2004). As a result, most children begin to develop onset-rime awareness by the end of kindergarten (Brady & Shankweiler, 1991).

Phonemic awareness is the knowledge that words and syllables can be broken down into individual phonemes. Phonemes are the smallest units of sound that carry meaning in a language (Perez, 2008). Changing or deleting a phoneme in a word results in a different word or in a non-word. For example, swapping the /p/ in ‘pin’ for a /b/ creates a new word – ‘bin’ (Finegan, 2014). Phonemic awareness is the last level of awareness to emerge and typically does not begin to develop until the first grade (Brady & Shankweiler, 1991). Nonetheless, the International Reading Association (1998) claims that more than 80% of children develop phonemic awareness by the middle of first grade.

³⁶ The onset of a syllable includes any consonants preceding the vowel while the coda includes any consonants that follow the vowel. For example, in the word ‘frog,’ /fr/ is the onset and /g/ is the coda. The Maximal Onset Principle states that during syllabification, languages prefer to assign intervocalic consonants to the onset of the following syllable rather than attaching them to the coda of the preceding syllable (McCarthy, 2008).

Phonemic awareness is particularly difficult, as phonemes are not clearly separated in the speech signal (Blachman, Ball, Black, & Tangel, 2000; Ehri et al., 2001; NICHD, 2000). Instead, they are coarticulated³⁷ and thus the exact acoustics of phonemes vary depending on their phonological environment (Adams, Foorman, Lundberg, & Beeler, 1998; Lane, Pullen, Eisele, & Jordan, 2002). Moreover, the pronunciation of a single phoneme may vary both within and across speakers, even when articulated in the same environment (McBride-Chang, 2004). Due to these phenomena, phonemes do not have definite realizations. Lonigan (2006, p.83) argues that phonemes are “abstract linguistic units that have only a psychological reality.”

It is important not to confuse speech discrimination with phonemic awareness. Speech discrimination is the ability to perceive and differentiate the sounds of one’s language (Snow et al., 1998). For example, knowing that ‘cat’ and ‘bat’ are different words depends on this ability. This ability to distinguish different sounds develops naturally and implicitly. Babies begin to tune in to the distinctive phonemes of their language by eight months of age (Byrd & Mintz, 2010). However, the ability to hear that ‘cat’ and ‘bat’ are not the same word is not the same as being able to consciously think about the difference between the two words (Adams, 1990). While speech discrimination is necessary in speech, it does not seem to relate directly to reading (Snow et al., 1998). However, phonemic awareness is crucial to the development of early word recognition in alphabetic languages as phonemes are the units represented by the letters of an alphabet (Juel, 1988).

³⁷ ‘Co-articulation’ is the term used to describe the phenomenon by which phonemes are not pronounced in isolation. Instead, the articulation of successive phonemes overlaps, which results in the acoustics of a phoneme becoming more like the phonemes before and/or after it (Stage & Wagner, 1992).

While some children naturally acquire the phonemic awareness skills needed for reading simply from being in stimulating classrooms and home environments, many others need to be consciously taught (International Reading Association, 1998; McBride-Chang, 2004). Research shows that roughly 25% of middle-class children need explicit training in order to obtain phonemic awareness. The percentage is significantly higher for children coming from less literacy-focused cultures (Adams et al., 1998)

3.2.1 Phonological Awareness Tasks

Children can display phonological awareness by engaging in any task that requires thinking about and possibly manipulating the sound units of a word (Moats, 2005). Researchers have created a variety of different tasks to assess and train phonological awareness. Tables 3.1 – 3.3 illustrate a variety of phonological awareness tasks (task descriptions adapted from Ehri et al., 2001; Gillon, 2004; NICHD, 2000; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993). This list is not exhaustive.

Table 3.1
Syllable Awareness Task Types

Syllable Identity	Task	Recognizing a common syllable in different words.
	Example	“Which part of these two words is the same... compete and compare ?” or “Which word begins with com : impair, compare, beware?”
Syllable Blending	Task	Figuring out what word is created when a string of isolated syllables is blended together.
	Example	“What word do you get when you put /kəm/...and /per/ together?”

Syllable Segmentation	Task	Requires breaking a word up into its constituent syllables.
	Example	“How many syllables are there in the word compare ?” or “Break up the word compare into syllables?”
Syllable Deletion	Task	Recognizing what word is generated after a syllable has been deleted from a previous word.
	Example	“Say compare . Now say it without the /kəm/.”

Table 3.2

Onset-rime Awareness Task Types

Rhyme Recognition	Task	Recognizing whether two or more words rhyme.
	Example	“Do ball and fall rhyme?”
Rhyme Oddity	Task	Recognizing which word in a group does not rhyme with the rest.
	Example	“Which word does not rhyme: ball , fall , dog , tall ?”
Rhyme Generation	Task	Thinking of a word that rhymes with a given word.
	Example	“What words rhyme with ball ?”
Onset-rime Blending	Task	Figuring out what word is created when an onset and a rime are blended together.
	Example	“What do you get when you put /b/...and /ɔ:l/ together.”

Table 3.3

Phonemic Awareness Task Types

Phoneme Categorization	Task	Recognizing which word in a group does not begin (or end) with the same sound (or have the same middle sound).
	Example	“Which word doesn’t belong?” cat , cup , dog , kite ”
Phoneme Identity	Task	Recognizing a common sound in different

		words.
	Example	“What sound is the same in cat , cup and kite ?” or “Which word begins with the same first sound as cat : rat, cup, man?”
Phoneme Isolation	Task	Isolating individual sounds in words.
	Example	“What is the first sound in cat ?”
Phoneme Blending	Task	Figuring out what word is created when a string of isolated phonemes is blended together.
	Example	“What word do you get when you put /k/ (pause) /æ/ (pause) /t/ together?”
Phoneme Segmentation	Task	Requires breaking a word up into its constituent phonemes
	Example	“How many sounds are there in cat ?” or “Break up the word cat into individual sounds?”
Phoneme Deletion	Task	Recognizing what word is generated after a phoneme is deleted from a given word.
	Example	“What word do you get when you say cat without the /k / sound?”
Phoneme Substitution	Task	Recognizing what word is generated after one phoneme in a word has been replaced with a different phoneme.
	Example	“The word is cat . Change the /k/ sound for an /h/ sound. What’s the new word?”

Certain factors contribute to the relative difficulties of phonological awareness tasks. Task complexity is traditionally measured along two dimensions of difficulty: the level of awareness targeted and the cognitive requirements of the task (Callaghan & Madelaine, 2012; Good et al., 1998). However, task difficulty is also affected by the linguistic characteristics of the word under analysis (McBride-Chang, 1995; Chafouleas, VanAuken, & Dunham, 2001). These three sources of difficulty intersect in such a manner that the same task may be linguistically complex but cognitively simple and vice versa.

Researchers use the term ‘linguistic complexity’ to refer to the level of awareness (word / syllable / onset-rime / phoneme) needed to complete the task. Linguistic complexity deals with the different levels of awareness discussed in section 3.3. As previously mentioned, manipulating larger units of sound is easier than manipulating smaller units of sound. Phonological awareness tasks become more difficult as the targeted sounds decrease in size (Brady & Shankweiler, 1991; Gillon, 2004; Hill, 2006). For instance, segmenting words into syllables is easier than segmenting words into onset and rime, which in turn is easier than segmenting onset and rime into phonemes.

‘Cognitive demand’ refers to the different mental processes needed to carry out the tasks. Experts generally agree that some tasks are more cognitively demanding than others. However, there is no consensus on the exact gradation of difficulty between the tasks (Stanovich, Cunningham, & Cramer, 1984). Some researchers attribute cognitive demand to the degree of explicit phonological awareness required to complete the task while others attribute cognitive demand to the number of operations required to complete the task. Additionally, some researchers claim that the cognitive demand of a task

depends on whether the task requires dissecting a word into sounds or combining sounds into a word.

Adams (1990) lists five levels of cognitive demand based on the degree of explicit phonological awareness required: 1) Rhyme detection categorizes the first level because it only requires an appreciation of sounds but no manipulation. 2) Oddity tasks, involving the comparison and contrast of sounds in words, categorize the second level because they challenge children to focus on the specific sounds under analysis. 3) Blending and initial sound isolation tasks characterize the third level. Children must be aware that words can be broken down into smaller units of sound and they must be able to manipulate certain units of sound in a word in order to complete these tasks. 4) Segmentation tasks characterize the fourth level because they require children to break words up into all of their constituent parts. Children must be able to attend to and sequentially isolate each sound in a word. 5) Manipulation (deleting, adding, and substitution) tasks characterize the fifth and most difficult level because they require children to manipulate a word in a way that generates a new word.

Some researchers discuss cognitive demand in terms of the number of operations they require (Yopp, 1988). Tasks that require one operation are labeled as simple tasks because they require minor memory demands (Gillon, 2004). Segmenting, blending and isolating are examples of simple demands. Contrastingly, compound tasks refer to those that require one operation to be held in memory while performing additional operations. Substitution and deletion are examples of compound tasks. To illustrate, phoneme isolation tasks require the child to isolate the first sound in a word. In a phoneme

substitution task, the child must first isolate the first sound in a word and then replace it with a different phoneme.

Some researchers classify cognitive demand by separating tasks into those that synthesize sound units into words and those that analyze words into constituent sound units (Lewkowicz, 1980; NELP, 2008). Synthesis tasks involve manipulating small units of sound into larger units. Children start with the individual sounds, such as syllables or phonemes, and combine them to form a word. Blending tasks fall under the synthesis category. Contrastively, analysis tasks involve breaking down bigger units of sound into constituent parts. Children begin with whole words and are then asked to perform an operation that requires attending to some smaller unit of sound in the word. Segmentation and isolation are examples of analysis tasks. Researchers believe synthesis tasks are easier to complete than analysis tasks (Troia, 2016).

The linguistic features of the target word, such as word length, phoneme characteristics, and item placement also contribute to the difficulty of phonological awareness tasks. However, Chafouleas et al. (2001) found that the varying phonological awareness tasks are unique in regard to how linguistic manipulations to the target word affect the relative difficulty of the task. In other words, not all tasks are affected by the same linguistic manipulations in the same way. For example, shorter words are generally easier to segment than longer words. Words that contain three phonemes are easier to segment than words containing four phonemes, which in turn are easier to segment than words containing five phonemes. McBride-Chang (1995) proposes that segmenting longer words is harder because it requires more short-term memory. However, word length effects may be specific to segmentation (and possibly other) tasks. Identification

tasks focusing on initial or final sounds may not be as impacted by target word length since children need only attend to the sounds at the beginning or end of the word.

Manner of articulation, especially with consonants, also seems to affect task difficulty (Vloedgraven & Verhoeven, 2009). Continuant sounds³⁸ are said to be easier to identify than stops because they can be stretched out in pronunciation (McKenna et al., 2010). Another level of difficulty involves the number of successive consonants in the onset or coda of a syllable. Segmenting blends (consonant clusters) is thought to be more difficult than segmenting single consonants (Chafouleas et al., 2001; Chard & Osborn, 1999). One explanation for this phenomenon is that children treat certain blends as a unit (Stahl & Murray, 1994).

Many researchers find that the position of the unit in question also affects the difficulty of phonological awareness tasks. Most researchers believe that initial sounds are easier to recognize than final sounds, which in turn are easier to recognize than middle sounds (Gillon, 2004; Perez, 2008). However, McBride-Chang (1995) found that final sounds were easier to identify than initial sounds, which in turn were easier to identify than middle sounds. In either case, medial sounds are thought to be the most difficult to identify.

McBride-Chang (1995) proposes that the serial position effect and coarticulation explain this phenomenon. According to the serial position effect, information presented first or last tends to be easier to remember than information presented in the middle (Troyer, 2011). Information presented at the beginning of a list is easily remembered because full attention can be given to the small number of items presented thus far. This

³⁸ A continuant is ‘‘a speech sound produced with an incomplete closure of the vocal tract allowing the sound to be prolonged (as in f, l, m, n, r, s, v)’’ (Crystal, 1991).

attention runs thin as more items are added to a list. Information presented at the end of a list is remembered because it has occurred most recently. Thus, items from the middle of the list are hardest to remember. Additionally, medial phonemes are more susceptible to co-articulation effects such as assimilation because they are surrounded by distinctive phonemes. Initial phonemes do not have any phonemes preceding them while final phonemes do not have any phonemes following them.

Thus far, this paper has discussed three factors that contribute to task difficulty. Linguistic complexity refers to the level of phonological awareness targeted by the task. Cognitive demand refers to the many operations required to complete the task. Target word characteristics refer to the different linguistic characteristics of the word being analyzed, such as word length, phoneme features and phoneme placement. These different dimensions of complexity overlap in such a way that a task may be cognitively demanding but linguistically simple (deleting an initial syllable), while another task may be linguistically complex yet cognitively simple (identifying an initial phoneme). In order to assess the relative difficulty of all tasks, a study would need to examine students' performance across all possible combinations of linguistic complexity, cognitive demand, and target word characteristics.

The existing research makes it difficult to compare and contrast the relative difficulty of the many different tasks (McBride-Chang, 2004). Very few studies set out to compare the relative difficulty of different tasks and no existing study examines the relative difficulty of all possible tasks. The question of relative task difficulty is further complicated by the fact that tasks are not carried out in exactly the same way across studies. In some phoneme segmentation tasks, children are asked to move a counter for

each sound they pronounce (Lundberg, Frost, & Peterson, 1988). For example, Nation and Hulme (1997) presented children with a grid containing one square for each phoneme in the target word; i.e., the grid for 'car' has three squares. As children vocally segment words, they move one counter for each phoneme they pronounce into a square. In other studies, children are only required to verbally list all the sounds they hear (O'Connor, Jenkins, & Slocum, 1995). The former may be easier because it allows children to visualize the illusive phoneme. In addition, a large number of the existing phonological awareness studies have been conducted on English monolinguals using tasks formulated around the English language (Stuart-Smith & Martin, 1999), yet task difficulty may be language specific. Phonological awareness studies need to be conducted on different populations of children in order to better generalize research findings.

As previously mentioned, phonological awareness is the ability to attend to the phonological structure of one's own language. As a corollary, phonological awareness tasks may be unique in their design depending on a language's phonotactic constraints. Different linguistic manipulations will be possible for different languages and we have already seen that target word linguistic features can impact the difficulty of various tasks. Speakers of different languages may respond to tasks differently. The same task may be easy to complete for speakers of one language but comparatively difficult to complete for speakers of a different language. Accordingly, languages may vary in terms of the relative difficulty and developmental patterns of the different phonological awareness tasks (Caravolas & Bruck, 1993). Therefore, careful and thorough attention should be given to a target language's phonological structure when developing assessment and intervention tasks.

Stuart-Smith and Martin (1999) conducted a study on Panjabi-English fluently bilingual children living in a Panjabi community in Birmingham, United Kingdom. The researchers chose 13 phonological awareness tasks across all levels of linguistic complexity including: syllable judgment (syllable blending), syllable segmentation, alliteration judgment (onset identification), generating alliteration, rhyme judgement, generating rhyme, isolating the onset, deleting the onset, isolating the coda, deleting the coda, phoneme blending, oral phonemic segmentation, and tapping phonemic segmentation. The researchers attempted to match the 13 tasks as closely as possible, in terms of linguistic manipulations, across both of the participants' languages. The purpose of the study was to compare the participants' performance on the matched tasks across the two languages. Some tasks were easy to match across the two languages and resulted in similar student outcomes. Other tasks were difficult to match and resulted in dissimilar student outcomes suggesting that each languages' unique phonology must be taken into consideration when designing assessment and intervention tasks. Two important implications of their finding merit discussion.

First, some tasks may not be appropriate in certain languages. For example, the oral phonemic segmentation task did not function well in Panjabi because there is a tendency to open the final consonant of monosyllables in the variety of Panjabi used in the study. Therefore, it was very difficult for both the native Panjabi-speaking test administrator and the children to orally segment words into disparate phonemes. Instead, they tended to produce disyllabic sequences adding a shwa vowel to the coda consonant. However, these same children were able to orally segment words into phonemes in English. Moreover, the children were able to complete the tapping segmentation task in

Panjabi with much more ease as they tapped for each phoneme instead of sounding out each phoneme. These findings suggest that the children had developed a good sense of phoneme segmentation skill. However, oral tasks may not be useful in assessing phoneme segmentation in this particular variety of Panjabi.

Second, the design of task items is heavily constrained by a languages' phonological structures and these constraints have an effect on task difficulty. For example, English words contain a substantial amount of onset consonant clusters. Therefore, onset isolation tasks can be made progressively more difficult in English as onset consonant clusters grow in length. Panjabi, on the other hand, is virtually void of word initial consonant clusters³⁹ (Stuart-Smith & Martin, 1999). Therefore, complex consonant clusters cannot affect onset isolation task difficulty in Panjabi. As such, an imbalance appeared between the Panjabi and English onset isolation task in the Stuart-Smith and Martin study: all task items in the Panjabi version consisted of simple onsets while task items in the English version consisted of both simple and complex onsets. Participants performed better on the Panjabi onset isolation task than on the English onset isolation task. Children performed more poorly on the English version of the task because some experienced difficulty isolating the consonants in complex onsets as a unit. Instead, they would isolate the initial phoneme on its own.

Further research is needed to confidently place the different tasks along a continuum of difficulty. This research is important because researchers and educators assess students' phonological awareness skill by their performance on different tasks (Stuart-Smith & Martin, 1999). Moreover, these tasks are used in intervention programs

³⁹ Onset consonant clusters are only found in loan words (Stuart-Smith & Martin, 1999).

to help train phonological awareness. Thus, it is crucial for researchers and educators to understand the language specific intricacies involved in the various tasks.

3.3 THE READING WARS

Many experts have emphasized the importance of alphabetics in early literacy instruction (Adams, 1990; NELP, 2008; NICHD, 2000; Snow et al., 1998). Nevertheless, the use of the alphabetic code in early reading instruction was not always supported (Nicholson, 2005). In William S. Gray's 1948 book, *On Their Own Reading*, he argues that it is unnecessary to teach the letters of the alphabet, the sounds they make, or how to sound out words. Gray thought children should focus on reading for meaning, and through practice, begin to recognize words by sight, just as adults do. This meaning-first approach was initially termed the 'look-say' method. The 'look-say' approach to literacy instruction was cultivated in the 70s and later became known as the Whole Language method (Kim, 2008). Whole Language gained popularity in the 1980s and 1990s, causing tension with proponents of the alphabetic code.

Whole Language presupposes that developing written language is like developing oral language. Children are not explicitly taught to speak or to break down words into separate phonemes. Instead, through exposure and experience with purposeful speech, they use context and meaning to recognize whole words. Kenneth Goodman, past president of the International Reading Association and founding father of Whole Language, believed that children could easily and naturally learn to read in a similar manner (Lieberman & Lieberman, 1990). Goodman believed children did not need to be

explicitly taught any reading-specific procedures. He argued that, as long as children are surrounded with meaningful and purposeful books, reading skills will develop in the same manner that oral language develops. Goodman also asserted that emphasis in reading instruction should be placed on constructing meaning rather than recognizing each individual word.

Goodman argued that decoding (using letter-sound correspondences to sound out words to reach their pronunciations) each individual word detracts memory space from creating meaning, which is the essence of reading. Phonics instruction, he claimed, leads to successful word decoding but insufficient comprehension. Furthermore, breaking up words into disparate sounds makes reading difficult and mechanic as it deters from natural speech. Instead of sounding out words, children should memorize whole words through repeated practice. If children do not recognize a word, they should be encouraged to skip the word or guess. Goodman likened reading to a ‘psychological guessing game’ in which children use context clues, background knowledge, pictures, and graphonic cues to identify the word in question. Although teachers should not systematically teach phonics, they can discuss phonic generalizations in the context of the reading. Through experience with print, children begin to make phonic generalizations by reading the same story frequently. However, phonic generalizations should only be used as a last resort for word recognition (Goodman, 1986).

Opponents of the Whole Language approach argue that Whole Language’s main assumption, that learning to read is the same as learning to speak, is fundamentally wrong (Lieberman & Liberman, 1999; Shaywitz, 2003). All typically developing humans acquire speech without explicit instruction. Contrastingly, children usually do not learn how to

read in the absence of reading instruction. Additionally, all communities of people have fully developed oral languages while only a minority of these languages has a respective written language. Along the same lines, oral languages have been around since the beginning of man. Alphabets, on the other hand, only came about in the last 4,000 years as a creation, not a biological trait, of man (Lieberman & Liberman, 1990; Moats, 1999).

Opponents of Whole Language also argue that skilled readers do not use the strategies endorsed by the Whole Language approach. Studies show that skilled readers read every word in a text and even visually process all the letters in a word (Adams, 1990; Liberman & Liberman, 1990). Additionally, skilled readers are less likely to use guessing strategies in word recognition (Adams, 1990; Liberman & Liberman, 1990; Perfetti & Lesgold, 1979). Moreover, Whole Language research does not advise on how to detect children who are at risk for reading failure, on what distinguishes skilled from unskilled readers, or on how to help poor readers catch up to their typically developing peers (Lieberman & Liberman, 1990). Research on the alphabetic code does shed light on all of these questions.

The dichotomy between whole language and phonics that was created by researchers, educators, and policy makers is not useful. Many different skills can be used to train early reading skills. Moreover, learning is not an event that happens outside of the learner. Each child is equipped with a different set of skills and thus different methods may be useful for different children. Teachers should be flexible and trained in different approaches so that they can provide their students with the most beneficial teaching method for each particular child (Hall, 2006). Educators, policy makers, and researchers should not be dogmatic about any one single approach to early literacy training.

Nevertheless, various studies have compared the effectiveness of different early literacy teaching approaches and reviews assessing these studies have concluded that systematic phonics approaches have a larger effect on early literacy development than whole language approaches (Torgerson, Brooks, & Hall, 2006). The NICHD (2000) also found that phonics based early reading programs are more effective than non-phonics based programs.

3.4 SCIENTIFIC EVIDENCE

The reading wars led to an explosion of research into emergent literacy skills. There is now substantial evidence that phonological awareness is directly related to reading (Adams, 1990; Moats, 2007; Nation & Hulme, 1997; NELP, 2008; NICHD, 2000; Nicholson, 2005; Perez, 2008). This section focuses on the existing studies that investigate the relationship between phonological awareness and reading.

3.4.1 Correlational and Predictive Studies

Many correlational studies identify phonological awareness in preschool and kindergarten as one of the strongest predictors of later word reading ability⁴⁰. The relationship between phonological awareness and later word reading has been found across languages such as English, Swedish, Norwegian, Spanish, French, Italian, Portuguese, and Russian (Adams, Foorman, Lundberg and Beeler, 1998). Researchers

⁴⁰ Adams, 1990; Blachman, 1991; Ehri et al., 2001; Juel, 1998; Lerner & Lonigan, 2016; Lonigan, Burgess, & Anthony, 2000; NELP, 2008; NICHD, 2000; Perez, 2008; Snow et al., 1998

have even found phonological awareness to be a more robust predictor of later word reading than intelligence (Shaywitz, 2003).

In an influential study, Share, Jorm, Maclean and Matthews (1984) tested 543 children from 22 different classrooms in Victoria, Australia. Children were assessed at both the beginning and end of Kindergarten and once more at the end of the first grade. Data collected at the beginning of the kindergarten year included emergent literacy skills assessments (letter naming, name writing, name reading, letter copying, letter recognition, and letter discrimination), oral language assessments (Northwestern Syntax Screening Test, Peabody Picture Vocabulary Test, Sentence Memory, Picture and color naming, pseudo-word learning, and phoneme segmentation), motor skills assessments, personality surveys completed by parents and teachers (Rutter Children's Behavior Questionnaire and Teacher predictions), and a home environment background survey completed by parents. The same assessment battery was administered again at the end of kindergarten and at the end of the first grade, along with early reading and spelling performance assessments (sight word reading of high frequency words, nonsense word reading, Neale Analysis of Reading Ability, and the Schonell Graded Word Spelling Test B). The study investigated the relationship between a total of 39 variables and early reading performance. At both the end of kindergarten and the end of the first grade, scores on phoneme segmentation and letter naming tasks had the highest correlations with later reading.

The robust predictive power of phonological awareness on later word recognition has been found to persist throughout the school years. While several studies have found phonological awareness in kindergarten to be one of the strongest predictors of later word

reading at the end of first and second grade⁴¹, few studies have examined the predictive power of phonological awareness on word reading after early primary school. However, those that do tend to find that phonological awareness remains a strong predictor of later reading success regardless of school grade level. Juel (1988) found that phonological awareness levels at the beginning of first grade were predictive of word recognition three and a half years later, at the end of the fourth grade. Kindergarten measures of phonological awareness were even found to be predictive of word reading at the end of high-school.

MacDonald and Cornwall (1995) administered tests of phonological awareness (phoneme deletion), vocabulary, word identification, and spelling to 24 children at the beginning of kindergarten and again, eleven years later, when the children were 16 or 17 years old. They found phonological awareness to be strongly associated with word recognition at the end of kindergarten while vocabulary and socioeconomic status were not strongly related. Furthermore, phonological awareness was the only kindergarten measure showing predictive power of word recognition skills eleven years later. Researchers did not find any associations between the participants' kindergarten word recognition skills or their kindergarten spelling skills and their word recognition skills eleven years later. It is clear that the majority of young children who perform poorly on phonological awareness assessments in preschool and kindergarten end up challenged with reading difficulties later on in life (Schuele & Boundreau, 2008).

⁴¹ Blachman, 1991; Bradley & Bryant, 1983; Lundberg et al., 1988; Mann, 1984; Stanovich, 1986; Stanovich, Cunningham and Cramer, 1984; Torgesen, Wagner & Rashotte, 1994

In fact, many researchers have documented the relationship between reading difficulties and poor phonological awareness⁴². This connection has been found in both children with specific reading disabilities and children whose reading difficulties stem from general learning disabilities (McBride-Chang, 2004). Shankweiler et al. (1995) tested the phonological, morphological, and syntactic skills of 353 children identified as having reading and learning problems. The children were aged between 7;5 and 9;5 and were categorized into four groups: reading disabled (n=56), mathematically disabled (n=85), both reading and math disabled (n=108) and attention deficit disorder (n=54). A group of 50 typically developing children served as a comparison group. The children labelled as reading disabled or both math and reading disabled scored significantly lower than the rest of the children on all phonological awareness tests. Measures of IQ did not differ between the reading and math disabled children. Therefore, the fact that only reading disabled children performed poorly on phonological awareness tasks supports the idea that phonological awareness is specifically related to the reading process. However, student performance was not affected by the cause of the reading difficulty. Children whose reading difficulties stem from specific reading disorders and children whose reading difficulties stem from more general learning disabilities, both perform poorly on measures of phonological awareness.

The relationship between dyslexia and phonological awareness has been highlighted in the past thirty years. Dyslexia is the most common reading specific disorder affecting one in five children (Shaywitz, 2003). Traditionally, dyslexia was characterized as a child's severe inability to acquire sufficient word recognition and

⁴² Brady & Shankweiler, 1991; Bruck, 1992; Fawcett & Nicholson, 1995; Foorman, Francis, Beeler, Winikates, & Fletcher, 1997; Snellings, Leij, Blok and Jong, 2010; Torgesen et al., 1999

spelling skills in the absence of any known sensory, neurological, cognitive, emotional, behavioral, linguistic, or learning disabilities. Researchers now describe dyslexia as a severe inability to acquire word recognition and spelling skills due to difficulties in phonological processing (Gillon, 2004; McBride-Chang, 2004; Shaywitz, 2003). This new definition of the reading disorder was brought on by the multitude of evidence showing extremely low levels of phonological awareness and phonological memory in children diagnosed with dyslexia.

Children with dyslexia repeatedly underperform their age-matched and reading-level matched peers in assessments of phonological awareness (Alexander, Andersen, Heilman, Voeller, & Torgesen, 1991; Bradley & Bryant, 1978; Bruck, 1992; Fawcett & Nicholson, 1995; Gillon, 2004). Reading-matched peers are younger children (usually over three years younger) who are reading at the same level as older children with dyslexia. The fact that children with dyslexia perform poorly on phonological awareness tasks in comparison to younger reading-level matched children proves that dyslexia cannot be characterized as delayed development. Additionally, the younger children's superior phonological awareness cannot be attributed to more experience with reading (Bradley & Bryant, 1978). Children with dyslexia can improve their word recognition abilities with proper intervention and motivation. However, they tend to exhibit poor phonological awareness skills throughout their lives (Bruck, 1992).

3.4.2 Experimental Studies

While correlational studies show a natural link between poor phonological awareness and poor reading, they do not prove cause and effect. Theoretically, there are three possibilities regarding the reasons for this correlation: 1) Individual differences in phonological awareness are responsible for differences in reading ability. 2) Reading experience improves phonological awareness. 3) A third factor (such as memory, vocabulary, intelligence, etc.) may be responsible for the correlation between phonological awareness and reading (Castles & Coltheart, 2004). However, carefully controlled experiments illuminate the causal relationship between phonological awareness and reading.

In a seminal study, Bradley and Bryant (1983) set out to test whether improving phonological awareness in poor readers resulted in improved word recognition ability. A sample of 65 five- and six-year old children who performed poorly on a sound categorization task administered the previous year were divided into four groups. The four groups were matched by their age, verbal intelligence, and scores on the sound categorization task at the first trial (prior to any reading instruction). Group 1 received training on sound categorization – children were explicitly taught that words could be grouped together by their first, medial or final sounds. Group 2 received the same sound categorization training as well as training in the connection between individual sounds and the letters of the alphabet. Group 3 received conceptual categorization training using the same pictures used in the sound categorization training. Group 4 received no training. After three to four months, Groups 1 and 2 outperformed groups 3 and 4 on the Schonell

reading test, the Neale reading test, and the Schonell spelling test. However, differences amongst all four groups on IQ and mathematical tests were insignificant. These results suggest that phonologically trained children's superior performance on reading and spelling measures was not the result of superior intelligence, general advances in academic achievement, or the Hawthorne effect⁴³. However, the training program ran for two years, which means that the children were in the second grade at the end of the intervention; ergo, these children would have undergone reading instruction before the end of the study.

Some researchers argue that the Bradley and Bryant (1983) study did not prove that phonological awareness had a causal role in reading acquisition because the participants had been receiving reading instruction in the classroom while simultaneously participating in the study (Castles & Coltheart, 2004). It is difficult to imagine that the majority of the children who went on to become good readers were randomly placed in the two training groups while the majority of the students who went on to acquire less proficient reading skills were randomly placed in the two control groups. Nevertheless, another group of researchers investigated the effects of phonological awareness training on students who did not receive any reading instruction throughout the entire length of the study.

Lundberg et al. (1988) took advantage of the late age at which children enter school in Denmark and administered their intervention before the children received reading instruction. Children are already seven years old when they begin kindergarten in Denmark. Therefore, they are cognitively capable of handling an in depth phonological

⁴³ The Hawthorne effect (or observer effect) describes a situation in which individuals change (usually improving) their behavior or performance because they know they are under observation (Gass & Mackey, 2007).

training program. An experimental group of 235 children from 12 classrooms was compared to a control group of 155 children from 10 classrooms. The experimental group received eight months of metalinguistic training that spanned from simple listening exercises to more difficult phonological awareness tasks such as phoneme segmentation⁴⁴. The control group received regular kindergarten curriculum that consisted of social development. Cognitive and linguistic development is not targeted in Scandinavian kindergartens. All children were tested on emergent reading ability, letter knowledge, language comprehension, vocabulary, and phonological awareness. The post-training results indicated that phonological awareness could be trained in students in the absence of reading instruction. Although the control group had slightly higher phonological awareness scores at the beginning of kindergarten, the experimental group significantly outperformed the control group at the end of kindergarten. Additionally, the number of children in the experimental group who could read any of the words from the reading test went from one to 15 while the number of children in the control group who could read words on the reading test remained at two. There were no significant differences between the two groups on letter knowledge, language comprehension, or vocabulary. Furthermore, post-tests showed that the experimental group not only maintained their phonological awareness advantage one year later in the first grade but they also significantly outperformed the control group on reading and spelling measures at the end of the first and second grade. No significant differences were seen on the math and intelligence test.

⁴⁴ The program had six levels: sound discrimination, rhyme identification, sentence to word segmentation, syllable segmentation, first phoneme identification, and phoneme segmentation.

Schneider, Küspert, Roth, Visé, and Marx (1997, study 2) repeated Lundberg et al.'s (1988) study with 346 German kindergarten students. German students start kindergarten at six years old and, like Danish students, do not receive any alphabetic or general linguistic and cognitive training. Instead, German kindergarten programs focus on social development. Schneider et al. (1997) followed Lundberg et al.'s (1988) method and added measures of phonological memory and rapid automatized naming (RAN)⁴⁵ to the test battery. The researchers wanted to examine whether the training programs affected general phonological processing or just phonological awareness. At the end of the kindergarten year, there were no differences amongst the two groups in regards to their performance on measures of letter knowledge, vocabulary, listening comprehension, phonological memory, RAN, or reading. However, the experimental group significantly outperformed the control group on measures of phonological awareness. At the end of the second-grade year, the experimental group outperformed the control group on both reading and spelling measures. These results suggest that phonological awareness, independent from other phonological processing skills, has a causal relationship with early reading.

Considered together, these studies bring us to important conclusions. First, phonological awareness can be trained. Second, phonological awareness training has a facilitating effect on the development of early reading and spelling skills. Similar effects of phonological awareness training on word recognition have been documented for all types of students: typically developing, at-risk, and disabled (NICHD; 2000; Perez, 2008). Numerous studies (Ball & Blachman, 1991; Bradley & Bryant, 1985; Brennan &

⁴⁵ Rapid automatized naming tests measure how quickly a person can vocally name an object, color, or number. These tests show how quickly people can access phonological representations (August & Shanahan, 2006).

Ireson, 1997; Kozminsky & Kozminsky, 1995; Lundberg et al., 1988) indicate that phonological awareness training gives typically developing children an advantage over their non-trained typically developing peers. Positive effects of phonological awareness training have also been documented for various at-risk students: children from low-income families (Blachman, Ball, Black, & Tangel, 1994; Juel, 1988), minority children (Juel, 1988), second language learners (Swanson, Hodson, & Schommer-Aikins, 2005), children with at least one dyslexic parent (Borstrom & Elbro, 1997) and children beginning school with poor phonological awareness skills (Bradley & Bryant, 1983; O'Connor et al., 1995). Alexander et al. (1991) showed that phonemic awareness training helped children with dyslexia catch up to their typically developing peers.

Studies also show that successful phonological awareness training can be administered in the absence of a reading expert. While reading researchers conducted many of the interventions in the studies discussed, other studies suggest that the presence of a reading expert is not necessary for an intervention to be successful. Classroom teachers and computers are also capable of successfully administering phonological awareness training programs (Blachman et al., 1994; Lundberg et al., 1998; O'Connor, Jenkins, & Slocum, 1995; Reitsma & Wesseling, 1998; Schneider et al., 1997). See section 3.6.3 for a discussion on computer based intervention studies.

To summarize, while correlational studies highlight the relationship between phonological awareness and reading, experimental studies highlight the causal relationship between the two. Phonological awareness can be trained and this training has a positive effect on reading and spelling acquisition (Bus & van IJzendoorn, 1999; NICHD, 2000). The different measures used across the referenced studies suggest that the

improved reading scores were not caused by overall improvements in academic achievement (math scores), intelligence, memory, listening comprehension, vocabulary, or general phonological processing ability. Although reading experience does tend to foster phonological awareness, the Lundberg et al. (1988) and Schneider et al. (1997) studies indicate that phonemic awareness can be developed in the absence of reading experience. Furthermore, results from the two studies suggests that children who develop phonological awareness prior to reading instruction become better readers than those who do not receive phonological awareness training. Thus, phonological awareness is not solely a product of reading experience (Brady & Shankweiler, 1991). The relationship between the two is best described as reciprocal. A certain level of phonological awareness is necessary to acquire fluent reading skills and fluent reading skills promote further phonological awareness growth (Perez, 2008; Shaywitz, 2003).

3.5 Relationship between letter knowledge and phonemic awareness

The focus of this chapter, thus far, has been on the development of phonological awareness. The purpose of developing phonological awareness is to help learners grasp the alphabetic code. However, phonological awareness on its own is not a sufficient condition. Children must also develop letter knowledge in order for them to successfully apply the alphabetic code to early word reading (Hulme, Snowling et al., 2005). Existing research indicates that letter knowledge is also a highly reliable predictor of later reading skills (Adams, 1990; Dickinson & Neuman, 2006; NELP, 2008). In fact, studies have found phonological awareness and letter knowledge to be the two strongest predictors of

later reading (Adams, 1990; Ball & Blachman, 1991; Bradley & Bryant, 1983; Chiappe, Siegel, & Gottardo, 2002; Muter & Diethelm, 2001; NELP, 2008; Share et al., 1984). Moreover, the literature clearly indicates that phonological awareness intervention programs that incorporate letter knowledge are far more effective than programs that do not incorporate letter knowledge (NICHD, 2000). As such, a discussion on letter knowledge and its relationship to phonological awareness is warranted.

Letter knowledge includes knowledge of both letter names and letter sounds, however, these two skills are not the same as they develop at different rates and have different relationships to early word reading (Blaklock, 2004; McBride-Chang, 1999). Research findings indicate that children tend to develop letter-name knowledge before they develop letter-sound knowledge (Lerner & Lonigan, 2016; McBride-Chang, 1999; Share, 2004; Treiman, Tincoff, & Richmond-Welty, 1996; Worden & Boettcher, 19990). McBride-Chang (1999) attributes the relative ease of letter-name knowledge to the fact that young children are already accustomed to assigning names to various things. Conversely, letter-sound knowledge may be more difficult because it requires children to implement the possibly unexperienced practice of directing their attention to individual sounds in isolation. Moreover, letter names tend to be used more often in the home considering that letter names are used in oral spellings and in alphabet songs (Foy & Mann, 2006). An exception to the letter name before letter sound developmental pattern has been highlighted by a study conducted on Greek-speaking children who acquired letter-sound knowledge before letter-name knowledge (Manolitis & Tafa, 2011). Manolitis & Tafa (2011) attribute this disparity to various factors unique to Greek-speaking children and their home and educational backgrounds. This finding is notably

less common in the literature. The vast majority of the research suggests that letter-name knowledge is the earlier emerging skill (Lerner & Lonigan, 2016). Still, Manolitsis and Tafa's (2011) study highlights the importance of using language-specific data when creating sequentially structured early literacy programs.

Research suggests that letter-name knowledge facilitates letter-sound knowledge because many letter names include critical clues to the letter sound within them (Castles, Coltheart, Wilson, Valpied, & Wedgwood, 2009; Kim, Petscher, Foorman & Zhou, 2010; McChang-Bride, 1999; Piasta, Purpura, & Wagner, 2010; Piasta & Wagner, 2010; Share, 2004). For example, the initial sounds in the names of letters B and T are analogous to the letters' corresponding phonemes. Similarly, the ending sounds in the names of letters M and F correspond to their respective phonemes. Children can use these clues to convert letter names to letter sounds. The letter-name-to-sound theory is supported by research indicating that children are better able to provide the sound for acrophonic letters (letters with phonemic cues in their names) than for non-acrophonic letters (McChang-Bride, 1999; Share, 2004).

Existing research suggests that letter-sound knowledge is an essential skill for alphabetic decoding (Castles et al., 2009; Fellowes & Oakley, 2014; Piasta et al., 2010) and thus, has a closer relationship with early word decoding than letter-name knowledge does (Huang, Tortorelli, & Invernizzi, 2014). Letter-sound knowledge is specifically fundamental to early word decoding because it helps children grasp the alphabetic principle by helping them understand that letters represent sounds (Huang et al., 2014; Manolitsis & Tafa, 2011). Moreover, accurate word decoding begins with converting written letters into sounds, a task critically dependent on robust letter-sound knowledge.

Thus, letter-name knowledge bolsters letter-sound knowledge, and letter-sound knowledge crucially facilitates word decoding (Kim et al., 2010).

Letter knowledge (letter-name knowledge and letter-sound knowledge inclusive) and phonological awareness have been found to be strongly correlated with each other, especially during the early stages of literacy acquisition (Blaklock, 2004; Caravolas, Hulme, & Snowling, 2001; Carroll, 2004; Castles et al., 2009; Gillon, 2004; Lerner & Lonigan, 2016). Letter-sound knowledge and phonological awareness both involve access to the sound structure of language (McBride-Chang, 1999) and they are both specifically developed for literacy. Moreover, the two skills interact in close ways, working in tandem when decoding words. Letter knowledge is used to convert letters into sounds while phonemic awareness skills are used to blend the sounds together to identify a word. It is no surprise then, that the two code related skills have an impact on one another's development (Lerner & Lonigan, 2016). However, the nature of this relationship remains unclear.

Many researchers believe that letter knowledge is robustly related with phonemic awareness levels but only weakly, if at all, related with supra-phonemic levels of awareness⁴⁶ (Bowey, 1994; Johnston, Anderson, & Holligan, 1996; Manolitsis & Tafa, 2011; Naslund & Schneider, 1996). Conversely, Lerner and Lonigan (2016) found evidence suggesting that preschool children's letter knowledge is also significantly related to phonological awareness at the word, syllable, and onset-rime level.

The causal relationship between letter knowledge and phonological awareness is also unclear. Some researchers believe that children begin to develop supra-phonemic

⁴⁶ 'Supra-phonemic' awareness refers to the awareness of any unit of sound larger than the phoneme, such as words, syllables, and onset-rimes (Lerner & Lonigan, 2016).

awareness skills before the acquisition of letter knowledge but that a certain degree of letter knowledge is necessary in order for children to develop phonemic awareness (Carroll, 2004; Goswami & Bryant, 1990; Johnston et al., 1996). This claim is disproved by experimental data indicating that phonemic awareness skills can be taught to children that do not have any letter knowledge skills (Caravolas et al., 2001; Castles et al., 2009; Hulme, Caravolas, Málková, & Brigstocke, 2005; Lundberg et al., 1988; Naslund & Schneider, 1996; Schneider et al., 1997). Conversely, some researchers believe that phonemic awareness is a foundational skill essential to the development of letter-sound knowledge (Stanovich, 1993). An intermediate view prevails, suggesting that there is a reciprocal relationship between phonological awareness and letter knowledge (Hulme, Snowling et al., 2005; Lerner & Lonigan, 2016). Letter knowledge promotes phonemic awareness growth and heightened phonemic awareness promotes letter knowledge growth (Huang et al., 2014; Lerner & Lonigan, 2016; Lonigan, 2006; Piasta & Wagner, 2010).

Letter-sound knowledge promotes phonemic awareness because letters help make psychological sounds more salient by attaching a symbol to the sound. Moreover, letter knowledge helps students realize that letters are individual entities corresponding to individual sounds. This realization, in turn, helps children become aware that words are not whole units. Rather, words are made up from patterns of individual letters representing individual sounds. This understanding encourages children to explicitly think about the phonemic structure of words (Blaklock, 2004; Carroll, 2004; Johnston et al., 1996). Likewise, phonemic awareness bolsters letter-sound knowledge because the ability to attend to individual phonemes makes it easier to associate sounds with their

corresponding letters (Castles et al., 2009). Children with higher levels of phonemic awareness are better able to access the sound structure of words, which in turn makes it easier to assimilate letter-sound correspondences (Naslund & Schneider, 1996). Existing research highlights the facilitative effect of each skill on the other.

A number of researchers have found that children need to possess a certain degree of letter knowledge in order to successfully complete phonemic awareness tasks (Carroll, 2004; Johnston et al., 1996). Similarly, adult studies indicate that proficient phonemic awareness skills are limited to alphabetically literate individuals when compared to illiterate adults or readers of non-alphabetic languages (Morais, Bertelson, Cary, & Alegria, 1986; Read, Zhang, Nie, & Ding, 1986). These findings suggest that letter knowledge bolsters phonemic awareness.

Conversely, Huang et al. (2014) found that children with proficient phonological awareness skills were better able to correctly identify letter sounds when compared to children with more rudimentary phonological awareness skills, indicating that phonological awareness has a facilitating effect on letter knowledge. Studies examining the letter-name-to-sound hypothesis also suggest that phonological awareness beneficially impacts letter knowledge growth. Researchers have found that proficient phonological awareness skills are needed in order for children to make use of the letter-sound clues found within their respective letter names (Kim et al., 2010; Lerner, & Lonigan, 2016). Recall that acrophonic letters include phonemic clues in their names. In order to utilize these clues, children must be able to identify, segment, and isolate the component sounds in a letter's name (Share, 2004).

Share (2004) conducted a study on Israeli kindergarten students who were not familiar with English letter names or sounds. The participants were randomly assigned into an experimental group and a control group. Both groups were presented with the same set of six letter-like symbols. The experimental group learned to associate the letter-like symbols with English letter names while the control group learned to associate the six symbols with semantically meaningful but phonologically unrelated Hebrew words. After completing this training, all participants were taught the same letter-sound correspondences for all six symbols. The children in the experimental group displayed a significant advantage over the control group, scoring considerably higher on letter-sound measures; however, this advantage was moderated by pre-training phoneme isolation scores. Error analysis also suggested that the children in the experimental group were using phonemic awareness skills to convert letter names into letter sounds. The acrophonic letter names consist of two phonemes, the letter's respective phoneme plus a vowel. A few of the participants in the experimental group provided the corresponding vowel sound instead of the target consonant providing evidence that the children were explicitly analyzing the phonological structure of the letter names.

Taken together, the existing research suggests that letter knowledge and phonological awareness are bi-directionally related; growth in one skill fosters growth in the other. Crucially, word reading tends to be strongly correlated with both letter knowledge and phonological awareness, particularly at the letter sound and phoneme level (Blaklock, 2004; Caravolas et al., 2001; Carroll, 2004; Castles et al., 2009; Gillon, 2004; Lerner & Lonigan, 2016). The relationship between letter knowledge and phonological awareness is important because one skill may mediate the effects of the

other skill on word reading. It is possible that phonological awareness directly impacts reading. It is also possible that phonological awareness indirectly impacts reading through letter knowledge; i.e., phonological awareness directly impacts letter knowledge and letter knowledge directly impacts reading. It is also possible that the effects of letter knowledge interact with the effects of phonological awareness in such a way that the effect of each skill cannot be considered separately (Hulme, Snowling et al., 2005).

Blaiklock (2004) found that there is indeed a significant positive correlation between phonemic awareness and reading but that the relationship is largely mediated by the role of letter knowledge. The correlation between phonemic awareness and reading significantly lowered in size when controlling for letter knowledge. Blaiklock argued that these findings do not indicate that phonemic awareness is not important. Rather it indicates that measures of phonemic awareness and letter knowledge overlap in the variance they explain in reading development and thus should be investigated together. Lerner & Lonigan (2016) also found that neither initial level of phonemic awareness nor initial letter-sound knowledge was uniquely associated with growth in phonemic awareness suggesting that phonemic awareness and letter-sound knowledge share much of their predictive variance.

Hulme, Snowling, et al. (2005) argue that the potential mediator effect, the claim that letter knowledge mediates how phonemic awareness impacts reading, does not weaken the status of phonemic awareness. Instead, it draws attention to the fact that various processes interact during literacy development making it difficult to determine the causal role of individual skills on literacy acquisition. Mediator effects give more nuanced explanations of how disparate skills work together. For example, dietary

changes may contribute to heart health. However, increases in heart health are mediated by lower cholesterol levels. Diet change still causes increased heart health even though this increase is a result of healthier cholesterol levels (Hulme, Snowling, et al., 2005).

In summary, letter knowledge and phonological awareness are both significantly related to each other and to later literacy development. However, the scope of this relationship, whether at just the phoneme level or at supra-phonemic levels as well, is unclear. The causal relationship between the two code-related skills is also unclear. It is necessary to investigate the effects of letter knowledge training in phonological awareness studies in order to account for the possibility that any gains in reading may have resulted from gains in letter knowledge (Blaklock, 2004). Training effects may be a result of phonological awareness increases, letter knowledge increases, or increases in both. Further research is needed to clarify the exact causal relationship between the two skills.

3.6 PHONOLOGICAL AWARENESS ASSESSMENT AND INTERVENTION

Assessment and intervention go hand in hand as a child's performance on an assessment can be used to decipher whether a child needs intervention and what specific intervention is needed. It is important to identify children who have poor phonological awareness skills as early as possible so that intervention can be administered before the child develops further reading and learning difficulties. The younger a child is, the more plastic and malleable their brain is. The earlier at-risk children undergo reading intervention, the more likely it is for them to rewire their neural circuits and this rewiring helps alleviate or

even prevent future reading difficulties (Shaywitz, 2003). Moreover, children who do not develop adequate word level reading strategies read considerably less and are thus exposed to significantly less words than their typically developing peers. This gap, between the amount of words read by reading disabled children and the amount of words read by typically developing children, grows larger with time as typically developing children continue to move forward. What is more, children who struggle to read at an early age tend to become discouraged and uninterested in reading (Shaywitz, 2003). It is clear that early assessment and intervention is crucial.

3.6.1 Assessment

Young children possess different levels of phonological awareness (Fellowes & Oakley, 2014), and identifying children's current levels can help educators place students in programs appropriate to their level of ability. Teachers can assure that children who are already competent in certain tasks are not placed in training programs that focus on skills they already possess (Fellowes & Oakley, 2014). Phonological awareness assessments also help teachers identify children who are at risk for future reading difficulties. Moreover, assessments help teachers monitor students' progress, which helps determine whether the current training is working or alternative measures must to be taken.

As mentioned in section 3.2.1, phonological awareness can be assessed by any task that requires children to attend to and possibly manipulate sound units (Moats, 2007). Nevertheless, careful attention should be given to choosing assessment tasks that correspond to the developmental level of the children assessed (Vloedgraven &

Verhoeven, 2009). Tasks tapping abilities on the simple side of the phonological awareness continuum, such as rhyme oddity tasks, are more appropriate for very young children and possibly disabled readers while tasks on the more complex side of the continuum, such as phoneme segmentation and phoneme substitution, are more appropriate for older children (Nicholson, 2005). Tasks should be developmentally appropriate so that they can help differentiate between good and poor readers (Vloedgraven & Verhoeven, 2009). Assessment tasks should also have the ability to reveal noticeable change over time. (Chafouleas & Martens, 2002). McBride-Chang (1995) suggests that linguistic manipulations on task items can be used in order to increase difficulty within a task and thus monitor student growth within a particular task⁴⁷.

Nonetheless, the existing research on phonological awareness does not clearly or conclusively state how to best assess children in regards to which tasks are most useful in highlighting the existence of problematic phonological awareness skills or on how to systematically use linguistic manipulations within and across tasks to monitor student progress (Chafouleas & Martens, 2002; Kilpatrick, 2012). As previously mentioned, deciphering which tasks best measure phonological awareness level is difficult because of the number of differing tasks available, the different variations within the same task (phoneme segmentation with or without counters; phoneme identification by matching a sound to a word or by asking what sound is the same in a list of words), and the various combinations of linguistic manipulations possible. Additionally, task difficulty may be language specific as the various languages have different phonological characteristics

⁴⁷ Linguistic manipulations such as asking children to identify the first phoneme in a target word versus asking children to identify the medial phoneme in a target word.

(Aidinis & Nunes, 2001; McBride-Chang, 2004). An abundance of research has asserted that there is a relationship between phonological awareness and early reading. However, limited research has been dedicated to comparing the difficulty amongst the various tasks or the difficulty amongst different test items within a particular task. Further research is needed to shed light in regards to the relative difficulty amongst assessment tasks.

3.6.2 Intervention

The primary goal of an intervention program is to help children become better readers and spellers by helping them understand that spoken words can be broken down into phonemes, which in turn are systematically represented by letters of the alphabet (Blachman et al., 2000). It is important to remember that improving phonological awareness is a means to an end. The point of improving phonological awareness is to facilitate reading, not to instill strong phonological awareness skills (NICHD, 2000). However, researchers have not yet reached an agreement in regards to which training characteristics most effectively facilitate reading acquisition (McKenna et al., 2010). Studies differ in regards to the content, duration, and delivery of the training as well as in the characteristics of the participating students. Fortunately, however, the research shows that most variations of phonological awareness intervention are effective in accelerating phonemic awareness growth (Gillon, 2004; NELP, 2008; NICHD, 2000).

In order to evaluate the effectiveness of different forms of phonemic awareness training, the National Reading Panel (NRP) conducted a meta-analysis of studies published in refereed journals (NICHD, 2000). Each was an experimental study

consisting of both an experimental group receiving phonological awareness training and a control group that did not receive phonological awareness training. Each study tested the hypothesis that phonemic awareness training improves later reading. The analysis included 52 studies, which allowed for 96 instructional comparisons. The studies differed in the type of phonemic awareness training administered, the grade level of the subjects, and the ability level of the subjects (typically developing, at-risk, or diagnosed disabled readers). Overall, phonemic awareness training proved to have a stronger impact on phonemic awareness, word reading, pseudoword reading, and reading comprehension than any other type of reading intervention (such as whole word intervention). Moreover, the positive effect that phonemic awareness training had on reading skills was retained long term. Additionally, positive effects were found across the studies regardless of the teaching method, testing method, or student characteristics.

The NRP report only examined interventions that targeted phonemic awareness. However, The National Early Literacy Panel's⁴⁸ 2008 research synthesis examined all code-based interventions. The NELP report included all studies that examined interventions designed to teach an alphabetic code related skill. One of 83 studies examined the effect of letter knowledge training on the development of literacy. The other 82 interventions included some form of phonological awareness training. Some of these 82 phonological awareness interventions also included letter knowledge training and/or early decoding skills. The panel found that phonological awareness interventions had moderate to large effects on measures of reading in all studies (with the exception of the one study that did not include phonological awareness training). The positive effects

⁴⁸ Endorsed by the US National Institute for Literacy and the US Department of Health and Human Services

were found regardless of the phonological awareness training method used, the age of the children studied, or whether letter knowledge and/or early decoding instruction were also included in the training. That being said, the research does suggest that certain circumstances have bigger impacts on later reading.

Training programs that include letter training are clearly more successful than purely phonetic programs (Ball & Blachman, 1991; Bus & IJzendoorn, 1999; Hohn & Ehri, 1983; NIHCD, 2000). Recall that the Bradley and Bryant study (1983) consisted of two experimental groups and two control groups. Group 1 received purely phonemic training, Group 2 received phonemic training as well as letter-sound correspondence training, Group 3 received semantic training, and Group 4 received no training. After three to four months, Group 1 performed slightly better than Groups 3 and 4 on both of the reading tests administered. Group 2, however, performed significantly better than Group 1 on both reading tests administered. Group 2 also significantly outperformed Group 1 on the spelling test.

The advantage in early reading cannot be attributed to letter knowledge training alone. Studies that included letter knowledge control groups prove that letter knowledge training alone does not have a significant effect on reading (Ball & Blachman, 1991; O'Connor et al., 1995). However, the inclusion of letter training significantly enhances phonological awareness training programs. Two explanations for this finding have been offered. First, the inclusion of letters helps children perceive individual phonemes because letters provide visual symbols for otherwise abstract entities (Adams, Treiman, & Pressley, 1998). Second, using letters in phoneme manipulation tasks helps children understand the connection between phonemic awareness and reading (NICHD, 2000).

Another common finding throughout the research is that intervention programs are most successful when they focus on phonological awareness at the phoneme level (Callaghan & Madelaine, 2012; Moats, 2007). Studies suggest that phonemic awareness measures account for a significant portion of the variance in post-training tests while sub-phonemic awareness⁴⁹ measures do not account for a significant portion of the variance (Mann & Foy, 2003; Lundberg et al., 1988). Many researchers believe that rhyme and syllable awareness are not as crucial to reading development as phonemic awareness is because letters represent phonemes (Gillon, 2004). However, manipulation of phonemes can be too difficult for preschool children (Lonigan, 2006) and syllable and rhyme awareness tasks are useful in preparing children to break down words into smaller and smaller units. Additionally, there is evidence that onset-rime awareness helps learners ‘read by analogy’ (for example, being able to read ‘tick’ because you know how to spell ‘sick’) (Ehri et al., 2001; Goswami & Mead, 1992). Thus, training programs can make use of tasks at sub-phonemic levels as long as the programs progress towards phonemic awareness tasks.

Another noteworthy finding is that the relationship between early reading and the different levels of phonological awareness may vary across languages considering that languages differ in their phonological characteristics. For example, English has various monosyllabic words made of complex syllables. Other languages, such as Portuguese and Greek, do not have many monosyllabic words and are predominantly made up of longer words with more simple syllables (Aidinis & Nunes, 2001). Aidinis and Nunes (2001) hypothesized that syllable awareness might play a bigger role in

⁴⁹ Sub-phonemic levels include units of sound higher than the phoneme such as syllable awareness and onset-rime awareness.

learning how to read and write in languages with fewer monosyllabic words and a higher number of multisyllabic words comprised of simple syllables. Their hypothesis was confirmed as they found that both syllable awareness and phonemic awareness made significant and independent contributions in predicting later reading in Greek-speaking children. Accordingly, it is important to investigate the relationship between early reading and the different levels of phonological awareness for the specific language being targeted by an intervention.

Existing research makes it difficult to clearly state the causal importance of disparate tasks on reading because there have only been a few attempts at comparing the relative relationship of the various tasks and word reading amongst the same children (Kilpatrick, 2012). Additionally, a particular task may have a facilitative effect on early literacy development in one language but may not be as beneficial in another language (Aidinis & Nunes, 2001). Perfetti, Beck, Bell, and Hughes (1987) argue that synthesis tasks (blending) are the most facilitative on emergent reading development while analysis tasks (segmentation, isolation) are mostly an artefact of reading instruction. Kilpatrick (2012) also found segmentation to have the weakest correlation with basic reading measures and found that it did not account for any portion of the variance after being controlled by the blending task. Contrastively, Helfgott (1976) found that phoneme segmentation had a stronger correlation with basic reading than phoneme blending did. In any case, blending-only training and segmentation-only training have both exhibited positive effects on reading (Davidson & Jenkins, 1994; Reitsma & Wesseling, 1998). However, evidence suggests that interventions are most successful when they combine

both blending and segmentation training (Fox & Routh, 1976 & 1984; NICHD, 2000; Torgesen, Morgan, & Davis, 1992).

Although the available research does not determine which kind of task has the most facilitative effect on reading acquisition, many researchers believe that phoneme blending and phoneme segmentation are the most significantly related tasks to reading acquisition (Lewkowicz, 1980; Nicholson, 2005; O'Connor et al., 1995; NICHD, 2000; Schuele & Bourdeau, 2008). Phillips and Torgesen (2006) argue that phoneme blending and segmentation are integral to applying the alphabetic code to decoding and spelling. When reading unknown words, children must first transform graphemes into sounds and then blend the sounds and scan their lexicons for matching words. Blending and segmentation skills also help emergent readers decode unknown words by analogy. For example, when students who are familiar with the word 'ball' encounter 'wall' for the first time, they can segment the onset and rimes of both words and then blend the onset of the new word /w/ with the rime of the old word /ɔ:l/. Eventually, students begin reading words by memory as they acquire orthographic representations for each word. It is argued that in order for children to save orthographic representations of words in memory, they must first be able to segment a spoken word into its constituent phonemes which are then linked to their corresponding letters (NICHD, 2000). This same process, segmenting a word into its constituent phonemes and linking them to their corresponding letters, is used for spelling. Therefore, it makes sense that phoneme blending and phoneme segmentation skills have been the focus of many interventions.

Many interventions also include phoneme identification training. Byrne and Fielding-Barnsley (1989; 1990) concluded from their studies that training phoneme

identification skill is more beneficial to later reading development than training phoneme segmentation skills. Høien, Lundberg, Stanovich, and Bjaalid (1995) also tested the relationship between phoneme identification, phoneme segmentation, and phoneme blending and early word reading on 1,509 first graders. Their data also suggests that phoneme identification skill has the strongest relationship with early word reading while phoneme blending had the weakest relationship.

Murray (1998) built on Byrne and Fielding-Barnsley's work and investigated whether phoneme identification training or phoneme segmentation and blending training had a bigger effect on children using the alphabet to decode words. Murray tested this question on 48 preliterate kindergarten children who were divided into three intervention groups: a segmentation and blending training group, an identification training group, and an indirect language experience group. Children in the indirect language experience group examined illustrations in storybooks, listened to stories read aloud, talked about the stories, and jointly composed their own story. Results from the reading post-test suggest that the identification group was better at applying the alphabetic principle to early reading tasks than the other two groups of children were. While the phoneme identification group made significant gains in phonetic cue reading, neither the segmentation and blending group nor the language experience group made above chance gains. Murray (1998, p.472) argues that "knowledge of phoneme identities is needed to recognize phonemes" and is therefore a requisite for acquiring letter-sound correspondences. Further research is needed to determine which tasks have the most facilitative effect on the development of early reading skill.

Interestingly, there is evidence that phonological awareness interventions that

focus on two tasks are slightly more successful than interventions focusing on only one task, which in turn are considerably more successful than interventions consisting of three or more tasks (McKenna et al., 2010; NICHD, 2000). Perhaps children in multiple skills training do not receive the necessary amount of time to master these skills. Another possible explanation is that multiple skill students become confused as to which trained skill they are meant to apply when they are assessed on an assortment of skills post training (NICHD, 2000).

O'Connor et al. (1995) set out to determine how extensive low-skilled kindergartners' phonological awareness training must be in order for them to catch up to their high-skilled peers. 75 non-readers with low phonological manipulation skills were randomly assigned to the low-skilled group. 25 non-readers with high phonological manipulation skills were randomly assigned to the high-skilled group. The low-skilled group was divided into three groups of 25: a blending-segmenting treatment group, a multi-skill treatment group, and a letter-sound control group. Students in the two treatment groups participated in two 15-minute training sessions a week for ten weeks. Throughout the ten weeks, children in the blending-segmenting group practiced blending and segmenting at the onset-rime and phoneme level. During this same ten-week span, children in the multi-skill treatment group practiced rhyming words, manipulating words in sentences, manipulating syllables in words, and manipulating phonemes in words. The multi-skill group participated in blending, segmentation, isolation, identification, and deletion tasks. During the last five weeks of training, all 75 students (from the low-skilled group) were taught the same letter-sound correspondences for three minutes twice a week.

At the end of the ten weeks, all 100 students (low and high-skilled) repeated the same blending, segmenting, deleting, and rhyming assessments taken during the pre-intervention phase. They also took a phoneme isolation test in which children were asked to give the first sound in a word. The researchers administered ‘mastery tests’ that incorporated the same words and tasks used during training in order to determine how well children in the treatment groups mastered the skills taught during the intervention. The researchers also wanted to know how well the children could transfer these skills to new words and phonological awareness tasks. The researchers administered the Lindamood Auditory Conceptualization Test (LAC) to all 100 students for the purpose of measuring transfer to more broad phonological contexts. The LAC included words and tasks very different to those used in the intervention. Lastly, researchers used a Reading Analog Test to measure the transfer of trained phonological awareness skills to early word decoding. For the reading analog task, researchers reviewed four letter-sound correspondences (A, M, S, and T) with the students and then asked them to read five monosyllabic regular words containing only these four letters (am, at, mat, sat, sam). The five words were presented once each per trial. After each trial, the cards were shuffled. The same procedure was repeated 25 times or until the student read all five words correctly in one trial.

Amongst the three groups in the low-skilled group, there were no significant differences on syllable deletion, rhyme production, or phoneme isolation measures. However, both treatment groups performed better than the letter-sound control group on segmenting tasks, blending tasks, the LAC, and the Reading Analog test. The only difference between the two treatment groups was that students in the blending-

segmenting treatment group were able to read all five target words in the reading analog test quicker, and more students were able to complete the task within 25 trials. The syllable deletion task was the only measure that produced significantly different results between the high-skilled group and the two treatment groups (with the exception of the multi-skilled group performing slightly worse on the reading analog test).

The results of this study suggest various ideas that are important when creating the most appropriate phonological awareness interventions for at-risk students. First, children solely trained in segmenting and blending are able to transfer these skills into a broad range of disparate phonological awareness skills. Second, blending-segmenting only trained children (BS) do just as well as multi-skill trained children (MS) when tested on those skills taught only to MS students. In fact, BS children performed equally to their MS peers (who were trained in a broader range of phonological skills) on a test of multiple phonological manipulations (the LAC test). Third, BS children were slightly better than MS students at transferring their newly trained phonological awareness skills to an early word decoding task. Fourth, at-risk students (who were only trained in segmenting and blending) were able to catch up to their highly-skilled peers on levels of general phonological awareness and early word decoding. These results suggest that training in segmenting and blending alone is enough to bring at-risk children's phonological awareness skills to a level similar to their high-skilled peers. Furthermore, focusing solely on just segmenting and blending (rather than a multitude of skills) may even be beneficial in facilitating early word decoding.

Regardless of the specific tasks used in a training program, all training programs should progress from easy to increasingly difficult tasks (Good et al., 1998; Schuele &

Bourdreau, 2008; Smith, Simmons, & Kameenui, 1998). Additionally, effective training programs should model tasks to children; i.e., children should receive guided practice before being asked to complete tasks on their own. This allows children to focus their cognitive abilities on the phonological operations rather than on figuring out task instructions (McKenna et al., 2010). Furthermore, successful interventions supply children with feedback throughout the training (Phillips et al., 2008). Feedback helps students learn from their mistakes. Moreover, positive feedback motivates students to continue learning.

In conclusion, the research strongly suggests that phonological awareness training helps promote reading acquisition. However, an agreement regarding best teaching practices does not exist. Researchers agree that training programs should progress from simple tasks to more difficult tasks. They should also include letter knowledge activities, guided practice, and feedback. Many researchers agree that interventions should focus on phonemic awareness tasks, specifically segmentation and blending tasks. However, very few studies have compared the effectiveness of the various different phonological awareness tasks on later reading. Existing research regarding the necessary duration of training needed to facilitate reading is also inconclusive.

Although the majority of studies show beneficial effects of phonological awareness training, some intervention programs have resulted in minimal effects or none at all. One explanation for the disparity between results is that certain components of training programs are more beneficial to early word reading than others (Stanovich, Cunningham, & Cramer, 1984). Therefore, further research is needed to determine how to best train phonological awareness so that interventions can be as effective as possible.

3.6.3 Computer Based Intervention Studies

A myriad of educational computer based programs are used today to help bolster children's academic skills. Computer administered instruction has proven to be effective and efficient in training academic skills to students because it gives students more independent practice, allows them to work at their own level, offers immediate feedback, and can be more motivating for young children (Chai, Ayres, & Vail, 2016; Fitzgerald & Koury, 1996; Kulik, Banger, & Williams, 1983). Reading specialists have been developing computer administered phonological awareness training programs since the 90s and the effectiveness of these programs has been investigated by many researchers.

The first study examining the effectiveness of a computer based phonological awareness training program was published in 1994 when Foster, Erickson, Foster, Brinkman, and Torgesen created and trialled DaisyQuest I and II (Erickson, Foster, Foster, Torgesen, & Packer, 1992). DaisyQuest begins with a rhyme recognition task which helps children become familiar with the program with an easy to complete task. The program then moves on to phoneme analysis activities (phoneme segmentation and phoneme identification targeting initial, middle, or final sounds) and phoneme synthesis activities (onset-rime blending and phoneme blending) as research suggests that both analysis and synthesis skills are important for early word reading. The creators found it difficult to train segmentation on a computer due to limitations imposed by computer capabilities. Therefore, DaisyQuest places a heavier emphasis on phoneme identification activities when training phoneme analysis skill. The computerized program revolves around the theme of finding Daisy the friendly dragon who is hiding. Clues to Daisy's

whereabouts are given to students as they master the different skills trained in the program. Findings from two separate experimental studies, one with pre-schoolers and another with kindergarten students, suggest that DaisyQuest is effective in improving the skills taught in the program. In both studies, children in the experimental groups outperformed students in the control groups on post-test measures. The training effect size was significant and comparable to effect sizes found in phonological awareness studies that examine the effectiveness of teacher led training programs (Foster et al., 1994).

Some researchers believe that computer administered training programs are only useful in the classroom if they are as effective as face-to-face training (Foster et al., 1994). As such, various studies have compared the effects of computerized training with the effects of teacher-delivered instruction on children's early literacy development and many have provided evidence suggesting that computerized training can be as effective as face-to-face training (Hecht & Close, 2002; Kyle, Kujala, Richardson, Lyytinen, & Goswami, 2013; Segers & Verhoeven, 2005; Wild, 2009). However, there is some evidence that computer based training may only be as effective as teacher delivered training on particular tasks. Teacher-delivered instruction may be more beneficial for certain tasks due to existing computer capabilities.

In a 2001 study, Mitchell and Fox compared the effects of computer administered phonological awareness instruction, teacher-delivered phonological awareness instruction, and computer based nonlinguistic academic instruction on the phonological awareness skills of at-risk kindergarten and first grade children. Children in the nonlinguistic software group spent the same amount of time interacting with the

nonlinguistic software as the students in the phonological awareness software group spent on the phonological awareness software. The teacher-delivered instruction targeted the same skills taught in the phonological awareness software program. After just four weeks, both the computer administered treatment group and the teacher delivered treatment group significantly outperformed the technology control group suggesting that both computer based and teacher delivered phonological awareness training programs are effective in enhancing at-risk children's phonological awareness skills. However, there were differences amongst the different skills tested: the teacher delivered instruction group outperformed the technology control group on rhyme discrimination, phoneme isolation, phoneme segmentation, and phoneme blending while the computer based training group significantly outperformed the technology control group on phoneme isolation, phoneme blending, and only minimally outperformed them on phoneme segmentation.

Various diverse computer based phonological awareness programs have been created since DaisyQuest and research studies have provided evidence of their effectiveness when compared to control groups. Computer based programs have taken the form of software programs, web-based programs, and even tablet (iPad/Samsung tab) and phone apps. The research has suggested that these computer based interventions can accelerate phonological awareness and word identification skills for typically developing children (Savage, Abrami, Hipps, & Deault, 2009; Savage et al., 2013), for at-risk children (Lonigan et al., 2003), for children coming from low socioeconomic status households (Comaskey, Savage, & Abrami, 2009; Di Stasio, Savage, & Abrami, 2012;

Hecht & Close, 2002; Kartal & Terziyan, 2016), and for children with low attention difficulties (Deault, Savage, & Abrami, 2009).

Researchers attribute the success of computer based programs on various qualities such as: they provide sufficient one-on-one practice, they provide immediate, individualized, and positive feedback, and they allow students to progress at their own pace. Furthermore, students may be highly motivated by the engaging game-like interactional features of computerized programs and the student's potential sense of control (Kartal & Terziyan, 2016; Macaruso & Rodman, 2011; Mioduser, Tur-Kaspa, & Leitner, 2000; Wolgemuth et al., 2013). Computerized training programs are also beneficial because they require less teacher aide time to deliver and are less likely to vary from classroom to classroom (Foster et al., 1994; Hecht & Close, 2002).

The appeal of requiring less teacher aide time with computerized programs sparked the interest of researchers focusing on Indigenous Australian students. Wolgemuth et al. (2013) suspected that computer based interventions would be particularly beneficial for Indigenous children attending schools in the Northern Territory, Australia that have a high rate of teacher turnover and a shortage of teachers trained in teaching early literacy. The researchers believed that computer programs might be able to help sustain educational continuity in these settings. Moreover, they believed computer administered interventions had the potential to help Indigenous children catch up to their non-Indigenous peers on measures of phonological awareness and early literacy skills. The researchers randomly allocated 360 kindergarten to Grade 2 Indigenous and non-Indigenous students into either an intervention group or a control group. The intervention group was pulled out of class four times a week to receive 30-45

minutes of a web-based phonological awareness training program. The control group participated in their usual literacy classes during this time. The results indicated that the intervention was in fact, particularly useful for Indigenous children.

All students in the intervention group outperformed the students in the control group on phonological awareness, letter knowledge, and reading post-test measures. Interestingly, the intervention results suggest that the Indigenous children benefited significantly more from the training than the non-Indigenous children did. The Indigenous students in the intervention group had lower attendance rates, and therefore spent less time participating in the intervention than the non-Indigenous students in the intervention group did. However, the Indigenous students in the intervention group had significantly greater standard score gains per hour of intervention than the non-Indigenous children in the intervention group on measures of phonological awareness and early reading. Moreover, the post-test scores for the Indigenous children in the intervention groups were almost three times the size of the post-test scores of the non-Indigenous students in the control group. This finding is particularly relevant to the current study as it focuses on computerized phonological awareness training for Indigenous Australian children in the Northern Territory, Australia.

3.7 CHAPTER DISCUSSION

The purpose of reading is to understand the context of any text. In order to understand a text, a child must first learn how to convert written language into oral language that can be processed in the brain's linguistic processing center. The alphabetic code is a robust

tool that can be utilized to convert all unknown written words into spoken language. Cracking the alphabetic code is a significant developmental feat for children attempting to learn how to read an alphabetic language. However, in order to make use of the code, children must first acquire phonological awareness.

Existing research makes it clear that phonological awareness has a significant and causal relationship to the development of early word reading skill. While some students acquire phonological awareness naturally, many others need explicit training. Correlational studies have shown that good readers tend to perform well on phonological awareness assessments while bad readers tend to perform poorly. Experimental studies have suggested that phonological awareness can be taught before children have undergone any kind of reading instruction and that this training bolsters early word recognition ability. Similar effects have been displayed by phonological awareness intervention studies targeting children who are already undergoing literacy training. However, it is important to administer phonological awareness training to children at risk for reading problems as early as possible.

Researchers have created a wide range of tasks designed to assess and train phonological awareness skill. These skills vary in difficulty based on the level of awareness targeted, the cognitive demands of the task, and the linguistic manipulations to the task items. Researchers have not reached consensus on how exactly the disparate tasks fit along a continuum of difficulty. The research is also unclear in regard to how the different tasks relate to early word reading. It is important to investigate the relative difficulty and the natural progression of skill attainment so that children at risk for reading problems can be identified as early as possible (Vloedgraven & Verhoeven,

2009). It is also important to investigate the relative difficulty of the different phonological awareness tasks as well as their relative effects on later literacy so that educators and researchers can create effective interventions (Chafouleas et al., 1997).

Existing research suggests that phonological awareness is to an extent language-specific (Stuart-Smith & Martin, 1999). The majority of the phonological awareness research has been conducted on popular Western languages. Not many studies focus on the development of phonological awareness skills in children who come from cultures primarily transmitted through oral tradition. Benchmarks may be different for children who are not exposed to literacy events in the home. Certain tasks may be more beneficial than others for one language but not for another language. As of now, specific information regarding the relationship between phonological awareness and early word recognition in Dhuwaya is not available. The current project aims to fill this gap of knowledge. Understanding the relationship between various phonological awareness tasks and word recognition in Dhuwaya may help educators create effective assessments and intervention programs for this particular population of children.

CHAPTER FOUR

4.0 YOLŬU MATHA PHONOLOGY AND ORTHOGRAPHY

This chapter overviews Yolŋu Matha phonology and orthography, beginning with a description of YM phonology in section 4.1. YM segmental phonology and phonotactics are discussed in this section. This analysis largely follows Amery (1985) and Morphy (1983) but has also been informed by Chong (2011), Jepsen (2019), Walker (1984), and Wilkinson (1991). Morphophonemic rules are not discussed in this chapter because they do not pertain to this thesis. The words used in this project are monomorphemic. Please refer to Morphy (1983) and Wilkinson (1991) for descriptions of Djapu and Djambarrpuyŋu (respectively) morpho-phonological rules. Note that the results from this project can be compared with similar studies conducted in other Yolŋu communities because of the use of isolated words. Recall that the different clan languages are largely distinguished by grammatical morphology. Section 4.2 describes the YM orthography. The differences between learning how to read in YM and English are then discussed.

4.1 YOLŬU MATHA PHONOLOGY

This section describes the consonant and vowel inventories of Dhuwaya. A discussion on the oral stop series is included because the phonemic analysis of these sounds is not straightforward amongst Yolŋu languages. The glottal stop is discussed in greater detail as it does not behave like the other phonemes found in the language.

4.1.1 Segmental Units

Consonants

The Dhuwaya consonant inventory is fairly typical of Australian language in that it is ‘long and flat’ (Butcher, 2006). As shown in Table 4.1, Dhuwaya has a six-way place of articulation contrast – bilabial, dental, alveolar, retroflex, palatal, and velar - for stops and nasals as well as two laterals, a trill, and three approximants. Another characteristically Australian feature is the absence of contrastive fricative phonemes. Less characteristic is the existence of a glottal stop in Dhuwaya and of a contrast amongst two stop series in certain Yolŋu Matha dialects (Wilkinson, 1991). Phonetic glottal stop can be contrastive but it behaves differently from the other segmental phonemes and has been analyzed as a prosodic feature of the syllable (Amery, 1985; Wilkinson, 1991). The possible distinction between the two different kinds of stops has often been referred to in the Yolŋu literature as a “fortis/lenis” distinction and I will continue to use these terms in this thesis. The fortis/lenis distinction only surfaces in certain intercontinuant morpheme internal positions and has been lost in all but a few words due to a historical process of lenition affecting the lenis stop series (Wilkinson, 1991). Thus, the number of consonant phonemes in Yolŋu Matha languages depends on whether fortis and lenis stops are analyzed as contrastive phonemes or as allophones of the same phoneme. Amery (1985) claims that “for eastern Dhuwal/Dhuwala dialects and probably for most, if not all languages spoken at Yirrkala, the only phonemic contrast left is between the retroflex stops in the environment (vowel/liquid) ____ (vowel). All other stops corresponding to the voiced series in Gupapuyŋu having been lenited to /y/ or /w/” (Amery, 1985, p.3).

Table 4.1*Dhuwaya Consonant Inventory #1*

	bilabial	Lamino-Dental	Apico-alveolar	Apico-retroflex	Lamino-palatal	Velar
Fortis Stops	p	t̪	t	ɽ	c	k
Lenis Stops				d̪		
Nasals	m	n̪	n	ɳ	ɲ	ŋ
Laterals			l	ɭ		
Trill			r			
Approximants	w			ɻ	j	

Yolŋu consonant inventories are also commonly organized under the major column headings of peripheral, apico-, and lamino- (see Table 4.2). This categorization reflects the way that phonemes from different place of articulation groups behave in both their distributions and in their role in morphophononemic processes.

Table 4.2*Dhuwaya Consonant Inventory #2*

	Peripheral		Apico-		Lamino-	
	Bilabial	velar	Alveolar	retroflex	dental	palatal
Fortis Stops	p	k	t	ɽ	t̪	c
Lenis Stop				d̪		
Nasals	m	ŋ	n	ɳ	n̪	ɲ
Laterals			l	ɭ		
Trill			r			
Approximants	w			ɻ	j	

Oral Stop Analysis

The phonemic analysis of oral stops in Yolŋu Matha languages is complex. It is clear that oral stops contrast at six different places of articulation: bilabial, lamino-dental, apico-

alveolar, apico- retroflex, lamino-palatal, and velar (some YM varieties only have contrasts at 5 places⁵⁰) (Amery, 1985; Morphy, 1983). However, some Yolŋu dialects also distinguish two different types of stops in certain word-medial positions and the analysis of this distinction is less clear (Morphy, 1983). The distinction is most commonly referred to as a fortis/lenis distinction but it has also been discussed in terms of voiced/voiceless, geminate/singleton, and tense/lax (Chong, 2011; Morphy, 1983). As previously mentioned, I will use fortis/lenis in this thesis.

The fortis/lenis distinction is only found in morpheme-medial intercontinuant positions when the preceding segment is either a vowel or a liquid and the following segment is a vowel. Elsewhere, the contrast is neutralized - lenis stops occur word-initially⁵¹ and following nasals while fortis stops occur word-finally and following stops (Morphy, 1983; Wilkinson, 1991). The word-medial fortis/lenis distinction is further restricted in some eastern Dhuwal/Dhuwala dialects where the contrast has been eliminated for most, if not all, but the apical series by a historical process of lenition to the lenis stops (Chong, 2011; Morphy, 1983). Peripheral and laminal lenis stops in intramorphemic intercontinuant position have been lenited to /w/ and /y/, respectively, resulting in the complete elimination of the peripheral and laminal stop contrast (Wilkinson, 1991). Evidence of this sound change can be taken from comparisons between cognates from western Dhuwal/Dhuwala languages where the stop contrast is still strong today and eastern Dhuwal/Dhuwala languages where lenition has applied extensively. The following examples are taken from Morphy (1983, p.14).

⁵⁰ Some western YM varieties such as Djinaŋ and Djinba only contrast stops at five places of articulation. These languages do not have the lamino-dental stop series in their phonemic inventory (Wilkinson, 1991).

⁵¹ Morphy (1983) claims that voiced and voiceless stops occur in free variation in word-initial position, however, this is only somewhat true. The vast majority of inherently Yolŋu words begin with a phonetically voiced consonant (Amery, 1985).

West (Gupapuyŋu)	East (Djapu)	
<u>l</u> irrgi	<u>l</u> irrwɪ	‘charcoal’
warguguyu-N	warwuwuyu-N	‘grieve’
baɭgapthu-N	baɭwapthu-N	‘crouch’
bulbul	bulwul	‘lethargic’
budju’yu-N	buyu-yu-N	‘rub’
gadjak	gayak	‘subsection term’
gudhaɭ’yu-N	guyaɭ’yu-N	‘cook’

Studies on eastern Dhuwal/Dhuwala languages have found that lenis /d/ only occurs in a contrastive environment in one word: *gurudut* ‘peaceful dove’ which appears in both eastern and western dialects (Morphy, 1983). Wilkinson (1991) argues that the inclusion of this word in eastern Dhuwal/Dhuwala dialects may be explained by the fact that it refers to the name of a bird and bird names tend to be onomatopoeic in Yolŋu languages. Therefore, the only remaining stop contrast in present-day eastern YM dialects found in morpheme-medial position is /t/ vs. /d/ (Morphy, 1983). The following minimal pair provides evidence of the contrast between the apico-retroflex series.

yarraɖa	/jaraɖa/	lightning
yarraɭa	/jaraɭa/	string, line, row

Three analyses concerning the interpretation of the intercontinuant fortis/lenis opposition have been proposed: segmental, geminate, and prosodic (Amery, 1985; Walker, 1984). The segmental solution, first proposed by Lowe, proposes that a phonemic contrast exists between the pairs of fortis/lenis stops. This approach also proposes that the glottal stop is a segmental phoneme (Amery, 1985; Walker, 1984). Yolŋu Matha orthography is based on the segmental solution (more on YM orthography

in section 4.2). The geminate solution, initially adopted by Schebeck (1976), proposes that the phonetically fortis, voiceless, and sometimes long stops are phonologically geminate clusters while the lenis, voiced, and short stops are phonologically simple stops (Walker, 1984 p.1). The glottal is analyzed as a prosody of the syllable in this approach (Amery, 1985). The prosodic solution, first proposed by Wood (1978) and later developed by Walker (1984), proposes that all stops in intercontinuant position are underlying lenis stops. Stops in intercontinuant position become fortis by fusing with a preceding underlying glottal stop (Amery, 1985; Walker, 1984a; Wood, 1978). The underlying glottal stop from the preceding fortis syllables does not surface as a glottal stop but instead manifests by giving a following stop its fortis quality. (Walker, 1984). The glottal stop is also analyzed as a prosodic feature of the syllable that plays an instrumental role in producing the apparent fortis/lenis distinction in the contrastive environment (Amery, 1985). The contrast between the three analyses can be seen in the analysis of the following data:

Phonetic Representation	Segmental Solution	Geminate Solution	Prosodic Solution	Gloss
[ba:ba]	/ba:ba/	/pa:pa/	/pa:pa/	‘gum nut’
[ba:pa]	/ba:pa/	/pa:ppa/	/pa:pa/	‘father’

Walker (1984) argues that the prosodic solution is the strongest solution because it can account for certain data that cannot be effectively explained by the segmental and geminate solutions. The prosodic solution is favorable in regard to phoneme economy. The prosodic approach also accounts for the restricted intercontinuant environment in which the contrast is found, it better generalizes phonotactic data such as the constraints placed on syllable final consonant clusters, and it better explains morpheme boundary data. See Wood (1978) and Walker (1984) for detailed discussions on the advantages and

disadvantages of the three solutions. Lenis stops and the glottal stop do not carry phonemic status in Amery's (1985) analysis of Dhuwaya phonology. This same view is followed in this thesis. The phonetic characteristics of the different kinds of stops remain under examination, however, evidence suggests that duration, tenseness, and voicing are all involved (Chong, 2011).

Glottal Stop

The glottal stop occurs in many Dhuwaya words and it can be the contrasting feature in a minimal pair, e.g., *lurryun* '(liquid) flow' and *lurr'yun* 'clap' (Christie, 1993; Wilkinson, 1991). However, the glottal stop does not function like the other segmental phonemes in both its distributional possibilities and in how it interacts with morpho-phonological rules (Morphy, 1983). A glottal stop may only occur in syllable final position and it cannot follow an oral stop. It is always the last member of a coda consonant cluster. It is unique in that it can be the only segment in a coda or it can follow one or two consonants. No other segment can do this (Wilkinson, 1991). The glottal stop tends to surface at the end of morphemes but it can also appear intra-morphemically. If the addition of an inflection to a stem leaves a glottal inside a syllable, then the glottal stop will shift to the end of the syllable, e.g., *yiki* /jiki?/ 'knife' plus INSTR inflection -y is realized as [jikij?] (Morphy, 1983, p.18).

Walker (1984, p.1) claims that there is "little doubt that it should be analyzed as a prosody feature of the syllable." The following points further support the analysis of the glottal stop as a prosodic feature of the syllable rather than a segmental phoneme. The maximal syllable type would be CVCC if glottal stop is removed from the phoneme

inventory because CVCCC syllables only occur if the final C is a glottal stop (Morphy, 1983). Furthermore, morphological rules ignore the presence of the glottal stop, operating in accordance to the preceding phoneme instead.

Table 4.3
Dhuwaya Vowel Inventory

	SHORT	LONG
HIGH FRONT	i	i:
HIGH BACK	u	u:
LOW	a	a:

The vowel inventory is somewhat larger than the more standard 3-vowel set. Dhuwaya has six phonemic vowels which contrast by height, backness, and length (Amery, 1985). There are two high front vowels (one short /i/ and one long /i:/), two high back vowels (one short /u/ and one long /u:/ and two low vowels: (one short /a/ and one long /a:/). Long vowels only occur in word-initial syllables. The following minimal pairs taken from Christie (1993) provide evidence for the contrastive nature of vowel length in word-initial position.

Mari ‘trouble’ vs māri ‘mother’s mother’
Gitkit ‘laughter’ vs getkit ‘tern sp.’
Bulu ‘again’ vs bolu ‘bamboo’

4.1.2 Phonotactics

This section briefly discusses syllable structure and the permissible position of phonemes within the syllable. Permissible combinations of segments are also discussed.

Syllable Structure

The permitted syllable structure in Dhuwaya is CV(C)(C)(/?/). That is, a syllable minimally contains one consonant and one vowel (CV) and this can be expanded into CVC, CV?, CVC?, CVCC, and maximally CVCC? syllables (Amery, 1985; Morphy, 1983; Wilkinson, 1991). The glottal stop is the only phonetic feature that can occur in the third position of a syllable coda. However, CVCC syllables can occur in any position in a word and so three consonant clusters (CCC) may occur in word-medial position (Morphy, 1983). Yolŋu languages generally allow for a large range of consonant clusters and they also permit wide range of options for syllable final position when compared to many other Australian languages (Wilkinson, 1991).

Initial Segments

With few exceptions, all Dhuwaya words begin with one single consonant. Morphy (1983) argues that a few words begin phonetically with [i] or [u] but these are analyzed as phonemic sequences /ji/ and /wu/, respectively. A few widely accepted loanwords beginning with vowels (such as *apatj* ‘half past’) are also in use (Amery, 1985). Vowel initial words are used in baby talk register where word-initial consonant dropping is permitted (Wilkinson, 1991). Consonant clusters are not allowed in word-initial position.

The fortis/lenis stop distinction is completely neutralized in word-initial position. All stops surface as lenis stops word-initially. Fortis stops never occur in this position (although they do occur in word-medial syllable initial position) (Amery, 1985; Morphy, 1983; Wilkinson, 1991). The apico-alveolar consonants (/t/, /n/, /l/, and /r/) rarely occur word-initially and are mostly found in Austronesian or English loanwords or in words that have lost their initial syllables (Morphy, 1983; Wilkinson, 1991). All other

consonants may occur in word-initial position. Long vowels may only occur in word-initial syllables.

Peripheral stops and nasals are the most common sounds found in word-initial position. In terms of place of articulation, peripheral consonants are more common than laminal consonants which in turn are more common than the apical sounds. In terms of manner of articulation, stops are more common word-initially than liquids and semivowels, which in turn are more common than nasals” (Morphy, 1983)

Word-final Segments

Vowels are the most common sounds found in word-final position (Amery, 1985, Morphy, 1983). A little over half of existing YM words end in vowels. The fortis/lenis distinction is neutralized word-finally with only fortis stops surfacing in this position. Lenis stops never occur in this position. Laminal dental consonants never occur syllable or word-finally (Morphy, 1983). The only exception to this rule is that lamino-dental nasals occur syllable finally in intramorphemic lamino-dental nasal + stop clusters” (Wilkinson, 1991). A near neutralization exists within the apical consonant series and the peripheral consonant series in final position (Morphy, 1983). Apico-alveolars occur more commonly than the apico-post alveolars and velar consonants occur more commonly than bilabial consonants. Rhotics are the most common final segments, then laterals, then nasals, then stops and then semivowels. The glottal stop is found syllable finally following any vowel or consonant except a stop (Wilkinson, 1991).

Word-final Consonant Clusters

Two consonant clusters may occur in word-final (syllable coda) position (Morphy, 1983).

The permissible word-final consonant clusters are of the form liquid/rhotic + velar consonant, i.e. any combination of /l/, /ɭ/, /r/, or /ɻ/ followed by /ŋ/ or /k/. A glottal stop can follow a CC cluster ending in the velar nasal. The cluster /wk/ occurs in one word: *dhiwkthiwk* ‘wet and dirty, mucky’. Syllable final clusters can combine with the onset of a following syllable to create three consonant clusters (Wilkinson, 1991). However, word-final clusters occurring at morpheme boundaries are not considered here.

Intramorphemic Clusters

Dhuwaya permits a fairly wide range of consonant clusters in comparison to many Australian languages (Wilkinson, 1991). Most CC clusters involve liquids and peripheral stops and nasals. Liquids only occur as the first member of a cluster (Amery, 1985). See Morphy (1983, p.24, Table 2.3) for a full list of possible CC intramorphemic consonant clusters. CCC clusters are rare in intra-morphemic position (Morphy, 1983). The following eight clusters have been attested for in intra-morphemic position: /lŋk/, /ɭkm/, /rrkm/, /rrŋk/, /rkm/, /rmp/, /rŋk/, and /jmp/. Six of these clusters have only been found in one word each (/lŋk/, /ɭkm/, /rrkm/, /rkm/, /rmp/, and /jmp). There are eight known examples of /rrŋk/ and five known examples of /rŋk/.

Stress

Stress is predictable and almost always occurs in the first syllable of a word but exceptions exist (Amery, 1985; Morphy, 1983). Long vowels only occur in stressed syllables.

4.2 PRACTICAL ORTHOGRAPHY

Beulah Lowe began developing the Yolŋu Matha orthography in the mid 1950s while working as a missionary linguist in Milingimbi (Gale, 1997). Lowe originally developed the orthography for Gupapuyŋu (a western Dhuwala dialect spoken in Milingimbi) but its use quickly spread and it is now the standard orthography used throughout the Yolŋu speaking area (Morphy, 1983; Wilkinson, 1991). Lowe's YM orthography is used in all educational settings where vernacular literacy is taught. It is also used in bible translation programs, on signage around Yolŋu speaking areas, across the literature focused on Yolŋu languages, and amongst speakers themselves in informal communication (Jepson, 2019).

YM orthography is based on the English alphabet (Lowe, 2004). Letters from the Roman alphabet along with devices such as diacritics and digraphs are used to sufficiently represent the sounds of Yolŋu Matha. There are 31 symbols used: 24 representing consonants, six representing vowels, and one representing the glottal stop. Digraphs, combinations of two letters used to represent a single sound, are used to represent the three interdental sounds (*th*, *dh*, & *nh*), the three alveo-palatal sounds (*tj*, *dj*, & *ny*) and the trill (*rr*). Diacritics are used to represent four of the five retroflex sounds (*ṭ*, *ḍ*, *ṇ*, & *ḷ*) and the long vowel *ä*. Additional symbols include the *ŋ* used to represent the

velar nasal and the apostrophe (') used to represent the glottal stop. See Table 4.3 below – the complete list of YM graphemes is given on the left with their corresponding sounds listed on the right column.

Table 4.3
List of Yolŋu Matha Graphemes

Yolŋu Alphabet Symbol	Corresponding IPA symbol
a	/a/
ä	/a:/
b	[b]
d	[d]
<u>d</u>	/d/
dh	[ɖ]
dj	/ɟ/
e	/i:/
g	[g]
i	/i/
k	/k/
l	/l/
<u>l</u>	/ɭ/
m	/m/
n	/n/
<u>n</u>	/ɳ/
nh	/ɳ̥/
ny	/ɲ/
ŋ	/ŋ/
o	/u:/
p	/p/
r	/ɻ/
rr	/r/
t	/t/
<u>t</u>	/t̪/
th	/t̪̥/

tj	/c/
u	/u/
w	/w/
y	/j/
‘	/ʔ/

The analysis of the Yolŋu stop series was discussed in section 4.1.1. We saw that lenis stops occur in word-initial position and following nasals while the fortis stops occur in word-final position and following stops. These tendencies are reflected in current spelling conventions. Lenis symbols (*b*, *d*, *ḏ*, *dh*, *dj*, & *g*) are used for stops occurring in word-initial position and for stops following nasals. Fortis symbols (*p*, *t*, *ṭ*, *th*, *tj*, and *k*) are used for stops in word-final position or for stops following other stops or a glottal stop.

Lowe devised the YM alphabet based on her segmental analysis of the Gupapuyŋu phoneme inventory. The 31 graphemes developed for the Yolŋu alphabet correspond to each of the 31 phonemes described in Lowe’s analysis of the Yolŋu phonemic inventory. Therefore, the Yolŋu alphabet is characterized as transparent; the relationship between letters and sounds is highly predictable and consistent. Each phoneme has only one written form (Christie, 2004) and most YM letters correspond to only one sound⁵².

⁵² An exception to the one-to-one letter-sound mapping found in YM is that /a/ has the allophone [eɪ] before a palatal, but is otherwise [ʌ].

English Orthography Compared

The Yolŋu and English orthographies are both based on the Roman alphabet but the two languages have distinct phonological systems and they map their sounds to the alphabet in different ways. As mentioned in the previous section, Yolŋu has sounds and corresponding graphemes (*ä, d, dh, dj, l, n, nh, ny, rr, t, tj, and '*) that generally are not used in English writing. The reverse is also seen; there are English letters (*c, f, q, s, v, x, z*) and digraphs (*sh, ph, qu, ch, etc.*) which are never used in Yolŋu writing. Furthermore, some letters appear in both orthographies but their phonetic realizations differ across the two languages. For example, the letters *e* and *o* are used in both languages but their corresponding phonetic realizations vary depending on the language. The letter *e* in YM is consistently the long high front vowel [i:], while in English it is typically [ɛ] as in *bet*, though it can be [i:] as in *be* or silent as in *note*. YM *o* is consistently [ʊ:], which doesn't quite exist in English, whereas it is typically [ɒ] as in *hot* in English or [oʊ] as in *so* or combined with other letters to represent other vowels and diphthongs. If we go on to consider digraphs, *rr* in YM is always a trill or rolled [r], while in Australian English it is always a glide [ɹ]. YM *th* is an interdental stop while in English it is a fricative [ð] or [θ] so they never have the same phonetic value. Explicit teaching and awareness of these differences can help children avoid confusion as they learn new sound-to-letter mappings.

Another significant difference between YM and English orthography is their placement on the orthographic depth continuum. The term “orthographic depth” is used to refer to the degree of spelling-to-sound/grapheme-to-phoneme consistency in a language. Orthographic depth is thought of as a continuum with transparent or shallow

orthographies on one extreme end of the continuum and opaque or deep orthographies on the other extreme end (Frost, 2005). Sound-symbol correspondences are highly predictable in shallow languages (Goswami Chapter 8). Each letter almost always represents a single sound and each sound a single letter irrespective of the word it appears in. Opaque (or deep) languages are less consistent and spelling-to-sound correspondences can be very ambiguous. YM orthography is characterized as a very shallow and transparent orthography while English orthography is classified as deep and complex (Frost, 2005; Seymour et al., 2003).

English orthography is thought to be an outlier on the orthographic depth scale (Share, 2008). The 26 letters and the digraphs used in English map onto the 44 phonemes (give or take depending on the dialect) with a high degree of irregularity. Each letter or group of letters may represent different sounds in different words (Miller, 2019). For example, *c* can be /k/ as in *cat* or /s/ as in *certain* and *oo* can be [ʌ] in *blood*, [ʊ] in *good*, and [u] in *food*. The same sound may be spelled in multiple ways (e.g., /k/ in *cat*, *trek*, *opaque*, and *check* and the sound /u/ in *flu*, *to*, *too*, *blue*, *you*, *through*, *coup*, *lieu*, and *Sioux*. Furthermore, some letters may not have corresponding sounds (e.g., *t* in *listen* and *whistle*) (Frost, 2005). The written vowels are particularly varied in their mappings to speech (Venezky found in Ellis et al. 2004). These one-to-many and many-to-one relationships between graphemes and phonemes makes word decoding especially difficult for English literacy learners (Miller, 2019).

The complexity of English orthography is certainly in stark contrast to the phonemic status of YM orthography and this may have an impact on literacy development in the two languages. Research suggests that reading acquisition becomes

more difficult as you move along the orthographic depth continuum from shallow to deep (Aro & Wimmer, 2003; Frith et al., 1994; Goswami, 2005; Landerl, 2005; Seymour, Aro, & Erskine, 2003; Schmalz et al., 2015). The more transparent the orthography, the easier and faster it becomes for children to learn to read aloud. Thus, YM literacy should be relatively easier and more quickly developed than English literacy due to the high discrepancy in orthographic depth. Christie (2004 p.) states that “Yolŋu languages are much easier to read and spell than English because unlike English, Yolŋu languages are written phonemically – that is as closely as possible to how they are pronounced using a limited alphabet. In English, you can’t tell by looking at a word how it is pronounced. In Yolŋu languages, if a word is spelt right, you should be able to pronounce it right.” This statement also highlights the relative role of alphabetic word strategies for word recognition in the two languages.

Orthographic depth also affects the cognitive processes used during word recognition (Ellis et al., 2004; Frost, 1994; Schmalz et al., 2014). Research indicates that two separate routes are used in lexical word recognition: a phonological route and an orthographic route. The phonological route involves decoding – words are sounded out by translating graphemes into phonemes. The orthographic route involves direct lexical access by way of stored orthographic representations that activate a word’s pronunciation – whole words are read by sight (Ellis et al., 2004). Readers develop both strategies to varying degrees and the two strategies are applied simultaneously during proficient reading (Frost, 2004). Research suggests that readers of shallow orthographies rely more heavily on the phonological route since most words can be successfully identified by sounding them out whereas many words cannot be sounded out when reading an opaque

orthography and successful reading of these words depends on the orthographic route (Ellis et al., 2004; Goswami, 2005; Landerl, 2005). Therefore, readers of opaque languages tend to rely on the orthographic route much more heavily than readers of shallow languages. This research predicts that YM reading supports the phonological route while proficient English reading encourages the orthographic route.

Conclusion

The orthographic depth differences discussed have implications for YM-English bilinguals learning to read in both languages. The relative ease of learning how to read in a language with a shallow orthography provides educators with another reason for using L1 literacy in Yirrkala. Yolŋu children may experience more ease developing literacy skills in YM because of the relatively shallow nature of its orthography when compared to English. Existing research also suggests that learners may be relying more heavily on certain cognitive processes for each language (Goswami, 2005; Schmalz et al., 2005). It can be predicted from the research that learners may rely on the phonological route (alphabetic decoding) more heavily when reading in Yolŋu than they can when reading in English (Ellis et al., 2004). The many irregularities in English orthography make decoding words more difficult in English. Therefore, the relationship between the alphabetic skills (phonological awareness and letter knowledge) and word recognition ability may be different in the two languages and different teaching methodologies may be required.

CHAPTER FIVE

5.0 METHODOLOGY

This project follows up on the research discussed in the previous chapter. The phonological awareness literature is applied to a unique setting with Dhuwaya-speaking Yolŋu children living in a remote community in the Northern Territory, Australia. The aim of this project was threefold: a) to investigate the relationship between phonological awareness, letter knowledge, and early word reading in Dhuwaya, b) to create a Dhuwaya phonological awareness training program, and c) to investigate if the Dhuwaya phonological awareness training program had any effects on the skills trained in the program and on later word reading. Specifically, the relationship between various phonological awareness tasks, letter knowledge, and single word recognition was investigated. Patterns found within each skill tested were examined.

Two iPad application software (apps) were developed for the current project. A Dhuwaya phonological awareness assessment app and a Dhuwaya phonological awareness game-like training app were created based on the research findings discussed in Chapter Three. The game-like training program was designed with the intention of helping young Dhuwaya-speaking children grasp the alphabetic code. More specifically, the aim of the training program was to help children understand that words can be broken up into smaller units of sound (phonemic awareness) and that these sound units are represented by letters of the alphabet (letter-sound knowledge). A pre-test measuring phonological awareness, letter knowledge, and word recognition was administered to all participants at the beginning of the current project's experimental phase. The training

program was then delivered to all of the participants over the course of a school term. Post-tests were administered immediately following the end of the training phase and again six months after the training ended. The effects of the training program were examined. The purpose of this project was to collect significant data that could be used to better understand how to best help remote Indigenous children grasp and apply the alphabetic code to early word reading.

The aim of this chapter is to explain the research methods used in the current study. The chapter begins with a review of the research questions followed by a discussion on the research design in sections 5.1 and 5.2, respectively. Section 5.3 provides a project overview meant to provide the background information needed to better understand how the different components of the study fit in together. After the overview is given, individual focus is given to the crucial components of the study. The participants, the materials, and the procedure are discussed in sections 5.4, 5.5, and 5.6, respectively. The chapter ends with an explanation of the data analysis methods used in this study.

5.1 RESEARCH QUESTIONS

The research questions were as follows:

1. How do Dhuwaya-speaking children perform on measures of letter knowledge, phonological awareness, and word recognition?

2. What is the relationship between phonological awareness, letter knowledge, and word recognition skills in Dhuwaya-speaking Yolŋu children?
3. Does a researcher designed phonological awareness training program help increase phonological awareness and letter knowledge for Indigenous children in their home language: Dhuwaya?
4. Do improvements in phonological awareness and letter knowledge (gained through the researcher designed phonological awareness training program) in turn facilitate early word reading?

5.2 RESEARCH DESIGN

Quantitative data was collected to address all four research questions. Exploratory research was used to address the first research question. A correlational method was used to address the second question and a quasi-experimental pre-test/post-test method was used to address the third and fourth questions.

5.2.1 Exploratory Research

Patterns in the participants' assessment battery data were analyzed to address the first research question. The data was examined to determine which tasks were easier for the children and which tasks were more difficult with respect to task type and task item characteristics. The relationship between student age and performance on the tasks was also investigated. It was hypothesized that the age of mastery for all skills measured

would be slightly delayed when compared to benchmarks proposed in existing literature. It was also hypothesized that phonological awareness would develop along a continuum based on linguistic complexity, task type, and target word linguistic features. Therefore, there would be a tendency for participants to display more ease completing certain tasks than others. For example, children would display more ease completing syllable level tasks than they would completing phoneme level tasks. Additionally, it was believed that blending tasks would be easier to complete than identification tasks, which in turn would be easier to complete than segmentation tasks. Children were also expected to display more ease completing tasks targeting continuant sounds (versus stop sounds), initial sounds (versus final sounds), and short words.

5.2.2 Correlational Method

Correlational studies are frequently used to investigate the relationship between preliteracy (emergent literacy) skills and early word reading ability. The belief is that if a particular preliteracy skill is naturally linked to early word reading, then children's reading scores will be positively correlated with their scores on measures of the preliteracy skill under examination. In other words, good readers will display proficiency in the preliteracy skill in question while poor readers display ineptness. It is important to note that these results only provide evidence of **relationship**, **not causation** as a confounding variable may be involved in the correlation. It may also be the case that no correlation is found between word reading and another skill tested which would suggest that word reading is unrelated to the particular skill in question.

Participants in the current study were tested on measures of letter knowledge, phonological awareness, and word recognition. The relationship between letter knowledge and word recognition ability was examined. The relationship between phonological awareness (at both the syllable and phoneme level) and word recognition ability was also examined. The relationship between letter knowledge and phonological awareness was investigated. It was hypothesized that children with high letter knowledge skills would perform better on a word recognition task than children with low letter knowledge skills. It was also hypothesized that children with high levels of phonological awareness, especially at the phoneme level, would outperform their low-skilled peers on reading measures. Finally, it was hypothesized that letter knowledge skill would be correlated with phonological awareness skill at the phoneme level.

5.2.3 Experimental Method

Experimental studies are used to show whether or not changes in one variable lead to changes in another variable; i.e., they show cause and effect. Pre-test/post-test designs allow researchers to measure changes caused by an experimental treatment. Accordingly, reading researchers commonly use experimental pre-test/post-test studies to observe the effects of phonological awareness interventions. Skills are tested before and after the intervention. Increases in scores suggest that the intervention was successful in training the specific phonological awareness skill(s) tested. If scores decreased or did not change then the results would suggest that the intervention was not successful in training the tested skill(s).

Generally, researchers aim to divide study participants into randomized treatment and control groups so that they can compare the measured changes between the two groups. ‘True experiments’ with randomized allocation of participants to groups allow researchers to ascertain that any measured changes were caused by the experimental treatment and not some other unidentified variable. However, randomized experiments are not always ethical or logistically feasible (as is the case for the current study, see section 5.4 for details). For these reasons, quasi-experimental (nonrandomized) studies are often utilized in the social sciences, particularly in education and psychology (phonological awareness falls under the field of psycholinguistics).

Control groups are not necessary for scientific studies to shed light on important situations. Cummins (2000) states that many descriptive studies have been disregarded on the basis that they were not methodologically sound because they did not have control and experimental groups. He argues that descriptive studies do provide us with significant data in the same way knowledge is generated by observation in many scientific disciplines. Cummins uses meteorology and climatology as an example: “What scientists do to generate knowledge in this discipline (and many others) is to observe phenomena (e.g. the conditions under which hurricanes appear) and build up theoretical models that attempt to predict these phenomena. With further observations, they test and refine their predictive models. There is no control group, for obvious reasons, yet theory-based predictions are constantly being tested and refined” (2000, p. 213). Descriptive studies make sense in educational research, as creating ‘scientifically sound’ experiments with valid control groups can be difficult if not impossible. Such is the case for the current experiment.

At the beginning of the current experiment, a Dhuwaya pre-test was administered to all of the participants. The pre-test measured letter knowledge, phonological awareness, and word recognition skills. After the pre-test had been completed, a Dhuwaya phonological-awareness training program was delivered to all participants. A post-test was administered to the students immediately following the phonological-awareness training phase. A second post-test was administered to the participants six months after the phonological awareness training period ended. The two post-tests measured the same skills measured in the pre-test.

In order to address the third research question, the students' letter knowledge and phonological awareness pre-test and post-test scores were compared. It was hypothesized that post-test scores would increase for students who completed the training program. In order to address the fourth research question, students' pre-test and post-test word recognition scores were compared. If increases in word recognition scores were related to increases in phonological awareness or letter knowledge scores, then the results would suggest that increasing that particular skill has a facilitating effect on early word reading. It was hypothesized that the children who completed the training program would outperform the children who did not complete the training program on post-test measures of word reading. However, it was hypothesized that this result would only be seen amongst the older students. It was believed that word recognition scores would increase for Grade 2, Grade 3, and Grade 4 students who completed the training program. This result was not expected for Transition and Grade 1 students due to their limited experience with reading instruction. Still, it was hypothesized that phonological

awareness increases (gained from the intervention) would be predictive of later reading skills for these younger students.

It is important to note that only one data collection process was involved in this study. Two different research methods were used to address the research questions but the data gathering process was one in the same. The same set of data is examined to address all four of the research questions. The data is simply examined via the most relevant scientific approach for the particular question. A complete overview of the data collection process is given in the following section.

5.3 PROJECT OVERVIEW

Three major phases were involved in the current study: the Material Development Phase, the Data Collection Phase, and the Analysis Phase. Each phase was dependent on the previous phase. The Material Development Phase needed to be completed in order to undertake the Data Collection Phase, which in turn needed to be completed in order to undertake the Analysis Phase. The Material Development Phase and the Analysis Phase are discussed in detail in sections 5.6 and 5.8, respectively. Components of the Data Collection Phase are discussed across sections 5.5 – 5.7 (5.6 is relevant to both the Material Development Phase and the Data Collection Phase). There were a few critical components in the Data Collection Phase (participants, materials, procedure) that each deserve individual focus. However, an overview of the Data Collection Phase is given in this section with the purpose of helping the reader better understand how the various components of the study fit together.

The Data Collection Phase took place at Yirrkala School from October 5 to December 9, 2015 (over the fourth school term) and from June 6 to June 24, 2016. All Transition to Grade 4 students enrolled at Yirrkala School during Term 4, 2015 were invited to participate in the study. Consent forms were signed by the care-givers of all participants included in the study. Then, pre-tests measuring phonological awareness, letter knowledge, and word recognition skills were administered to all participants during the first few weeks of the school term. A sound-to-letter matching task was used to measure letter knowledge. Six separate tasks were used to measure phonological awareness: syllable identification, syllable blending, syllable segmentation, phoneme identification, phoneme blending, and phoneme segmentation. The first three tasks measure phonological awareness at the syllable level (syllable awareness) while the latter three tasks measure phonological awareness at the phoneme level (phonemic awareness). An isolated word-reading task was used to measure early word recognition skill. The same assessment battery was administered to all of the participants regardless of age. The assessment battery is explained in detail in section 5.5.1 and in appendices A and B.

After the pre-tests were completed, a Dhuwaya phonological awareness training program was delivered to all participants. This researcher created training program took the form of a game-like iPad app. The game-like training app encompassed 24 levels of increasing difficulty. Each level contained a segmentation activity, a letter knowledge activity, and a blending activity (see section 5.2.1 for more information on segmentation and blending tasks). The training program is explained in detail in section 5.5.4 and in Appendix C.

The participants played with the iPad phonological awareness training game each day that they came to school for the remainder of the school term. Students were given thirty minutes each day to interact with the training program. Students were encouraged to complete at least one level of the training program per day. If students completed one level quickly, then they were encouraged to start working on a second level. However, students were encouraged to play with a different educational app if they completed two levels before the thirty minute session ended. Post-tests were administered to the students during the last week of the school term (immediately following the end of the training period) and again six months after the training period ended. The same assessment battery used for the pre-tests was used for both of the post-tests. All students completed the same assessment battery regardless of age.

We now give individual focus to each of the crucial components of this project beginning with the participants.

5.4 PARTICIPANTS

The participant pool was comprised of Transition to Grade 4 students enrolled at Yirrkala School. In 2015, Transition and Grade 1 students at Yirrkala School were grouped into one classroom *Wurrpan* ‘kangaroo’ Class and all Grade 2 through Grade 4 students were grouped together in another classroom *Djet* ‘eagle’ Class. All *Wurrpan* and *Djet* class students that attended school during Term 4, 2015 were invited to participate in the study. At the beginning of the study, there were five Transition students, eleven Grade 1 students, five Grade 2 students, three Grade 3 students, and six Grade 4 students in the

participant pool. All of these students completed the pre-test battery (or at least part of it). However, the students' attendance patterns were very erratic during the Data Collection Phase, ergo, not all of the participants were present throughout the entire experiment. Consequentially, not every participant completed the training program and/or the post-tests. See Table 5.1 below for complete number of participants present during each testing time. Note that post-test 2 was conducted during the 2016 school year so the participants were all one school grade ahead of the school grade they were in at the beginning of the project. Table 4.1 lists the number of students present at each testing time by student grade level.

Table 5.1

Participant Numbers by Student Cohort for Each Testing Time.

Pre-test: October 12 - 29, 2015	Post-test 1: December 1 -9, 2015	Post-test 2: June 6 – 24, 2016
5 Transition students 10 Grade 1 students 5 Grade 2 students 3 Grade 3 students 6 Grade 4 students	3 Transition students 5 Grade 1 students 4 Grade 2 students 2 Grade 3 students 6 Grade 4 students	4 Grade 1 students 8 Grade 2 students 4 Grade 3 students 2 Grade 4 students 5 Grade 5 students
Note: Font colors are used to indicate the same cohort of students (e.g. the post-test 2 Grade 1 students (red) are the same students that were in Transition during the pre-test and post-test 1 phases).		

The phonological awareness and letter knowledge assessment and training tools created for this project are based on activities recommended in the literature for Transition and Grade 1 students. However, I chose to include Grade 2 through Grade 4

students in the current study for a few reasons. First, early reading development benchmarks may be different for children coming from cultures primarily transmitted through oral tradition. The research on phonological awareness and emergent reading is heavily based on mainstream Western cultures. Children from mainstream Western populations tend to be introduced to books and alphabet letters at home. Contrastively, Indigenous children living in remote communities tend not to be introduced to books and alphabet letters until they set foot in a formal classroom. Similarly, they do not tend to engage in early literacy practices (such as singing the alphabet song and reading storybooks) with their parents in the same way that many mainstream Western children do. Therefore, Indigenous children may develop emergent reading skills at a later age than Western children who enter the classroom already equipped with pre-literacy skills do. Second, the inclusion of older students in the study makes it possible to compare the outcomes of the younger students with limited previous literacy training with the outcomes of the older students who have already received a few years of reading instruction. Third, including all students from *Wurrpan* and *Djeḷ* class allowed for a bigger subject pool. Yirrkala School is the only Dhuwaya-English bilingual school so possible participant numbers were already low.

As previously mentioned, including a control group in the study was impractical due to small participant numbers and poor attendance rates. The number of students in each student cohort was small, ranging from three to eleven students per cohort. Splitting these cohorts up into a control group and an experimental group would result in there being only one to six students in each group. Comparing scores between such small groups could be misleading. For example, let's imagine that the Grade 3 students were

divided into an experimental group with two students and a control group with one student. Children exhibit a wide range of individual variation in terms of their phonological awareness abilities. Therefore, let us imagine that one of the two children assigned to the experimental group experienced particular difficulties with phonological awareness tasks while the one child in the control group happened to be a naturally high achiever. This allocation of students into experimental and control groups would drastically skew the results. Moreover, attendance patterns and trends at Yirrkala School suggested that participant numbers would be even lower by the end of the project. As discussed in section 2.4, Yolŋu people move around a lot, travelling between Yirrkala and the surrounding Homeland centers. Additionally, cultural ceremonies take precedence over Western schooling. The teachers of the two classrooms participating in the study both warned me about their students' low attendance patterns. Participant dropout was expected, ergo, splitting up student cohorts into two groups could potentially result in there being little to no students in an experimental group for any given cohort. As such, I decided to include all participants in the experimental group. Although I was not able to compare experimental group scores to control group scores, I was able to compare the scores of students who got farther along the training program to the scores of students who only completed a few levels.

5.5 MATERIALS

This study focuses on the Yolŋu students' home language: Dhuwaya. However, standardized phonological awareness testing in Dhuwaya does not exist. Formal phonological awareness training programs in Dhuwaya also do not exist. Therefore, the first aim of this project was to design and create both an assessment battery and a training program in Dhuwaya. As such, Material Development was the first phase of this study. The Material Development Phase lasted fourteen months, spanning from mid 2014 to late 2015. I spent half of this time in Yirrkala collaborating with community members and the other half in Melbourne collaborating with an Apple software programmer.

The assessment battery consisted of two separate tests: a researcher-designed iPad app assessment and an oral assessment. The intervention delivered in this project involved a phonological-awareness training program that was delivered through a researcher developed game-like iPad app.

iPad apps were used in this study for various reasons: (a) The Northern Territory Department of Education has equipped Indigenous schools with an ample amount of iPads, (b) the school expressed a need for interactive IT resources in the students' home language, (c) it is simple for teachers to assess children using apps, (d) qualified Dhuwaya-speaking teachers are not needed to assess students' Dhuwaya phonological awareness skills or to run Dhuwaya phonological awareness training programs, (e) children receive one-on-one practice and immediate feedback, and (f) apps are fun and engaging for young children. We now turn to a description of the individual materials

created for this project beginning with the Indigenous Language Early Literacy 1 (iLe1) assessment app.

5.5.1 Assessment Battery

5.5.1.1 Assessment App: Indigenous Languages Early Literacy 1 (iLe1)

An experimenter-designed iPad app was used as a screening tool to assess letter knowledge, syllable identification skill, phoneme identification skill, syllable blending skill, and phoneme blending skills. I devised the assessment questions with the help of my supervisor, Yirrkala Community School's teacher-linguist, two Yolŋu senior teachers from the school, and a linguist with expertise in the Dhuwaya dialect. Existing letter-sound knowledge and phonological awareness questions were adapted to suit the Yolŋu language and culture. Then, I worked with an Apple programmer to create an iPad application assessment.

The programmer created a template for the app that does not operate unless correctly named and structured files are stored in the app via iTunes. I added these files (all the audio files, the image files, and an answer key file) myself. This method was advantageous because it gave me the ability to make immediate changes to the assessment while I was in the field in the case that certain questions or images proved to be problematic. It also gave me the ability to change questions involving words that

became taboo after a community member passed away.⁵³ Moreover, this method allowed for the option of adding different languages to the app. This way, if the app proved to be beneficial, then it could be dispensed to other bilingual schools throughout Indigenous Australia.

Design

When the app is launched, a login screen appears in which an administrator must select a language⁵⁴ and enter both the student and the administrator's name. After logging in, a welcome screen appears greeting children with an inviting message (*yothu marngithi djorra'wu* 'child will learn about books'). The welcome screen is followed by twenty questions. There are six letter knowledge questions and fourteen phonological awareness questions. Letter knowledge questions ask the children to select the letter that makes a given sound. Only letter-sound matching questions were included because research suggests that letter-sound knowledge is more essential for early reading than letter-name knowledge, as discussed in section 3.5. Seven of the phonological awareness questions are identification tasks, three at the syllable level and four at the phoneme level. Students are asked to select the image of the object whose name begins or ends with a given syllable or phoneme. Seven of the phonological awareness questions are blending tasks, three at the syllable level and four at the phoneme level. Students are asked to select the

⁵³ When a community member passes away, it is prohibited to say any name or word that is phonetically similar to the name of the deceased. A new word, usually borrowed from a different Yolngu Matha dialect, will be used in its place for a specified amount of time.

⁵⁴ As previously mentioned, the template of the app allows for the addition of assessment questions in different languages. Although the app currently only has data files for Dhuwaya, an administrator still needs to choose Dhuwaya in the language menu to begin the assessment.

image depicting the word you get when you blend the syllables or phonemes together. See Appendix A for a list of the 20 questions.

A new screen appears for each question. In order to hear the question, students must tap on the speaker icon located on the top right corner of the page (see Figure 5.1 for screenshots of Assessment App questions). An answer cannot be selected unless the question has been played at least once. However, children can listen to the question as many times as they like. For all questions, there is a grid in the middle of the screen with four cells containing letters or images. Students select an answer by tapping on one of the four cells, which then becomes highlighted. Children are free to change their answer as many times as they find necessary. A green arrow located on the bottom right corner of the screen must be pressed to move on to the next question. Children cannot proceed to the following question without having first selected an answer for the existing question. Once children have completed all twenty questions, a closing screen appears. The closing screen provides a congratulating message for all children regardless of their performance.

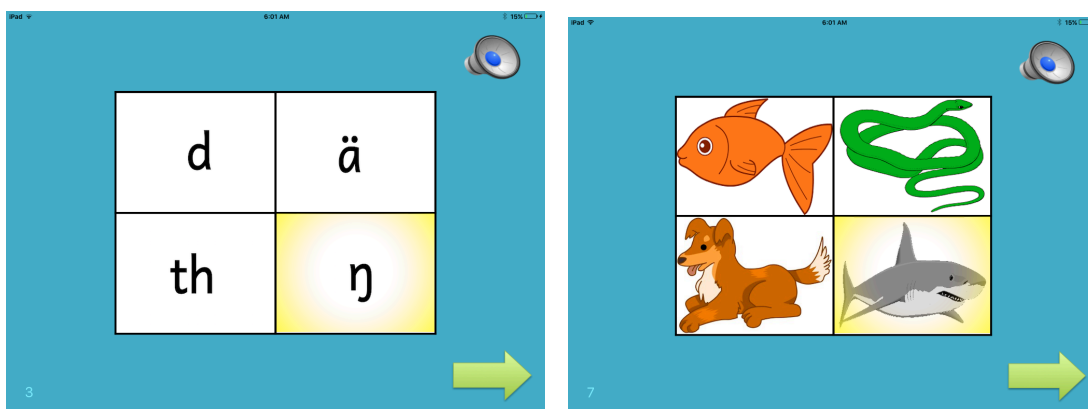


Figure 5.1 – Screenshots of iLe11 (Assessment App) questions.

A results file is created every time someone logs into the app. The title of the file includes the administrator's name, the student's name, and the test date and time (adminnameStudentName_date_time.csv). Result files are saved both on the device and in a Results folder on iTunes. The Results folder can be dragged from iTunes to the desktop. When these files are directly opened in excel, the student's results are presented in a spread sheet format. The first column lists the question number. The second column lists the student's response. The third column notes whether the student's answer was correct or incorrect and the fourth column lists the correct answer.

The design of the app was kept simple for ease of use. The visual design of the app is basic in order to avoid any distractions. The interface is very straightforward; students are only required to click on an image (the image representing the correct answer, the replay icon, or the arrow that introduces the next question). All questions are asked orally through a familiar voice: the preschool teacher's voice. A special Yolŋu font is used so that the appropriate Dhuwaya graphemes appear on the app. Andika, the font used by the school's Literature Production Centre, is used to avoid any confusion (e.g. **g** not **g** and **a** not **a**). Lowercase letters are used because the teachers asserted that they were more familiar to students.

5.5.1.2 Oral Assessment

An oral assessment was designed to measure syllable segmentation, phoneme segmentation and word recognition abilities. The oral assessment included one task for each skill tested. A Yolŋu research assistant administered the oral assessment in

Dhuwaya. However, English translations are used in the following descriptions to help the reader better understand the instructions and questions used in the assessment.

Syllable Segmentation task

The syllable segmentation task began with the Yolŋu research assistant telling the students that she (the assistant) was going to say words aloud and then she was going to break the words up into syllables. She asked the students to listen carefully to her examples. The assistant said a Dhuwaya word aloud and then clapped out the syllables as she pronounced them aloud. For example:

Däma ŋäthili nhe yurru ŋarranha ŋäthili, ŋi'.

You listen to me first okay.

Darra ŋäthili waŋa dhawar'yun bala beŋuya bitjana nhena ŋi'.

I will speak and when I finish then you will speak okay.

Yäku ŋarra yurru lakama bala ŋarra yurru beŋuya bitjana barrkuwatjkumana, ŋi'.

I will say a word and then I will say it separated okay

(Examples given)

gara ga (pause) ra gara

The assistant continued with five more examples. After the sixth example, the research assistant told the students that it was now his or her turn and asked the student to break up words in the same manner.

Students were asked to segment seven words of increasing difficulty. The first two assessment items were bi-syllabic CVCV words. The third test item was a bi-syllabic CV-CVC word. The fourth test item was a tri-syllable CV-CV-CV word. The fifth test item was a tri-syllable CVC-CVC-CV word. The sixth test item was a four-syllable CV-

CV-CV-CV word. The final test item was a four-syllable CV-CVC-CV-CV word. See Appendix B for list of test items.

Phoneme Segmentation Task

The phoneme segmentation task began with the Yolŋu research assistant telling the students that she (the assistant) was going to say words aloud and then she was going to break the words up into individual phonemes. She asked the students to listen carefully to her examples. The assistant said a word aloud and then pronounced each phoneme individually. The assistant continued with five more examples. After the sixth example, the research assistant told the students that it was now his or her turn and asked them to break up words in the same way.

Students were asked to segment six words of increasing difficulty. The first test item was a monosyllabic CV word beginning with a continuant consonant. The second test item was a monosyllabic CV word beginning with a stop consonant. The third test item was a monosyllabic CVC word beginning and ending with continuant sounds. The fourth test item was a CVC word beginning and ending with stop consonants. The fifth test item was a bi-syllabic CVCV word consisting of continuant consonants and vowels. The sixth test item was a bi-syllabic CVCV word consisting of a stop consonant, a vowel, a semivowel, and another vowel. See Appendix B for list of test items.

Word Recognition Task

The word recognition task involved asking the students to read from two different word lists of increasing difficulty: Dhuwaya Word List #1 and Dhuwaya Word List #2. Each word list consisted of ten words. Words were presented to the students one at a time. The Yolŋu research assistant asked the students if they recognized the word. If the students could not automatically read the word aloud, then the assessment administrator encouraged the children to sound out the letters and then blend them together to identify the word. If a student could read any of the first five words on Word List #1, then they were presented with the second set of five words from Word List #1. If the student could read from Word List #1 with ease, then they were presented with the first five words from Word List #2. If the student could read any of the words from the first half of Word List #2, then they were presented with the second set of five words from Word List #2. The word recognition task was administered in this discontinuation rule type manner so that non-readers would not have to struggle or feel discouraged by the test administrator repeatedly asking them to complete a task outside of their capabilities.

Dhuwaya Word List #1

Dhuwaya Word List #1 was comprised of ten monosyllabic words of increasing difficulty. Students were shown a piece of paper with words written in large font. Only one word was uncovered at a time. The Yolŋu research assistant asked the students if they recognized the word. If the students could not automatically read the word aloud,

then the assessment administrator encouraged them to sound out the letters and then blend them together to identify the word. If students struggled or refused to read words 1 - 5, then the assessment ended there. If students could automatically read or sound out any of words 1 - 5, then words 6-10 were also shown to them. If students struggled or refused to read words 6 – 10, then the assessment ended there. If students could automatically read or sound out any of words 6 – 10, then Word List #2 was shown to them. The ten words on List #1 were all high frequency words consisting of two to three phonemes. Seven of the words were featured in the training app while three of the words were not. See Appendix B for the list of words on Dhuwaya Word List #1.

Dhuwaya Word List #2

Dhuwaya Word List #2 also consisted of ten words. The same procedure used for Dhuwaya Word List #1 was used with Dhuwaya Word List #2. The ten words were all high frequency words consisting of three to four phoneme monosyllabic and bi-syllabic words. Five of the words were featured in the training app while five of the words were not. See Appendix B for list of words on Dhuwaya Word List #2.

5.5.2 Recording Device

A Zoom H4n recorder was used to voice record the oral assessments.

5.5.3 Observation Forms

Observation forms were created and used for both the iLe1 assessment and the oral assessment. I used these to document any observations I made watching the participants complete the assessments. The iLe1 Observation Form was used to note down how much time it took for the student to complete the assessment, whether or not the student was guessing, which questions the students struggled with, which questions were easy for the students, and any other significant notes. The Oral Assessment Observation Form was used to take note of how much time it took for the students to complete the assessment, exactly how students segmented each word into syllables, exactly how students segmented each word into phonemes, which word lists were shown to the students, and any other significant notes.

5.5.4 Intervention App: Indigenous Languages Early Literacy 2 (iLe2)

A researcher-designed game-like iPad app was used to administer letter knowledge and phonological awareness training. The purpose of the app was to train sound and letter awareness through a series of game-like activities, with the intention of helping students crack the alphabetic code – the realization that words are made up of smaller units of sounds and that these sounds are represented by letters of the alphabet.

I investigated existing computerized phonological awareness and letter knowledge training activities; segmentation, blending, and letter knowledge tasks specifically. Activities were adapted to be relevant to Yolŋu students' lives. Each activity was based

on a story about animals commonly seen in and around Yirrkala. A list of basic high frequency words that all young children would know was created with the help of Yirrkala School's preschool teacher. The language used in the app was based on this list of words. The target words used in each activity came from this list of basic high frequency words.

Activities were then designed to be delivered in the form of an interactive iPad game. I worked with the same Apple programmer involved in the creation of iLe11 (the Assessment App). We used the same method in which the programmer created a template that does not operate unless correctly named and structured files are stored in the app via iTunes. The audio and image files were created with the help of a Yolŋu research assistant. All of the audio files, all of the image files, and an activity answer key were then inserted into the app's programming by myself making the app fully functional.

Again, the design of the app was kept simple for ease of use. The visual design of the app is basic in order to avoid any distractions. The interface is very straightforward; students are only required to click on images on the screen or to drag images across the screen. All questions are asked orally through a community member's voice. A special Yolŋu font is used so that the appropriate Dhuwaya graphemes appear on the app. Andika, the font used by the school's Literature Production Centre, is used to avoid any confusion (e.g. *ḡ* not *g* and *ḁ* not *a*). Lowercase letters are used because the teachers asserted that they were more familiar to students

The training game has 24 levels. Each level has three activities. The first activity is a segmentation activity. The second activity is a letter knowledge activity and the third activity is a blending activity. The second activity appears as soon as the first activity is

completed. The third activity appears as soon as the second activity is completed. Once the children finish the third activity, the level is completed and a closing screen appears saying *Dhappirk!* ‘beautiful!’. Children cannot begin another level without closing and reopening the app and logging in again. Children are meant to complete one whole level at a time. If they complete level one, then next time they log in level 2 appears. If they did not complete level one, then the next time they log in level one will start from the beginning.

The activities increase in difficulty with each level. The first eight levels focus on syllables while levels nine through 24 focus on phonemes (for the segmentation and blending activities). Syllables are targeted first to help beginners become aware that words are broken up into smaller units. Phonemes are targeted in the majority of the levels because they are the most relevant for reading. Only sounds, not letters, are involved in the segmentation and blending activities for the first sixteen levels. This is to help children crack the first part of the alphabetic code: understanding that words are broken up into individual sounds. In the last eight levels, letters are introduced into the segmentation and blending activities in order to help children crack the second part of the alphabetic code: letters are used to represent the individual sounds of words.

The Segmentation Activity

The first activity that appears every time a level begins is the segmentation activity. For this activity, children are asked to feed the hungry crocodile one fish for each syllable or phoneme (depending on the level) they hear. A bucket full of fish, a

crocodile, and a feeding bowl appear on the screen (see Figure 5.2 for a screenshot of the activity). The children are instructed to listen to the stimulus and then drag one fish for each sound (syllable or phoneme depending on the level) they hear from the bucket into the crocodile's bowl. If the stimulus is /a/ then they are meant to drag one fish into the bowl. If the stimulus is /a/ (pause) /a/ or *ma* /ma/ 'CONT', then they are meant to drag two fish into the bowl (if they are on a level targeting phonemes, not syllables). If the stimulus is *goŋ* /ku:ŋ/ 'hand', then they are meant to drag three fish into the bowl. If the stimulus is *guya* /kuja/ 'fish', then they are meant to drag four fish into the bowl. The stimuli only have one to four syllables or phonemes. The stimuli get harder to segment as the levels increase based on: whether the levels target syllables or phonemes, the number of syllables or phonemes in the stimulus, the type of syllables in the stimulus (CV versus CVC, for example), and the sonority and manner features of the phonemes constructing the stimulus.

Every time the game is played, the first screen that appears gives instructions for the activity. Then, the app's voice-over demonstrates how to play the game by talking the children through two examples. In the examples, the voice-over presents the stimulus and then models the correct way to answer questions. Then the voice-over tells the students that it is their turn to play on their own and the first stimulus is heard. Students can hear the stimulus as many times as they need to by clicking on the crocodile. Once they are finished answering; i.e. dragging fish from the bucket into the crocodile's bowl, they click on the green button located on the bottom left corner of the screen. If the student answers correctly, the crocodile walks to the bowl and eats the fish. Then, the next stimulus is presented. Students are instructed to listen carefully and try again if they

answer incorrectly. If they answer correctly the second time, the crocodile eats the fish from the bowl and then the next stimulus is presented. Students are given two chances to answer correctly. After two failed attempts to answer correctly, the app's voice-over explains the correct answer and the expected action is simulated on the screen (the correct number of fish are dragged into the crocodile's feeding bowl). Then, the crocodile eats the fish from the bowl and the next stimulus is presented. There are six stimuli for this activity on each level. Students receive immediate feedback on their answer. See Figure 5.2 for screenshots of the segmentation activity in action. See Appendix C for in length details on the segmentation activity including the language as well as the structure used in the instructions, demonstrations, questions, and feedback.

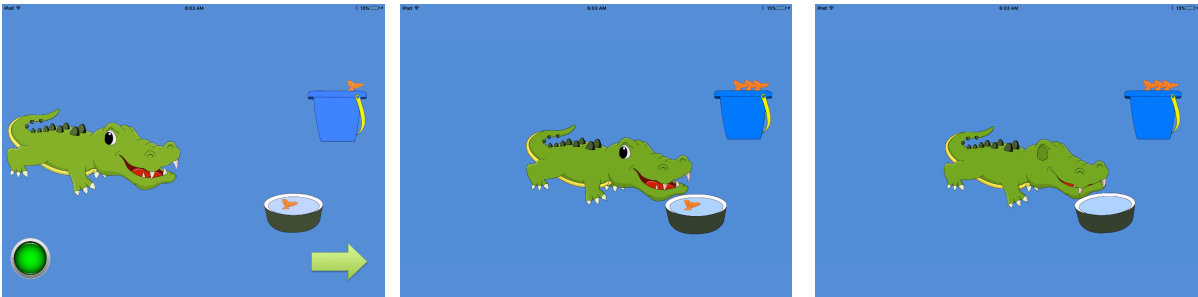


Figure 5.2 – Screenshots of the segmentation activity in iLel2 (Intervention App).

The Letter Knowledge Activity

The letter knowledge activity is the second activity in each level, beginning as soon as the segmentation activity is finished. First a letter is introduced. Then a letter knowledge activity is played. During the letter introduction, a letter is displayed in the middle of the screen while the app's voice-over articulates the name of the letter and the sound that the letter makes. Words beginning with that sound are then voiced. An image

representing a word appears on the screen as the word is voiced. Then a letter knowledge activity appears. See Figure 5.3 for a screenshot of the Intervention App's letter knowledge introduction screen.

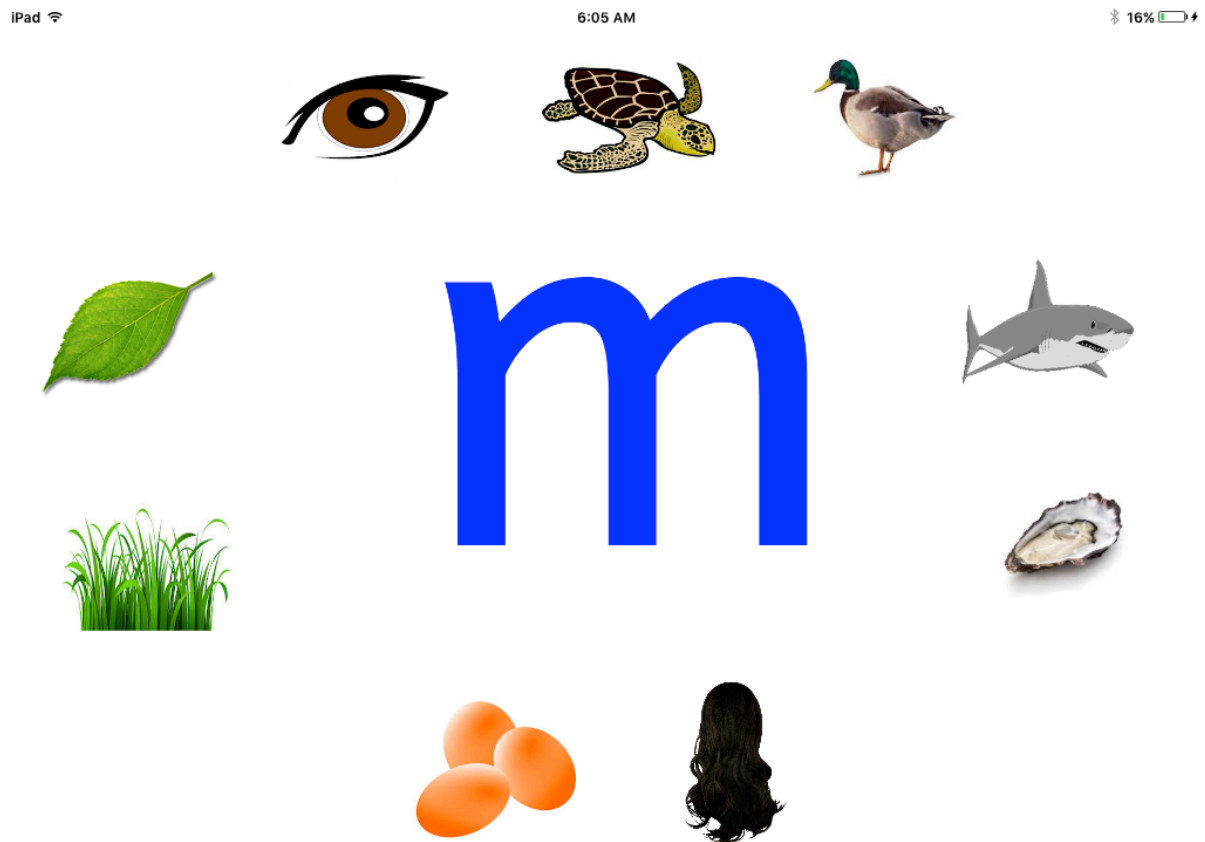


Figure 5.3 – Screenshot of letter knowledge introduction screen in iLe12 (Intervention App). Note that all the words depicted by the images on this screen begin with the /m/ sound in Dhuwaya.

There are three different letter knowledge activities: letter search by letter name, letter search by letter sound, and a sound-to-letter matching kangaroo activity. Each level contains only one of these activities. The first two activities are both letter search games. The children are presented with a picture that takes up the whole screen and has different letters hidden throughout it. They are instructed to click on all the letter Ms (or whatever

letter is being introduced) in the picture. The only difference between the first and the second activity is that in the first activity the children are asked to find all the letter Ms in the picture:

Go ḡalimu ḡala'yun
Come let us play
Maḡḡ'mama nhe yurru rirrakay 'M' Yurr dhikalami wuḡuli'ḡu
you find the letter 'M' here in the pictures

and in the second they are asked to find all the letters that make the /m/ sound:

Go ḡalimu ḡala'yun
Come let us play;
Maḡḡ'mama nhe yurru rirrakay ḡunhi ḡayi ga rirrakay warkthun /m/ (sounds out the sound of the letter)
Now look for the sound that makes the sound /m/

If the children click on the correct letter, then they are congratulated and asked to keep looking for more letters until they have clicked on all the correct answers:

Dhapirrk. Baḡak ḡarruḡu.
Beautiful. Keep looking
Dhaḡaḡ dhikaya rirrakay 'M' (or /m/)⁵⁵
Lots here of the sound 'M'

If they click on the wrong letter, then they are given the name or sound of the letter they clicked on and asked to keep looking for the correct answer. See Figure 5.4. for a screenshot of the Intervention App's letter search activity screen.

⁵⁵ The feedback is the same in letter search by name and letter search by sound tasks except that the app's voiceover says the name of the letter in the search my letter name levels

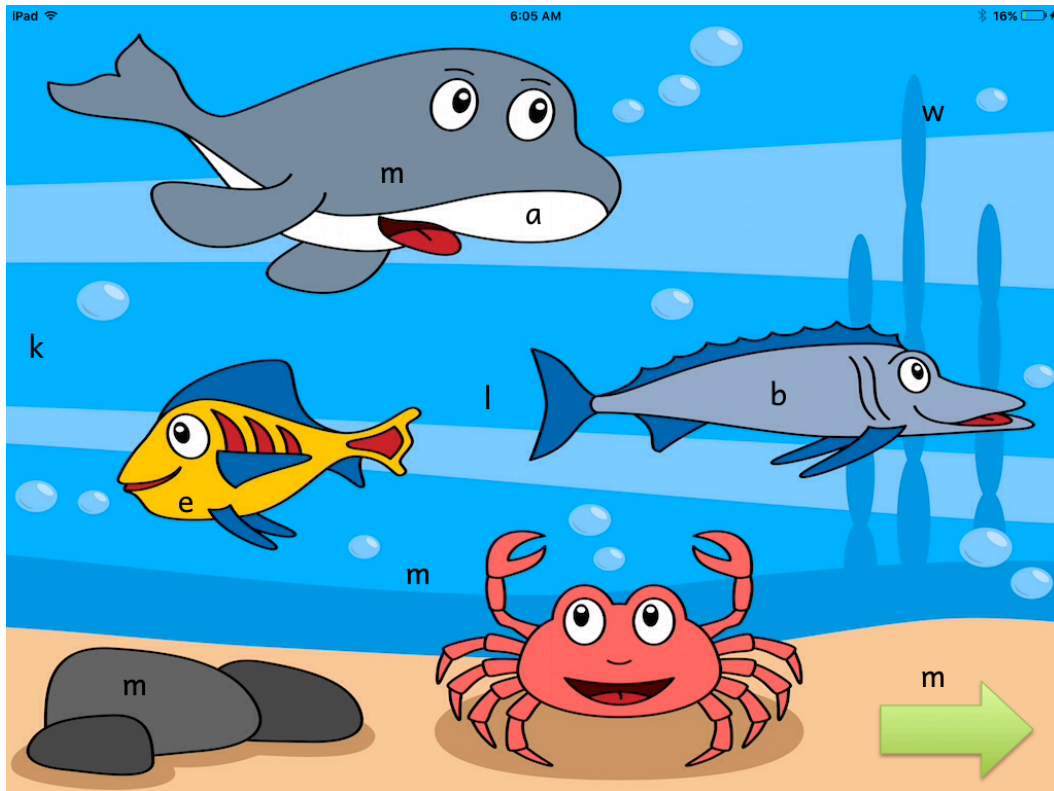


Figure 5.4 – Screenshot of letter search activity in iLel2 (Intervention App).

In the sound-to-letter matching kangaroo activity, the children are asked to help the lost baby kangaroos find their mothers. The baby kangaroos make a sound when they are pressed on. Students are instructed to drag the baby kangaroo to the mother kangaroo that has the letter representing that sound written on her pouch. For example, students are intended to drag the baby kangaroo that makes the /m/ sound when clicked on to the mother kangaroo with the letter M written on her pouch. The app's voice-over talks the students through two examples before asking them to try some on their own. Every time the kangaroo game appears, one more baby kangaroo and one more mother kangaroo are added. Level 3 (the first level with a kangaroo game) only displays one baby kangaroo and two mother kangaroos but by level 24 there are 8 baby kangaroos and eight mother kangaroos on the screen. Level 3 includes two mother kangaroos compelling children to

make a decision based on letter knowledge which would not be the case if there was only one answer option. See Figure 5.5 for screenshots of the Intervention App's sound-to-letter matching activity in action.

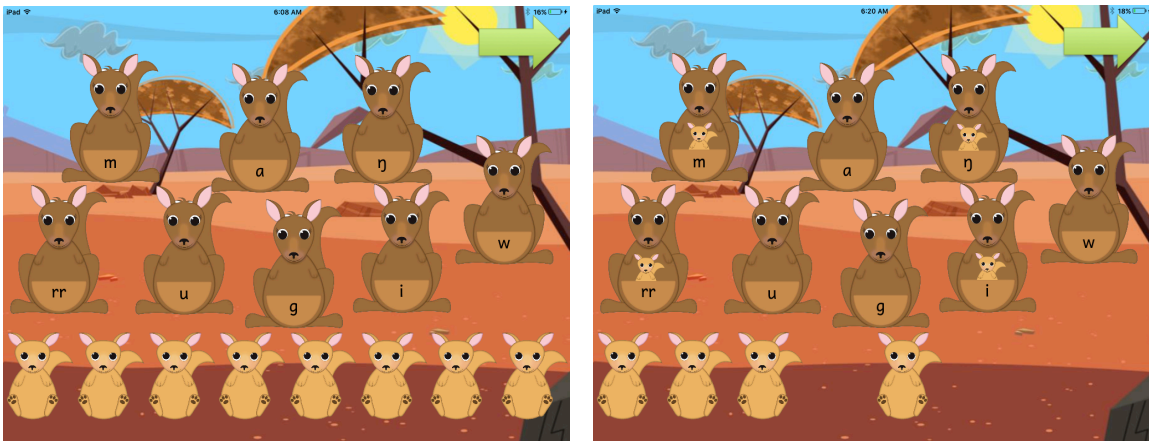


Figure 5.5 – Screenshots of sound-to-letter matching activity in iLe12 (Intervention App).

The same letter-sound pair is introduced for three consecutive levels but the activity presented after the letter introduction screen is recursive. For example, levels one through three all introduce the letter-sound pair M-/m/. However, level one includes a letter search by name activity, level two includes a letter search by sound activity, and level three includes a letter-sound kangaroo activity. Levels four through six introduce the letter-sound pair A-/a/. Level four includes a letter search by name activity, level five includes a letter search by sound activity, and level six includes a letter-sound kangaroo activity. The same pattern continues throughout the 24 levels. Eight letters are introduced by the last level. See Appendix C for a list of letters and activities used in each level.

The Blending Activity

The blending activity is the third and final activity presented in each level. For this activity, children are told that Spotty the turtle speaks really slowly and are asked if they could guess what word Spotty is saying. A word is pronounced in separate syllables or phonemes depending on the level. Four images are displayed in the center of the screen. Students need to blend the syllables or phonemes together in order to create a word that matches one of the four images displayed on the screen. For example, if the stimulus is /ku/...pause... /ja/, then children are expected to click on the image depicting *guya* ‘fish’. Task items get harder to blend based on how many syllables or phonemes are in the word (see Figure 5.6 for a screenshot of the Intervention App’s blending activity screen). The phoneme features of the phonemes in the target word also adds to task difficulty. Additionally, as the levels in the game increase, the number of minimal pairs found in the incorrect answer group increases.

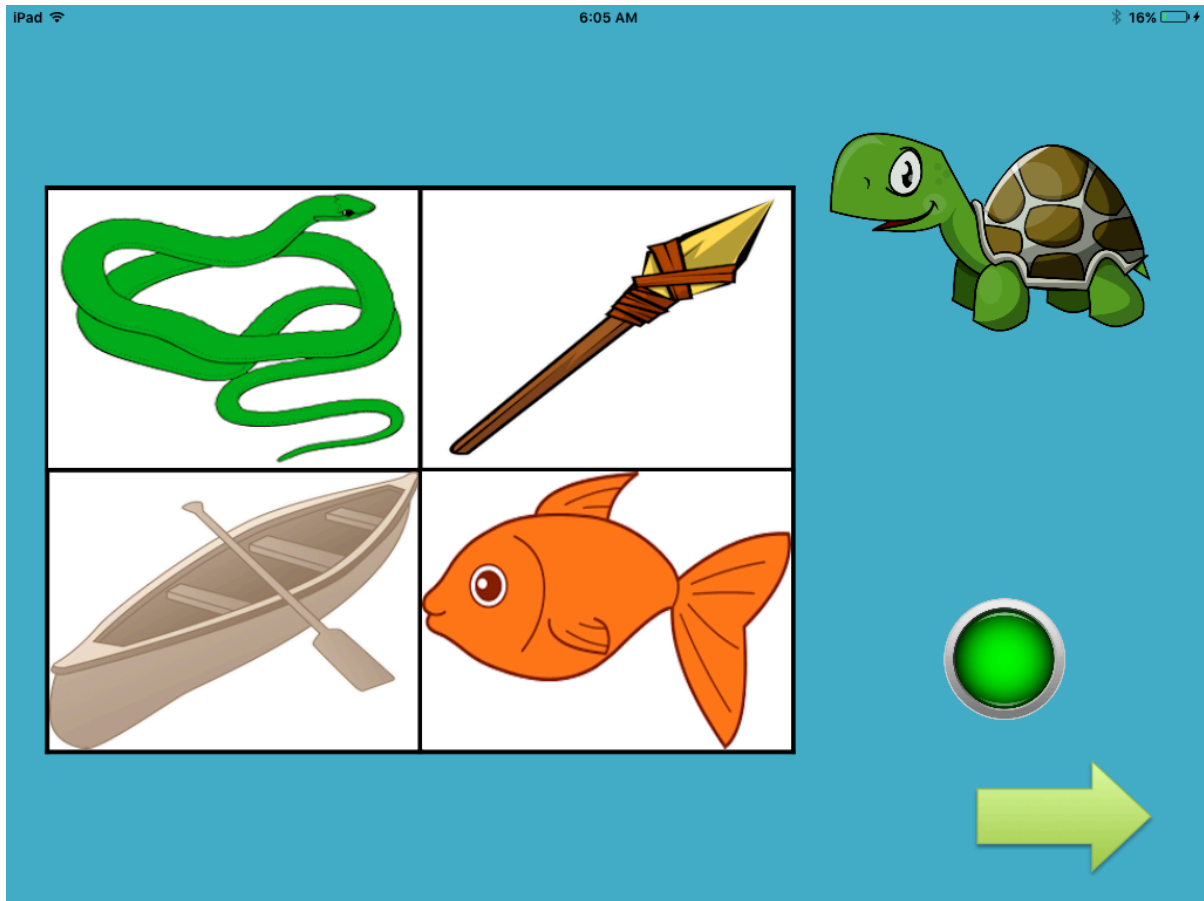


Figure 5.6 – Screenshot of sound blending activity in iLel2 (Intervention App).

The first screen presented for this activity provides the instructions for the activity. The app’s voice-over demonstrates how to play the game by talking through two examples and simulating the expected action on the screen. After the two examples, students are asked to try to answer on their own. There are six stimuli for this activity on each level. The app’s voice-over gives feedback for every response given by the child whether correct or incorrect. If students answer correctly, the app’s voice-over says *yo, latju* ‘yes, great’ and then the next question appears. Students are instructed to listen carefully and try again if they answer incorrectly on their first attempt. If they answer incorrectly a second time, then the app’s voice-over explains the correct answer and then the next question is presented. See Appendix C for thorough details on the instructions,

demonstrations, questions, and feedback for this activity.

ACTIVITY LOG

An activity log is automatically created on each iPad every time someone logs into the app. The activity log takes the form of an excel spreadsheet. Separate sections are created for each activity. The first column for each activity documents the name of the student logging into the app. Each activity also has a column documenting which level was played and on what date it was played. Then, three columns are created for each question in each activity. These three columns list the target answer, how many attempts the student made to answer correctly, and what the student's response was for each try. The activity log only documents iLe12 activity conducted on the specific iPad. Also, all of the activity data collected is presented together by chronological order, not by participant. It is up to interested parties to organize the data by participant (if multiple iPads were used and/or if more than one student played iLe12 on the same iPad).

5.6 PROCEDURE

5.6.1 Informed Consent

Prior to the onset of the current study, approval was obtained from the University of Melbourne's Human Research Ethics Committee, the Northeast Arnhem Land Council, and the principal of Yirrkala School. A plain language statement, stating the purpose of

the study and explaining the proposed experimental design, was presented to the lead school principal, the principal in training, and the teachers of the two classrooms involved in the study. Principals and teachers signed preapproved written consent forms. The participants' guardians were also presented with a plain language statement that was verbally translated by a Yolŋu community member who was paid for their participation in this activity. The caregivers signed preapproved written consent forms that were also verbally translated to them by the Yolŋu community member assistant.

5.6.2 Pilot Study

The assessment app was piloted six months prior to the beginning of the study in order to ascertain whether the students would be receptive to educational literacy iPad apps. Twenty-four students from Transition to Grade 4 were tested⁵⁶. Student performance ranged from six to eighteen correct out of twenty. Although assessment scores varied, all students found the app easy to navigate. I pointed to the green arrow on the welcome screen to direct the child to press on it. When the first question appeared, I pointed to the speaker to direct the child to press on it. The children listened to the question; and without any direction, automatically pressed on one of the answer choices. After children made their selections, I directed the child to press on the green arrow to bring up the next question. After the second question, all the students were able to run the app without

⁵⁶ Some of these students also participated in the experimental phase of the study. However, the students did not receive feedback on their assessment answers and phonological awareness training was not administered during the six months in between the pilot study and the onset of the experimental phase.

assistance. It was clear that even the youngest of children would be able to interact with an interactive iPad app.

5.6.3 Pre-test

The pre-test phase took place during the first three weeks of the fourth school term in 2015. However, note that students were still included in the study if they started attending class after the first three weeks of the term. Pre-tests were administered to these latecomers on the first day of their return to school. The assessment battery was conducted over two separate sessions, one session for the iLe11 assessment and another session for the oral assessment. Students with hearing impairment were asked to wear their hearing aids during testing times. Recall from section 2.2.2 that many Indigenous children suffer from OM-related hearing loss.

The iLe11 assessment was administered first. Students were individually pulled out of class and taken into a familiar quiet space in the school. A Dhuwaya-speaking community member was hired as a research assistant to clarify questions and to help students navigate the app if needed. I observed the participants' behaviors while they worked through the assessment and made notes on the observation forms. Notes included observations such as: which types of questions were easy for the participant, which types of questions were difficult for the participant, and did the participant seem confident or did he or she seem to be guessing?

A research assistant was also hired to administer the oral assessment. Again, students were individually pulled out of class and taken into a familiar quiet space in the

school. I observed the participants' behaviors and filled out the observation forms with notes such as: how is the participant syllabifying the words, how is the participant breaking up words for the phoneme segmentation task, is the participant automatically recognizing words in the reading assessment, is the participant guessing random words that begin with the same letter, is the participant sounding out letters and then blending them to decode the word, or is the participant able to sound out letters but not blend them into a word? The oral assessments were recorded on a Zoom H4n audio recorder.

5.6.4 Intervention

The intervention began in the fourth week of the school term, immediately following the pre-test phase. On the first day of the intervention, I went to the students' classrooms with the Yolŋu teacher-linguist and we played the first level of iLe12 (the game-like phonological awareness training ipad app) together as a class. The Indigenous teacher-linguist talked the students through the instructions of how to play each activity in the app. Then, the students were broken up into groups of two and instructed to play the first level again in pairs. The next day, children began playing with the Intervention App on their own. As previously mentioned, students who started attending school later on in the term were still included in the study. They would complete the pre-test first and then they would commence playing with the Intervention App the next day that they came to school.

Participants played with the Intervention App over the remainder of Term 4, 2015. I visited both classrooms for thirty minutes every school day. Each student was

given his or her own iPad and was signed into the app by myself or one of the classroom teachers to assure that the student's name was spelled correctly. Otherwise, the app would not recognize the student's login and they would not be taken to the correct Intervention App level. Each student was also given a set of headphones so that each student could hear the app's audio clearly. Participants in *Djeŋ* class, Grades 2 through 4 students, worked independently. Participants in *Wurpan* class, Transition and Grade 1 students, received help if they asked for it or if they looked as if they were not engaging with the app. The *Wurpan* classroom teacher, the assistant Yolŋu teacher, and I walked around the room offering help and making sure students were on task.

5.6.5 Post-test One

The assessment battery was administered to the children again during the last week of Term 4, 2015. Participants completed both the iLe1 app assessment and the oral assessment. The assessments were delivered in the exact same way that they were delivered during the pre-test phase except that I administered the iLe1 assessment alone due to difficulties experienced with appointing a research assistant to come in. I helped the students whilst also making observational notes. My letter and sound training jargon in Dhuwaya is fluent so I was able to help students when they asked for clarifications. A new research assistant administered the oral assessment this time. The assistant read from the same script used for the pre-test in order to assure that students received the same instructions and guidance throughout the assessment. I observed and took notes on the observation forms. The oral assessments were recorded on a Zoom H4n audio recorder.

Students with hearing impairments were asked to wear their hearing aids while they completed the assessments.

5.6.6 Post-test Two

The complete battery of assessments was administered a third time in June 2016, six months after the intervention ended. All children completed the iLel1 app assessment as well as the oral assessment. Students with hearing impairments were asked to wear their hearing aids while they completed the assessments. The assessments were administered in the same way that they were administered during the pre-test except that a research assistant was not present when the students worked through the iLel1 app assessment. I helped students when needed whilst also making observational notes. A new research assistant came in to administer the oral assessment. The new assistant read from the same script used at both of the previous testing times in order to assure consistency. I observed the participants' behaviors and took observational notes. The oral assessments were recorded on a Zoom H4n audio recorder. Students with hearing impairment were asked to wear their hearing aids during testing times.

5.7 Analysis

5.7.1 The Data

The data set includes a folder file for each student consisting of four excel files: Assessment App Scores, Oral Assessment Scores, Complete Scores, and Intervention App Activity Data. The Assessment App Scores file lists: what skill each question was targeting, the expected assessment answers, what the student's response was, and whether the response was correct or incorrect. The data collected during each of the three testing times is listed side-by-side so that comparisons can easily be made. See Figure 5.7 for a screenshot example of the data files created to document each participant's Assessment App scores.

Student: Number 15		Pre-Test			Post-Test 1			Post-Test 2		
Date:		October 21st, 2015 10:05AM			December 7th, 2015 9:44AM			June 7th, 2016 10:33AM		
Admin:		Bayini, Gemma, & April			Gemma			Gemma		
Page Number	Skill Tested	Correct Answer	Response	Correct	Correct Answer	Response	Correct	Correct Answer	Response	Correct
1	Letter Knowledge	a	a	Yes	a	a	Yes	a	a	Yes
2	Letter Knowledge	l	d	No	l	ny	No	l	d	No
3	Letter Knowledge	ŋ	ŋ	Yes	ŋ	th	No	ŋ	ŋ	Yes
4	Letter Knowledge	i	i	Yes	i	i	Yes	i	i	Yes
5	Letter Knowledge	rr	rr	Yes	rr	rr	Yes	rr	rr	Yes
6	Letter Knowledge	g	e	No	g	g	Yes	g	g	Yes
Correct Answers				4			4			5
7	Initial Syllable Identification	guya	guya	Yes	guya	guya	Yes	guya	guya	Yes
8	Initial Syllable Identification	mapu	mapu	Yes	mapu	mapu	Yes	mapu	mapu	Yes
9	Final Syllable Identification	ŋaku	ŋaku	Yes	ŋaku	bolu	No	ŋaku	bolu	No
Correct Answers				3			2			2
10	Initial Phoneme Identification	mapu	yalu	No	mapu	mapu	Yes	mapu	buku	No
11	Initial Phoneme Identification	djări	wāŋa	No	djări	djări	Yes	djări	djări	Yes
12	Final Phoneme Identification	mel	bārr	No	mel	djeŋ	No	mel	goŋ	No
13	Final Phoneme Identification	gārak	līkan	No	gārak	gārak	Yes	gārak	gārak	Yes
Correct Answers				0			3			2
14	Syllable Blending - 2 syllables	bāru	bāru	Yes	bāru	bāru	Yes	bāru	bāru	Yes
15	Syllable Blending - 2 syllables	weŋi	weŋi	Yes	weŋi	weŋi	Yes	weŋi	weŋi	Yes
16	Syllable Blending - 3 syllables	muthali	muthali	Yes	muthali	muthali	Yes	muthali	muthali	Yes
Correct Answers				3			3			3
17	Phoneme Blending - 3 phonemes	mel	bārr	No	mel	mel	Yes	mel	mel	Yes
18	Phoneme Blending - 3 phonemes	goŋ	ŋāl	No	goŋ	goŋ	Yes	goŋ	goŋ	Yes
19	Phoneme Blending - 4 phonemes	rrāma	raŋj	No	rrāma	rrāma	Yes	rrāma	rrāma	Yes
20	Phoneme Blending - 4 phonemes	ŋatha	yiki	No	ŋatha	dowu	No	ŋatha	ŋatha	Yes
Correct Answers				0			3			4
Total Correct		10			15			16		
Time Taken		12:32.8			10:10.1			09:13.9		

Figure 5.7 – Screenshot of one student's iLel1 (Assessment App) scores data file.

The oral assessments were transcribed by myself three times each to make sure transcriptions were correct. Colleagues were consulted when uncertainties emerged. Data was organized into an Oral Assessment Scores file which lists what skill each question was targeting, the expected assessment answers, what the student's response was, and whether the response was correct or incorrect. The data collected during each of the three testing times is listed side-by-side so that comparisons can easily be made. See Figure 5.8 for a screenshot example of the data files created to document each participant's oral assessment score data.

Student: Number 25		Pre-Test			Post-Test 1			Post-Test 2		
Date:										
Admin:		Tasha & Gemma			Shandi & Gemma			Wayalwaja & Gemma		
Skill Tested	Word	Correct Answer	Response	Correct	Correct Answer	Response	Correct	Correct Answer	Response	Correct
Syllable Segmentation	1. rrepa	rre-pa	rre-pa	Y	rre-pa	rre-pa	Y	rre-pa	rre-pa	Y
Syllable Segmentation	2. dawu	da-wu	da-wu	Y	da-wu	da-wu	Y	da-wu	da-wu	Y
Syllable Segmentation	3. maypal	may-pal	may-pal	Y	may-pal	may-pal	Y	may-pal	may-pal	Y
Syllable Segmentation	4. gulapa	gu-la-pa	gu-la-pa	Y	gu-la-pa	gu-la-pa	Y	gu-la-pa	gu-la-pa	Y
Syllable Segmentation	5. djinydjalm	djiny-djal-ma	djiny-djal-ma	Y	djiny-djal-ma	djiny-djal-ma	Y	djiny-djal-ma	djiny-djal-ma	Y
Syllable Segmentation	6. miyapunu	mi-ya-pu-nu	mi-ya-pu-nu	Y	mi-ya-pu-nu	mi-ya-pu-nu	Y	mi-ya-pu-nu	mi-ya-pu-nu	Y
Syllable Segmentation	7. djamarrkuli	dja-marr-ku-li	dja-marr-ku-li	Y	dja-marr-ku-li	dja-marr-ku-li	Y	dja-marr-ku-li	dja-marr-ku-li	Y
Total Correct				7			7			7
Phoneme Segmentation	1. ma	m-a	✗	N	m-a	ma-a/m-A-a	Y	m-a	m-a	Y
Phoneme Segmentation	2. go	g-o	✗	N	g-o	g-o	Y	g-o	g-o	Y
Phoneme Segmentation	3. njäl	ñ-ä-l	✗	N	ñ-ä-l	ñ-ä-l	Y	ñ-ä-l	ñ-ä-l	Y
Phoneme Segmentation	4. djët	dj-e-t	✗	N	dj-e-t	dj-e-T-t	Y	dj-e-t	dj-e-t	Y
Phoneme Segmentation	5. pama	p-a-m-a	pa-ma	N	p-a-m-a	N/p-a-m-A-a	Y	p-a-m-a	p-a-m-a	Y
Phoneme Segmentation	6. dawu	d-a-w-u	da-wu	N	d-a-w-u	d-a-w-u	Y	d-a-w-u	d-a-w-u	Y
Total Correct				0			6			6
Word Decoding	1. ñe	ñ-e	ñ-e	N	ñe	ñe	Y	ñe	ñe	Y
Word Decoding	2. yo	y-o	y-o	N	yo	yo	Y	yo	yo	Y
Word Decoding	3. ma	m-a	m-a	N	ma	ma	Y	ma	ma	Y
Word Decoding	4. mel	m-e-l	m-e-l	N	mel	m-e-l/mel	Y	mel	mel	Y
Word Decoding	5. yol	y-o-l	y-o-l	N	yol	yol	Y	yol	yol	Y
Word Decoding	6. ga	g-a	g-a	N	ga	ga	Y	ga	ga	Y
Word Decoding	7. nhä	nh-ä	nh-ä	N	nhä	nhä	Y	nhä	nhä	Y
Word Decoding	8. dhä	dh-ä	dh-ä	N	dhä	dhä	Y	dhä	dhä	Y
Word Decoding	9. gäl	g-ä-l	g-ä-l	N	gäl	gäl	Y	gäl	gäl	Y
Word Decoding	10. rom	r-o-m	r-o-m	N	rom	rom	Y	rom	rom	Y
Word Decoding	11. nyäl	ny-ä-l	ny-ä-l	N	nyäl	nyäl	Y	nyäl	nyäl	Y
Word Decoding	12. djäl	dj-ä-l	dj-ä-l	N	djäl	djäl	Y	djäl	djäl	Y
Word Decoding	13. mala	m-a-l-a	m-a-l-a	N	mala	mala	Y	mala	mala	Y
Word Decoding	14. dawu	d-a-w-u	d-a-w-u	N	dawu	da-wu/dawu	Y	dawu	dawu	Y
Word Decoding	15. pama	p-a-m-a	p-a-m-a	N	pama	pama	Y	pama	pama	Y
Word Decoding	16. detj	d-e-tj	d-e-tj	N	detj	detj	Y	detj	de-tja	N
Word Decoding	17. gol	g-o-l	g-o-l	N	gol	gol	Y	gol	gol	Y
Word Decoding	18. ñatha	ñ-a-th-a	ñ-a-th-a	N	ñatha	ñatha	Y	ñatha	ñatha	Y
Word Decoding	19. rrepa	r-re-pa	r-re-pa	N	rrepa	rre-	N	rrepa	rrepa	Y
Word Decoding	20. buku	b-u-k-u	b-u-k-u	N	buku	buku	Y	buku	buku	Y
Total Correct				0			19			19

Figure 5.8 – Screenshot of one student's oral assessment scores data file.

The Complete Scores file lists the participant's scores on both assessments, the student's school grade level, and the number of Intervention App levels completed. The data collected during each of the three testing times is listed side-by-side so that

comparisons can be made easily. See Figure 5.9 for an example of the data files created to document each participant's complete assessment score data.

Student: Number 25			Pre-Test	Post-Test 1	Post-Test 2
	Student Grade Level:		4	4	5
	iLe12 Level Completed:		N/A	21	21
	Skill	# Of Questions			
Letter Knowledge	Letter Knowledge	6	6	6	6
Syllable Awareness	Syllable Identification	3	3	3	3
	Syllable Blending	3	3	3	3
	Syllable Segmentation	7	7	7	7
Phonemic Awareness	Phoneme Identification	4	4	3	4
	Phoneme Blending	4	4	4	4
	Phoneme Segmentation	6	0	6	6
Reading	Word Decoding	20	0	19	19

Figure 5.9 – Screenshot of one student's complete scores data file.

The Intervention App Activity Data file is an excel workbook containing one tab for each activity featured in the Intervention App. Each individual student's data was organized into one excel workbook. Each Intervention App activity has its own spreadsheet. Information added to these spreadsheets includes: what skill each level was targeting, the date each level was completed, how many attempts the student made to answer correctly, what the student's answers were, and what the expected answer was. See Figure 5.10 for a screenshot example of the excel workbooks created to document the Intervention App activity data collected from each participant.

Spotty											
	A	B	C	D	E	F	G	H	I	J	K
1	Spotty										
2	Activity	Name	Administrator	Date	Level	Skill Tested	Stimuli #	Word	Correct	# of Attempts	First Attempt
3	Spotty	Number 25	Gemma	November 3, 2015	1	Syllable Blending - CV.CV	1	rrāma	Yes	1	rrāma
4	Spotty	Number 25	Gemma	November 3, 2015	1	Syllable Blending - CV.CV	2	ṛāṭi	Yes	1	ṛāṭi
5	Spotty	Number 25	Gemma	November 3, 2015	1	Syllable Blending - CV.CV	3	māla	Yes	1	māla
6	Spotty	Number 25	Gemma	November 3, 2015	1	Syllable Blending - CV.CV	4	ṇatha	Yes	1	ṇatha
7	Spotty	Number 25	Gemma	November 3, 2015	1	Syllable Blending - CV.CV	5	mapu	Yes	1	mapu
8	Spotty	Number 25	Gemma	November 3, 2015	1	Syllable Blending - CV.CV	6	reṭja	Yes	1	reṭja
9											
10	Spotty	Number 25	Gemma	November 3, 2015	2	Syllable Blending - CV.CV	1	wāṇa	Yes	2	wāṇa
11	Spotty	Number 25	Gemma	November 3, 2015	2	Syllable Blending - CV.CV	2	weṭi	Yes	1	weṭi
12	Spotty	Number 25	Gemma	November 3, 2015	2	Syllable Blending - CV.CV	3	bāru	Yes	1	bāru
13	Spotty	Number 25	Gemma	November 3, 2015	2	Syllable Blending - CV.CV	4	buku	Yes	1	buku
14	Spotty	Number 25	Gemma	November 3, 2015	2	Syllable Blending - CV.CV	5	ḷirra	Yes	1	ḷirra
15	Spotty	Number 25	Gemma	November 3, 2015	2	Syllable Blending - CV.CV	6	walu	Yes	2	walu
16											
17	Spotty	Number 25	Gemma	November 4, 2015	3	Syllable Blending - CVCV, CV.CVC, CVC.CV	1	dowu	Yes	1	dowu
18	Spotty	Number 25	Gemma	November 4, 2015	3	Syllable Blending - CVCV, CV.CVC, CVC.CV	2	dhatam	Yes	2	dhatam
19	Spotty	Number 25	Gemma	November 4, 2015	3	Syllable Blending - CVCV, CV.CVC, CVC.CV	3	dharpa	Yes	1	dharpa
20	Spotty	Number 25	Gemma	November 4, 2015	3	Syllable Blending - CVCV, CV.CVC, CVC.CV	4	ṇaku	Yes	1	ṇaku
21	Spotty	Number 25	Gemma	November 4, 2015	3	Syllable Blending - CVCV, CV.CVC, CVC.CV	5	dawurr	Yes	1	dawurr
22	Spotty	Number 25	Gemma	November 4, 2015	3	Syllable Blending - CVCV, CV.CVC, CVC.CV	6	bogba	Yes	1	bogba
23											
24	Spotty	Number 25	Gemma	November 6, 2015	4	Syllable Blending - CVCV, CV.CVC, CVC.CV	1	djāri	Yes	1	djāri
25	Spotty	Number 25	Gemma	November 6, 2015	4	Syllable Blending - CVCV, CV.CVC, CVC.CV	2	ḷikan	Yes	1	ḷikan
26	Spotty	Number 25	Gemma	November 6, 2015	4	Syllable Blending - CVCV, CV.CVC, CVC.CV	3	biḷma	Yes	1	biḷma
27	Spotty	Number 25	Gemma	November 6, 2015	4	Syllable Blending - CVCV, CV.CVC, CVC.CV	4	guya	Yes	1	guya
28	Spotty	Number 25	Gemma	November 6, 2015	4	Syllable Blending - CVCV, CV.CVC, CVC.CV	5	borum	Yes	1	borum
29	Spotty	Number 25	Gemma	November 6, 2015	4	Syllable Blending - CVCV, CV.CVC, CVC.CV	6	djongu	Yes	1	djongu
30											
31	Spotty	Number 25	Gemma	November 6, 2015	5	Syllable Blending - CVCV, CV.CVC, CVC.CV	1	ranji	Yes	1	ranji
32	Spotty	Number 25	Gemma	November 6, 2015	5	Syllable Blending - CVCV, CV.CVC, CVC.CV	2	djewul	Yes	1	djewul
33	Spotty	Number 25	Gemma	November 6, 2015	5	Syllable Blending - CVCV, CV.CVC, CVC.CV	3	ḷorpu	Yes	1	ḷorpu
34	Spotty	Number 25	Gemma	November 6, 2015	5	Syllable Blending - CVCV, CV.CVC, CVC.CV	4	djuku	Yes	1	djuku
35	Spotty	Number 25	Gemma	November 6, 2015	5	Syllable Blending - CVCV, CV.CVC, CVC.CV	5	buram	Yes	1	buram
36	Spotty	Number 25	Gemma	November 6, 2015	5	Syllable Blending - CVCV, CV.CVC, CVC.CV	6	yolṭu	Yes	1	yolṭu
37											

Figure 5.10 – Screenshot of one student’s iLel2 (Intervention App) activity data. Note that there is a tab for each iLel2 activity on the bottom of the excel workbook. This image only shows a portion of the blending activity data.

5.7.2 The Analysis Procedure

Research Question #1:

How do Dhuwaya-speaking children perform on measures of letter knowledge, phonological awareness, and word recognition?

Children’s performance on the various tasks measured was analyzed. Each skill assessed was examined individually. The relationship between participant age and their performance on task measures was investigated. A mean score was calculated for each student cohort and presented as both a percentage and a raw score. The range of scores and standard deviation was also given for each student cohort. SPSS was used to find

means and standard deviations. Averages and standard deviations were rounded to the hundredths place.

Student cohort average scores were examined to decipher if a benchmark, or expected age of mastery, could be determined for the particular skill under investigation. The 90th percentile was chosen as the mastery criterion based on similar guidelines presented by Chafouleas et al. (1997). For example, if Transition and Grade 1 students' average letter knowledge scores were less than 90% while the Grade 2, Grade 3, and Grade 4 students' average letter knowledge scores were 90% or above, then it could be suggested that most typically developing Dhuwaya-speaking children develop letter knowledge by the end of Grade 2. This analysis was carried out with the data collected during each testing time. Pre-test data was used to investigate the age at which children develop particular skills spontaneously, without any explicit instruction (with the exception of letter knowledge and word recognition which were already being taught in the classroom). Post-test data was used to investigate the age at which children develop particular skills after explicit training; i.e., post-test data was indicative of the age in which children are susceptible to or capable of benefiting from explicit training.

The relative difficulty of the various tasks was also investigated. The relative difficulty of the three syllable level tasks was analyzed as well as the relative difficulty of the three phoneme level tasks. I also examined how the linguistic characteristics of task items affected task difficulty. Specifically, I investigated the effects of phoneme features, word length, and syllable/phoneme position. This analysis helped place the various tasks along a developmental continuum.

Additionally, the different word recognition techniques displayed by the children are discussed. It was noted whether participants read words automatically or they sounded letters out and then blended them together to decode words. Failed attempts to decode words were also analyzed. For example, a few children seemed to be using a first letter guessing technique while others sounded out all the letters but could not accurately blend them together.

Research Question #2:

What is the relationship between phonological awareness, letter knowledge, and word recognition skills in Dhuwaya-speaking Yolŋu children?

Various relationships between the participants' performance on letter knowledge, phonological awareness, and word recognition measures were considered. The relationship between letter knowledge and word recognition was examined. The relationship between word recognition and each of the phonological awareness subskills was investigated individually. Then, syllable level subskills were grouped together and phoneme level subskills were grouped together. The relationship between word recognition and both syllable awareness and phonemic awareness was then explored. These relationships were examined in order to establish which tasks are more closely related to word recognition ability and thus, more facilitative for early literacy development.

The relationship between each of the six phonological awareness skills measured and letter knowledge was also explored. This analysis was carried out to discern whether letter knowledge was related to phonological awareness at the phoneme and/or supra-phonemic level, if any at all. Additionally, the relationship between the three syllable level skills was examined in order to investigate whether the three measures all tapped into the same unifying construct of syllable awareness. Similarly, the relationship between the three phoneme level skills was examined in order to investigate whether the three measures used all tapped into the same unifying construct of phonemic awareness.

SPSS was used to calculate bivariate correlations. The Pearson product-moment correlation coefficient was used to measure the relationship between variables. Correlations were considered to be significant when p was less than 0.05. However, it was noted whether correlations were significant at the 0.05 or 0.01 level. The strength and the p value are both reported every time a significant correlation is mentioned in Chapter Five.

Initially, I sought to use only data from the pre-test to address the second research question. However, word recognition scores were very low for the pre-test, making it difficult to find correlations between word recognition and the other skills tested. It was then decided to include the data from all three testing times so that different patterns could be investigated. Data from post-test 1 and post-test 2 was examined in the same way that the data from the pre-test was examined. The results for each testing time are discussed separately in Chapter Five followed by a summary of the major findings found from all three testing times collectively.

Research Question #3:

Does a researcher designed phonological awareness training program help increase phonological awareness and letter knowledge for Indigenous children in their home language: Dhuwaya?

Data for students who completed both the pre-test and post-test 1 was used to address the third research question. The immediate effect that iLel2 training had on letter knowledge and phonological awareness skills was examined. Intervention outcomes were measured both manually and on SPSS using paired samples t-Tests.

Students' syllable identification, syllable blending, syllable segmentation, phoneme identification, phoneme blending, phoneme segmentation, and letter knowledge pre-test and post-test 1 scores were compared. If syllable blending, syllable segmentation, phoneme blending, phoneme segmentation, and letter knowledge scores increased then the results would suggest that the training program was successful in developing the skills trained in the app. If syllable identification scores increased then the results would suggest that the training app helped develop syllable awareness more broadly and that this awareness was transferable to other syllable level tasks. If the phoneme identification scores increased then the results would suggest that the training program helped develop phonemic awareness in general and that this awareness acquired was transferable to other phoneme level tasks. If scores decreased or did not change for any given skill, then the results would indicate that the training program was not successful in training that specific skill.

The relationship between student age and intervention outcomes was examined to determine whether age had an impact on intervention outcomes. The relationship between Intervention App level completed and intervention outcomes was also investigated. This would allow me to determine how much of the training program needed to be completed in order for children to experience improvements. Intervention outcomes of students who completed most, if not all, of the training program were compared to the outcomes of students who only completed a few Intervention App levels. These comparisons were useful because the study did not include a control group.

Some of the participants were administered the same assessment battery in April 2015, six months before the experimental phase began. These April assessments will be termed baseline assessments for readability purposes. The baseline and pre-test assessments were both conducted during the same school year meaning that children were in the same classrooms with the same teachers following the same curriculum. Therefore, it was surmised that the scores earned during these two testing times could be compared in order to establish a baseline for natural spontaneous skill development. Changes in score, if any, between the pre-test and the baseline assessments were divided by six (number of months in between testing times). The resulting number was considered the average change in score per month expected from the participants' natural classroom experience. Post-test 1 was also conducted in the same school year as the baseline and the pre-test meaning that the participants' classroom environment was still the same. Following this line of reasoning, the size of the difference between post-test 1 and pre-test scores was divided by 1.5 (number of months in between tests) to calculate an average change in score per month. This number, the average score change per month

based on the pre-test and post-test **1**, was compared to their natural skill level development baselines in order to investigate whether gains were higher than expected from natural scholastic growth. This analysis was only conducted with the skills that the children displayed significant gains in after iLel2 training.

Data for students who completed the pre-test, post-test **1**, and post-test **2** was used to investigate whether the students were able to maintain any of the gains, if any, received from the intervention.

Research Question #4:

Do improvements in phonological awareness and letter knowledge (gained through training app) in turn facilitate early word reading?

Data for students who completed both the pre-test and post-test **1** was used to address the third research question. Students' pre-test and post-test **1** scores were compared. If increases in word recognition scores were related to increases in letter knowledge or any of the phonological awareness skill scores, then the results would suggest that increasing that particular skill had a facilitating effect on early word reading. The data from students' whose word recognition score increased, if any, was analyzed first. I investigated whether these students also increased their scores for any of the other variables measured. The letter knowledge and phonological awareness scores of the children whose word recognition scores increased were then compared to the letter knowledge and phonological awareness scores of the participants whose word

recognition scores did not increase. This comparison was made with the aim of identifying the skills responsible for differences in word recognition scores.

Students' post-test **1** and post-test **2** scores were compared for students who were present during all three testing times. This comparison was used for two reasons: 1) to examine whether students had retained any of the skills gained from the intervention, and 2) to investigate whether increases in any particular phonological awareness skill could predict later word reading. It was possible that younger students with little literacy training would not be able to apply their phonological awareness skills to reading practices. However, it was possible that students would be able to apply their phonological awareness skills to reading practices once they had received more literacy training in the classroom. Therefore, if increases in post-test **2** word recognition scores were related to post-test **1** increases in any of the phonological awareness skill scores, then the results would suggest that increases in that particular phonological awareness skill were predictive of later word reading ability.

We now turn to an in depth exploration of the first two research questions in Chapter Six. The third and fourth research questions are explored in Chapter Seven.

CHAPTER SIX

6.0 PATTERNS AND RELATIONSHIPS FOUND IN THE PARTICIPANTS’ LETTER KNOWLEDGE, PHONOLOGICAL AWARENESS, AND WORD RECOGNITION DATA

The relationship between letter knowledge, phonological awareness, and word recognition has been widely discussed in the reading literature. Extensive research indicates that a significant connection between phonological awareness and early reading exists across languages. However, researchers have not reached a consensus in regard to which specific phonological awareness tasks have the most predictive power or most accurately monitor students’ phonological awareness level. The existing research is also unclear in regard to which tasks contribute most robustly to early reading, how to sequentially order tasks, or on how linguistic manipulations to the task items affect task difficulty (Chafouleas et al., 1997; Dickinson & Neuman, 2006). In other words, there are no clear standards for how to best assess students’ phonological awareness levels or on how to most efficiently create intervention programs. Having clear phonological awareness benchmarks and assessments can help educators evaluate whether students are meeting academic standards or if they are at risk for future reading difficulties and as we have noted, early detection of at-risk children is crucial. Additionally, educators can create more efficient training and intervention programs if they know which specific skills have the most facilitative effect on emergent reading.

The interplay between letter knowledge and phonological awareness is also a contentious but important topic. Information on how the two code related skills affect

each other can be used to create lesson plans that strategically incorporate the two skills in a manner that growth in one skill facilitates growth in the other and vice versa.

Furthermore, the available research is heavily based on widely spoken languages. Limited focus has been allotted to the early development of literacy skills in languages spoken by Indigenous children coming from cultures primarily transmitted through oral tradition. Answers may be language and learner specific when asking “which specific phonological awareness tasks have the most facilitating effect on early literacy acquisition?”. Moreover, pre-literacy skill benchmarks, and the relationship between these skills and early word recognition, may be different for children coming from cultures primarily transmitted through oral tradition. Yolŋu children do not encounter many early literacy practices in the home and thus letter knowledge, phonological awareness, and word recognition benchmarks may be delayed compared to existing benchmarks based on children coming from literacy focused cultures. In order to create assessments and interventions that best serve a targeted population, studies need to be conducted on the language spoken by that population and in the children’s unique environment. I am not aware of any studies focusing on the acquisition of early Dhuwaya literacy skills at this time. Thus, this study hopes to fill the research gap by addressing the project’s first two research questions:

- 1) How do Dhuwaya-speaking children perform on measures of letter knowledge, phonological awareness, and word recognition?

2) What is the relationship between phonological awareness, letter knowledge, and word recognition skills in Dhuwaya-speaking Yolŋu children?

As discussed in Chapter Five, six separate phonological awareness sub-skills were used to measure phonological awareness: syllable blending, syllable segmentation, syllable identification, phoneme blending, phoneme segmentation, and phoneme identification. Two assessments were administered to address this question (see section 5.5.1 for a detailed description of the assessments). The same two assessments were administered at three separate testing times: the pre-test phase, the post-test **1** phase, and the post-test **2** phase. The data collected at each testing time was considered so that different patterns could be observed and investigated as it is possible for different patterns to emerge as the various skills continue to develop.

Including the data collected at each testing time allowed for more appropriate correlations to be made between the various skills measured and word recognition. During the pre-test phase, only five out of 24 students were able to recognize any of the words in the word recognition task. Two of these students were only able to read one word. Another student was only able to read three words. I presumed that the correlations between the various sub-skills and word recognition ability would be skewed by these very low word recognition scores. Therefore, I decided to include the data collected at each testing time in this analysis. Additionally, including the data collected at each testing time allowed me to compare students' natural development of the various skills measured (with the exclusion of letter knowledge and word recognition which were already being taught in the classrooms) to the students' development of these skills after

explicit instruction. Note that comments are made in this chapter regarding the age of spontaneous skill acquisition versus the age of skill acquisition after receiving explicit training in that skill. These observations are used to suggest benchmarks for natural skill acquisition as well as to suggest ages at which children are capable of benefiting from training in a particular task. However, the purpose of this chapter is to discuss patterns and relationships found amongst Dhuwaya-speaking children's distinct emergent literacy skills. The specific effects of the Intervention App training will be discussed in detail in Chapter Seven.

This chapter includes a section for each of the skills measured: letter knowledge, syllable identification, syllable blending, syllable segmentation, phoneme identification, phoneme blending, phoneme segmentation, and word recognition. Each section begins with a brief explanation of the particular skill being discussed, and a recap of the task used to measure the skill in the current study. Each section is then divided into four subsections, one for each testing time and then a final discussion putting all of the data on the particular skill together.

Each of the testing time subsections (pre-test, post-test 1, and post-test 2) begins with a description of the participants' performance by age. This is followed by a description of the participants' performance by task item. Each testing time subsection ends with a statistical analysis using the Pearson product-moment correlation coefficient to state the relationship between the individual task and word recognition ability. The Pearson product-moment correlation coefficient is also used to investigate the relationship between the individual task and letter knowledge. Correlations between variables are based on full data sets. However, all of the students' responses are

considered when discussing the participants' response patterns for each sub-skill tested. All of the students' responses are also included in the student cohort average scores for each sub-skill tested. In other words, if students completed the phoneme blending section of the assessment, then their performance is included in the phoneme blending discussion whether they completed all other assessment sections or not. However, their data is only included in the correlation discussion if they completed all parts of the assessment battery (both the Assessment App and the oral assessment) at the specific testing time being discussed.

Each section closes with a discussion subsection which includes an overview of the participants' behavior on the particular skill discussed in that section. The data is used to propose benchmarks, or expected age of mastery, for that skill. The 90th percentile was chosen as the mastery criterion based on similar guidelines presented by Chafouleas et al. (1997). A statement on how these proposed benchmarks fit into existing research follows. The effects that different linguistic features had on the students' performance on each task are then discussed shedding light on the interplay between task type and item features for the purpose of better understanding how to accurately assess students' phonological awareness progress. Accounting for both task type and the linguistic complexity of the assessment items allows for more precise benchmarks to be made. The discussion subsections end with an analysis of the specific task's relationship with word recognition and letter knowledge.

This chapter also includes a section discussing the participants' overall syllable awareness skills and a section discussing their overall phonemic awareness skills. The syllable awareness section includes a subsection for each testing time. For each testing

time, scores for the three syllable level tasks are averaged together to calculate an average syllable level score for each student cohort. The relative difficulty of the three tasks is discussed. Then, the relationships found between syllable awareness and both word recognition and letter knowledge are discussed. Additionally, the relationship amongst the three syllable level tasks is discussed. The syllable awareness section closes with a summary of the significant findings. The phonemic awareness section follows the same organization as the syllable awareness section, with a focus on the phoneme level tasks. The chapter closes with a general discussion of all the findings.

Throughout the chapter, comments are made about children guessing or answering confidently. I observed all of the participants as they completed the assessment battery. Various different behaviors were observed. Some students immediately clicked on the correct answer and moved on to the next question. This behavior was marked as answering confidently and with ease. Other students took their time analyzing all the answer choices and sometimes clicked on the speaker icon so that they could hear the question again. This behavior was marked as answering correctly (if they did) after focused thinking. A few of the younger children clicked on every answer choice one at a time and then looked up at the research assistant and myself and said ‘eh?’ In a similar manner, a few of the younger students clicked on several answer choices while either singing or looking around the room before selecting a final answer. This behavior was accompanied with frustrated sighs or an obvious lack of focus. One child clicked on the second cell on the screen for every single letter knowledge and identification question. These last three behaviors were marked as guessing.

Note that the participants were in different school grade levels when the third testing time took place. Pre-tests took place in October 2015 (during the first few weeks of school Term 4). Post-test **1** took place December 2-9, 2015 (last week of Term 4). The participants were in Transition to Grade 4 during these first two testing times. Post-test **2** took place in June 2016, six months after post-test **1** was completed. Post-test **2** took place in the 2016 school year meaning that students were one school grade ahead than they were when they took the pre-test and post-test **1**. Therefore, students were in Grades 1 – 5 when they completed post-test **2**.

6.1 LETTER KNOWLEDGE

Letter knowledge involves being able to recognize all the letters of the alphabet, both the lowercase letters and the uppercase letters, and knowing their names and sounds (Ehri & Roberts, 2006). In the current study, letter knowledge was measured by asking the children to click on the lowercase letter on the iPad screen that corresponded to the sound voiced by the app's audio. Six letter-sound pairs were tested: two vowels (A-/a/ & I-/i/), one nasal consonant (Ō-/ŋ/), one stop consonant (K-/k/), one trill (RR-/r/), and one lateral approximant (L-/l/). Students received one point for each item answered correctly. Possible scores for this section of the assessment battery ranged from zero to six.

6.1.1 Letter Knowledge Data: Pre-test

During the pre-test phase, 29 students completed the letter knowledge section of the assessment battery. The data for all 29 students is discussed below.

Table 6.1

Average Pre-test Letter Knowledge Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	63.3%	3.80	2 – 6	1.64	5
Grade 1	65.0%	3.90	1 – 6	1.85	10
Grade 2	80.0%	4.80	3 – 6	1.64	5
Grade 3	94.4%	5.67	5 – 6	0.58	3
Grade 4	94.4%	5.67	5 – 6	0.52	6
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Average letter knowledge scores improved with age (see Table 6.1 for participant scores). The two younger student cohorts, Transition and Grade 1 students, achieved comparable scores. Moderate guessing was observed amongst these younger students on letter knowledge questions with scores ranging from a low one to a perfect six. There was a substantial increase between these younger students' average scores and the Grade 2 students' average scores. The range of scores obtained by Grade 2 students was smaller than the range of scores obtained by the younger students. Two Grade 2 students answered half of the letter knowledge questions correctly. Moderate guessing was observed for both of these students. The remaining three Grade 2 students confidently answered all letter knowledge questions correctly. There was a substantial increase between the Grade 2 students' average letter knowledge scores and the older students'

average scores. All Grade 3 and Grade 4 students answered letter knowledge questions confidently and almost all of them received a perfect score. None of the Grade 3 or Grade 4 students answered more than one letter knowledge question incorrectly.

Students had the most success matching the trill /r/ to its corresponding digraph (rr). Only three students linked /r/ to a mismatching letter. The majority of the children were also able to correctly match the vowel sounds (/a/ and /i/) and the velar nasal (/ŋ/) to their corresponding letters (a, i, & ŋ; respectively). Twenty-four out of 29 children matched /i/ to its corresponding letter, 23 out of 29 children matched /a/ to its corresponding letter, and 23 out of 29 children matched /ŋ/ to its corresponding letter. Almost a third of the students were unable to correctly match the lateral approximant /l/ to its corresponding letter (l). Students had the most difficulty matching the velar stop [g] with its respective letter (g), with 12 out of 29 students answering incorrectly to this task item.

During the pre-test phase, 24 students completed both the letter knowledge and word recognition sections of the assessment battery. The following correlation analysis is based on the data collected from these 24 students. Letter knowledge was not significantly correlated with word recognition.

6.1.2 Letter Knowledge Data: Post-test 1

During the post-test 1 phase, 19 students completed the letter knowledge section of the assessment battery. Their performance on the letter knowledge section is discussed

below. Note that participants completed post-test 1 immediately after participating in the Intervention App training.

Table 6.2

Average Post-test 1 Letter Knowledge Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	55.6%	3.33	2 – 6	2.31	3
Grade 1	76.7%	4.60	3 – 6	1.34	5
Grade 2	79.2%	4.75	2 – 6	1.89	4
Grade 3	100.0%	6.00	6	0.00	2
Grade 4	96.7%	5.80	5 – 6	0.45	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Average letter knowledge scores improved with age (see Table 6.2 for participant scores). Guessing on the letter knowledge questions was observed with just under half of the Transition and Grade 1 students. Only one Grade 2 student was observed guessing on letter knowledge questions. This student only answered two out of the six letter knowledge questions correctly, which lowered the Grade 2 average score. All remaining Grade 2 students answered confidently and scored either a five or a perfect six. All Grade 3 and Grade 4 students answered letter knowledge questions confidently and scored a perfect six with the exception of one Grade 4 student who scored a five.

The students displayed the most ease matching /r/ to its corresponding digraph. All 19 students correctly matched this sound to its corresponding digraph. The majority of the children were also able to match the vowel sounds to their respective letters. Only one student was unable to correctly match /a/ to its corresponding letter and only three students were unable to correctly match /i/ to its corresponding letter. Four students were

unable to match the velar nasal /ŋ/ to its corresponding letter. Students experienced the most difficulty with the lateral approximant /l/ (6 out of 19 students answered incorrectly) and the velar stop [g] (7 out of 19 students answered incorrectly).

Seventeen students completed both the letter knowledge section and the word recognition section of the assessment battery during this testing time. The following correlation analysis is based on the data collected from these 17 students. Letter knowledge was not significantly correlated with word recognition.

6.1.3 Letter Knowledge Data: Post-test 2

Twenty-three students completed the letter knowledge section of the assessment battery during the post-test 2 phase. Their performance on the letter knowledge questions is discussed below. Note that post-test 2 was administered six months after the Intervention App training ended.

Table 6.3

Average Post-test 2 Letter Knowledge Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Grade 1	66.7%	4.00	2 – 6	1.83	4
Grade 2	75.0%	4.5	3 – 6	1.39	8
Grade 3	87.5%	5.25	3 – 6	1.50	4
Grade 4	100.0%	6.00	6	0.00	2
Grade 5	96.7%	5.80	5 – 6	0.45	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Average letter knowledge scores increased with age (see Table 6.3 for participant scores). Guessing was observed amongst some of the Grade 1 and Grade 2 students. One Grade 3 student was guessing and only answered half of the questions correctly but the remaining Grade 3 students confidently answered all letter knowledge questions correctly. All Grade 4 students answered all letter knowledge questions correctly with ease. One Grade 5 student answered incorrectly to one of the six letter knowledge questions. All other Grade 5 students answered all letter knowledge questions correctly with ease.

Students displayed the most ease matching the trill to its corresponding digraph with only one student answering incorrectly to this test item. The majority of the participants were able to correctly match the vowel sounds to their letters. Twenty-one out of 23 students answered each vowel letter knowledge question correctly. Most participants also correctly matched the velar nasal to its respective letter, with 20 students correctly matching /ŋ/ to η. Seventeen of the 23 students correctly matched the velar stop [g] to its corresponding letter. Students experienced the most difficulty matching the lateral approximant /l/ to its corresponding letter, with nine students answering incorrectly.

Twenty students completed both the letter knowledge and word recognition sections of the test battery during this testing time. The following correlation analysis is based on the data collected from these 20 students. Letter knowledge was significantly correlated with word recognition at the .01 level ($r = .581, p = .007$).

6.1.4 Letter Knowledge Discussion

Throughout all three testing times, letter-sound knowledge increased with age. The current data suggests that many Dhuwaya-speaking children living in remote areas begin to master letter-sound knowledge in Grade 2 and that most have mastered this skill by the end of Grade 3. The findings indicate that the benchmark may be slightly delayed for Indigenous children living in very remote communities. The existing research suggests that many children have learned some, if not all, of the letter-sound correspondences in their language by the end of kindergarten and that all typically developing children are expected to have done so by the end of Grade 1 (Dickinson & Neuman, 2006; NELP, 2004; Shaywitz, 2003). This contrast can be expected considering that letter knowledge does not develop without explicit instruction and most Yolŋu children do not encounter literacy experiences in the home.

Throughout all three testing times, children experienced the most ease recognizing the letters corresponding to the trill sound, followed by the vowel sounds, followed by the nasal sound. During the first two testing times, students experienced the most difficulty recognizing the letter corresponding to the stop consonant. The lateral approximant sound was the second most difficult sound for students to match to its corresponding letter. During the last testing time, students experienced the most difficulty identifying the lateral approximant to its corresponding letter. The stop consonant was the second most difficult sound for the children to match with its corresponding letter. This data is consistent with previous findings which state that children find plosives and lateral approximants challenging to master (Kartal & Terziyan, 2016).

Phonological aspects of Yolŋu Matha stop consonants may have also contributed to student performance. Voiced and voiceless stop consonants are not thought to be contrastive in the Yolŋu Matha varieties spoken in Yirrkala (Amery, 1993) with the exception of the retroflex stops /ɖ/ and /t/ in the environment (vowel, liquid) ____ (vowel) (Amery, 1985). For all other places of articulation⁵⁷, voiced and voiceless stops act as allophones of the same phoneme. Stop realization tends to be determined by word environment. For example, [g] occurs word initially and following nasal consonants while [k] occurs word finally and in inter-continuant position. Spelling rules follow the same pattern: the letter g is used word initially and following nasal consonants while the letter k is used word finally and in inter-continuant positions. Therefore, it may be more difficult to associate the velar stop phoneme with its corresponding letter as it has two possible answers depending on its articulation (or allophonic variety), which is dependent on word environment. The letter-sound identification task used in this study did not include environmental clues.

Data collected during the first two testing times suggests that letter-sound knowledge is not statistically correlated with word recognition in Dhuwaya. This result is unexpected. Across studies, letter knowledge has been found to have a sizeable relationship with word recognition and even more, to be one of the strongest predictors of later literacy (Adams, 1990; Dickinson & Neuman, 2006; NELP, 2008). However, data collected during the third testing time suggests that letter-sound knowledge is correlated with word recognition skills in Dhuwaya. I offer the following explanation: the floor effect, extremely low scores across the board, found in the word recognition task during

⁵⁷ Bilabial, velar, apico-alveolar, interdental, and lamino-alveolar (Amery, 1985).

the first two testing times made it difficult to find any statistically significant relationships amongst the variables and word recognition.

Statistical analysis may have been skewed by small participant numbers. If we look at Table 6.4 below, we can see that across all three testing times, all of the students that were able to decode words were also able to answer at least five of the six letter-sound knowledge questions correctly. Across the board, not one student with a low letter-sound knowledge score was able to decode any words. Therefore, the data provides evidence that suggests there is a significant relationship between letter-sound knowledge and word recognition ability in Dhuwaya speakers.

Table 6.4*Letter Knowledge Scores Compared with Word Recognition Scores.*

Pre-test		Post-test 1		Post-test 2	
Letter Knowledge Score (out of 6)	Word Recognition Score (out of 20)	Letter Knowledge Score (out of 6)	Word Recognition Score (out of 20)	Letter Knowledge Score (out of 6)	Word Recognition Score (out of 20)
6	20	6	20	6	20
6	18	6	19	6	19
6	1	6	7	6	13
6	1	6	7	6	8
6	0	6	4	6	5
6	0	6	1	6	5
6	0	6	1	6	4
6	0	6	0	6	4
6	0	6	0	6	2
6	0	6	0	5	4
6	0	5	6	5	0
6	0	5	0	5	0
5	3	4	0	5	0
5	0	4	0	4	0
5	0	3	0	4	0
5	0	2	0	3	0
5	0	2	0	3	0
4	0			3	0
3	0			3	0
3	0			2	0
3	0				
3	0				
3	0				
1	0				

6.2 SYLLABLE IDENTIFICATION

Identification tasks involve the identification of specific sounds, i.e. identifying the same sound in different words (Gillon, 2004). In particular, syllable identification tasks require

children to recognize a specific syllable in a group of words. In this particular study, children were given a list of four words and then asked to click on the image depicting the word that either starts or ends with a specific syllable. For example:

[Dhuwaya wuṇuli' bathi dowu mapu' ga lorri...]
 [Here are the pictures: bag wave (ocean) egg truck]
 Maṇ'maṇu ṇarraku rirrakay ṇunhi ṇurru-yirr'yun yukurra rirrakayyu /ma'/
 Look for the word for me those that begin with 'ma'

Participants were asked to identify two initial syllables and one final syllable. Students received one point for each item answered correctly. Possible scores for this section of the assessment battery ranged from zero to three.

6.2.1 Syllable Identification Data: Pre-test

Twenty-nine students completed the syllable identification section of the assessment battery during the pre-test phase. The data for all 29 students is discussed below.

Table 6.5

Average Pre-test Syllable Identification Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	60.0%	1.80	0 – 3	1.30	5
Grade 1	63.3%	1.90	1 – 3	0.74	10
Grade 2	73.3%	2.20	1 – 3	0.84	5
Grade 3	33.3%	1.00	0 – 2	1.00	3
Grade 4	61.1%	1.83	1 – 3	0.75	6
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Average syllable identification scores were not related to student age. A wide range of scores was found across all student cohorts. A few students in each cohort, with the exception of Grade 4, were observed guessing on syllable identification questions. Interestingly, the Grade 3 students obtained the lowest average score while the Grade 2 students earned the highest average score. See Table 6.5 for participant scores.

Students performed better on the initial syllable identification questions than they did on the final syllable identification question. Amongst the initial syllable identification questions, scores were higher on the continuant consonant initial task item (22 of the 29 students answered correctly) than on the stop consonant initial task item (17 of the 29 students answered correctly). Just over half of the students (15) experienced difficulty with final syllable identification. The majority of the students who answered incorrectly to the final syllable identification question (12 of the 15) chose the picture representing the Dhuwaya word *bolu* /pu:lu/ ‘bamboo’ which ends with the same phoneme as the target syllable /u/.

During the pre-test phase, 24 students completed both the syllable identification and word recognition sections of the assessment battery. The following correlation analysis is based on the data collected from these 24 students. Syllable identification scores were not significantly correlated with word recognition scores. During this testing time, 29 students completed both the syllable identification and letter knowledge sections of the assessment battery. The following correlation analysis is based on the data collected from these 29 students. Syllable identification scores were not significantly correlated with letter knowledge scores.

6.2.2 Syllable Identification Data: Post-test 1

Nineteen students completed the syllable identification section of the post-test 1 assessment battery. Their performance on the syllable identification section is discussed below. Note that participants completed post-test 1 immediately after participating in the Intervention App training.

Table 6.6

Average Post-test 1 Syllable Identification Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	66.7%	2	2	0.00	3
Grade 1	66.7%	2	2	0.00	5
Grade 2	83.3%	2.5	2 – 3	0.58	4
Grade 3	66.7%	2	1 – 3	1.41	2
Grade 4	73.3%	2.2	1 – 3	0.84	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Average syllable identification scores were not related to student grade level (see Table 6.6 above for participant scores). All Transition and Grade 1 students obtained a syllable identification score of two. All Grade 2 students scored either a two or a three. One of the Grade 3 students guessed on syllable identification scores and answered all three questions incorrectly. The other Grade 3 student confidently answered all three questions correctly. Grade 4 students earned a range of scores from one to three.

Students performed better on questions targeting initial syllables than they did on the question targeting a final syllable. Eighteen out of 19 students correctly identified the

word beginning with a continuant sound. Fourteen out of 19 students correctly identified the word beginning with an oral stop consonant. Many students had difficulty with final syllable identification. Only eight out of 19 students were able to correctly identify the word ending with the target syllable. Incorrect answers varied amongst all three of the incorrect answer options.

Seventeen students completed both the syllable identification section and the word recognition section of the assessment battery during the post-test 1 phase. The following correlation analysis is based on the data collected from these 17 students. Syllable identification scores were not significantly correlated with word recognition scores. Nineteen students completed both the syllable identification section and the letter knowledge section of the assessment battery during this testing time. The following correlation analysis is based on the data collected from these 19 students. Syllable identification scores were not significantly correlated with letter knowledge scores.

6.2.3 Syllable Identification Data: Post-test 2

Twenty-three students completed the syllable identification section of the assessment battery during the post-test 2 phase. Their performance is discussed below. Note that post-test 2 was administered six months after the Intervention App training ended.

Table 6.7*Average Post-test 2 Syllable Identification Scores by Student Cohort.*

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Grade 1	75.0%	2.25	1 – 3	0.96	4
Grade 2	63.0%	1.89	1 – 3	0.60	8
Grade 3	83.3%	2.50	2 – 3	0.58	4
Grade 4	66.7%	2.00	1 – 3	1.41	2
Grade 5	86.7%	2.60	2 – 3	0.55	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Syllable identification scores were not related to student grade (see Table 6.7 for participant scores). A moderate amount of guessing was observed amongst Grade 1 and Grade 2 students. The older students answered confidently with the exception of one Grade 4 student who struggled with all identification questions (at both the syllable and phoneme level and across all three testing times).

Students performed better on initial syllable identification questions than on final syllable identification questions. Twenty-three out of the 24 students were able to identify the word that began with a continuant sound. Sixteen students were able to identify the word that began with a stop consonant. Students struggled the most with final syllable identification. Fourteen students were able to correctly identify the word that ended with the target syllable. The remaining ten students incorrectly chose the picture representing the Dhuwaya word *bolu* /pu:lu/ ‘bamboo’, which ends with the same phoneme that the target syllable ended with.

Twenty students completed both the syllable identification and the word recognition sections of the test battery during this testing time. The following correlation

is based on the data collected from these 20 students. Syllable identification scores were significantly correlated with word recognition scores at the .05 level ($r = .468$, $p = .037$). Twenty-four students completed both the syllable identification and the letter knowledge sections of the test battery during this testing time. The following correlation is based on the data collected from these 24 students. Syllable identification scores were significantly correlated with letter knowledge scores at the .05 level ($r = .455$, $p = .025$).

6.2.4 Syllable Identification Discussion

Syllable identification scores did not increase with age. A wide range of scores was observed amongst students of all ages, including the oldest participants. None of the student cohorts' average scores reached a level of mastery. This result was found across the data (at each testing time). Syllable identification benchmarks have not been widely discussed in the literature so it was not possible to compare these results to existing research.

Students performed better on questions targeting initial syllables than on questions targeting final syllables. It was taken into account that students may not have listened to the question carefully and therefore would continue to look for an image representing a word with the same initial syllable. Thus, the Dhuwaya-speaking research assistant paused students after the question was delivered so that she could reiterate that the question was targeting the word's final syllable. Moreover, none of the possible answers started with the target syllable [ku]. This syllable is actually prohibited word initially in Dhuwaya. Thus, it was believed that the lower performance on the final

syllable task item was not a result of misunderstanding the question. The students truly experienced more difficulty identifying final syllables. This result supports the widespread belief that initial sounds are easier to recognize than final sounds (Gillon, 2004; Perez, 2008) and contradicts McBride-Chang's (1995) claim that final sounds are easier to identify than initial sounds.

The current data also supports the theory that students perform better on phonological awareness tasks that target continuant sounds than on phonological awareness tasks that target stop sounds (McKenna et al., 2010). Amongst the initial syllable identification questions, scores were higher for the task item targeting a continuant consonant initial syllable than on the task item targeting a stop consonant initial syllable. This result was found across the data (at each testing time).

Syllable identification scores were not significantly correlated with word recognition scores in the data collected during the first two testing times. However, syllable identification scores were significantly correlated to word recognition scores in the data collected during the third testing time. As previously mentioned, it is possible that correlations were skewed by the floor effect found amongst word recognition scores during the first two testing times. A table was created comparing the syllable identification scores to the word recognition scores of each individual participant. A relationship between the two measures does begin to emerge in the data collected during the third testing time but it is not enough to suggest that a strong correlation exists between syllable identification skill and word recognition ability in Dhuwaya. See Table 6.8 below.

Pre-test and post-test 1 syllable identification scores were not significantly correlated with letter knowledge scores. However, post-test 2 syllable identification scores did correlate with letter knowledge scores.

Table 6.8

Syllable Identification Scores Compared with Word Recognition Scores.

Pre-test		Post-test 1		Post-test 2	
Syllable Identification Score (out of 3)	Word Recognition Score (out of 20)	Syllable Identification Score (out of 3)	Word Recognition Score (out of 20)	Syllable Identification Score (out of 3)	Word Recognition Score (out of 20)
3	0	3	1	3	4
3	0	3	19	3	20
3	1	3	4	3	19
3	0	3	0	3	4
3	0	3	1	3	5
3	0	2	6	3	13
3	0	2	0	3	0
2	1	2	7	3	0
2	20	2	0	2	5
2	0	2	0	2	2
2	0	2	0	2	0
2	18	2	0	2	8
2	0	2	0	2	0
2	0	2	7	2	0
2	0	2	0	2	0
2	0	1	20	2	0
1	0	1	0	2	0
1	0			1	4
1	0			1	0
1	0			1	0
1	0				
1	0				
1	0				
0	3				

6.3 SYLLABLE BLENDING

Blending refers to the ability to blend together isolated sounds to form recognizable words (Ehri & Roberts, 2006) or non-words. Syllable blending tasks require children to blend together isolated syllables to form words. In the current study, the participants were presented with four images on the iPad screen. The app's voiceover told the participants what word was depicted by each image. Then the voiceover presented a string of isolated syllables. Finally, participants were asked to click on the image that represented the word created by blending those syllables together. There were two questions targeting bi-syllabic words and one question targeting a tri-syllabic word. Students received one point for each item answered correctly. Possible scores for this section of the assessment battery ranged from zero to three.

6.3.1 Syllable Blending Data: Pre-test

Twenty-nine students completed the syllable blending section of the assessment battery during the pre-test phase. The data for all 29 students is discussed below.

Table 6.9*Average Pre-test Syllable Blending Scores by Student Cohort.*

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	100.0%	3	3	0.00	5
Grade 1	93.3%	2.8	2 – 3	0.42	10
Grade 2	80.0%	2.4	1 – 3	0.89	5
Grade 3	100.0%	3	3	0.00	3
Grade 4	100.0%	3	3	0.00	6
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

The majority of the students (25 out of 29) were able to answer all syllable blending questions correctly. In fact, none of the students received a score of zero on the syllable blending task (see Table 6.9 for participant scores). Of the four students who did not receive a perfect score on the syllable blending task, three answered two of the three questions correctly and the fourth answered one of the three questions correctly. Some students were even able to answer all syllable blending questions correctly despite their low scores on all other question types. For example, one Transition student answered all three syllable blending questions correctly despite receiving a score of zero on every other type of phonological awareness question. No difference was found between the participants' performance on the bi-syllabic task items and their performance on the tri-syllabic task item.

During the pre-test phase, 24 students completed both the syllable blending and word recognition sections of the assessment battery. The following correlation analysis is based on the data collected from these 24 students. Syllable blending scores were not significantly correlated with word recognition scores. Twenty-nine students completed

both the syllable blending and letter knowledge sections of the assessment battery during the pre-test phase. The following correlation analysis is based on the data collected from these 29 students. Syllable blending scores were not significantly correlated with letter knowledge scores.

6.3.2 Syllable Blending Data: Post-test 1

Nineteen students completed the syllable blending section of the post-test 1 assessment battery. Their performance on the syllable blending questions is discussed below. Note that participants completed post-test 1 immediately after participating in the Intervention App training.

Table 6.10

Average Post-test 1 Syllable Blending Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	88.9%	2.67	2 – 3	0.58	3
Grade 1	100.0%	3.00	3	0.00	5
Grade 2	83.3%	2.50	1 – 3	1.00	4
Grade 3	100.0%	3.00	3	0.00	2
Grade 4	100.0%	3.00	3	0.00	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Most students were able to easily answer all syllable blending questions correctly. Only two of the 19 students were unable to answer all three questions correctly (see Table 6.10 for participant scores). One of these students exhibited difficulty blending the

tri-syllabic task item but was able to accurately blend the two bi-syllabic task items. The other student experienced difficulty blending both bi-syllabic and tri-syllabic words.

Seventeen students completed both the syllable blending section and the word recognition section of the assessment battery during the post-test **1** phase. The following correlation analysis is based on the data collected from these 17 students. Syllable blending scores were not significantly correlated with word recognition scores. Nineteen students completed both the syllable blending section and the letter knowledge section of the assessment battery during the post-test **1** phase. The following correlation analysis is based on the data collected from these 19 students. Syllable blending scores were not significantly correlated with letter knowledge scores.

6.3.3 Syllable Blending Data: Post-test 2

Twenty-three students completed the syllable blending section of the assessment battery during the post-test **2** phase. Their performance on the syllable blending questions is discussed below. Note that post-test **2** was administered six months after the Intervention App training ended.

Table 6.11*Average Post-test 2 Syllable Blending Scores by Student Cohort.*

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Grade 1	100.0%	3.00	3	0.00	4
Grade 2	92.6%	2.78	1 – 3	0.67	8
Grade 3	100.0%	3.00	3	0.00	4
Grade 4	100.0%	3.00	3	0.00	2
Grade 5	100.0%	3.00	3	0.00	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Most students could easily answer all syllable blending questions correctly. Many students orally predicted the target word out loud after hearing only the first or first two syllables of the word. Only one student was unable to answer all three syllable blending questions correctly (see Table 6.11 for participant scores). However, this student initially pointed to the correct answer but then changed it a few times until ultimately choosing an incorrect response for two of the three questions.

Twenty students completed both the syllable blending section and the word recognition section of the test battery during the post-test **2** phase. The following correlation analysis is based on the data collected from these 20 students. Syllable blending was not correlated with word recognition. Twenty-four students completed both the syllable blending and letter knowledge sections of the test battery during the post-test **2** phase. The following correlation analysis is based on the data collected from these 24 students. Syllable blending scores were not significantly correlated with letter knowledge scores.

6.3.4 Syllable Blending Discussion

A ceiling effect occurred with the syllable blending questions. Most of the students were able to correctly answer all three of the syllable blending questions with ease. This result was found across all three testing times. This data suggests that the majority of Dhuwaya-speaking children develop syllable blending skills by the end of their Transition school year. These results are consistent with previous research, which states that syllable blending ability is one of the earliest phonological awareness tasks to develop. Gillon (2004) claims that syllable blending tasks can be used to assess the phonological awareness development of children as young as four years old.

Word length did not affect participant performance on the syllable blending questions. An equal number of incorrect responses was given for the bi-syllabic and tri-syllabic assessment items.

Across all three testing times, syllable blending scores did not significantly correlate with word recognition scores or letter knowledge scores. It can be concluded from the data that syllable blending skill is a lower level phonological awareness skill developed at an early age and therefore it may not be very facilitative in helping children crack the alphabetic code.

6.4 SYLLABLE SEGMENTATION

Segmentation refers to the ability to break up words into their constituent sounds (Fellowes & Oakley, 2014). In particular, syllable segmentation requires the ability to

break up (segment) words into their constituent syllables. In the current study, students were given a word and asked to orally segment the word into syllables. The syllable segmentation section of the assessment included seven words of different syllable lengths and type. See Appendix B for a list of words included in the syllable segmentation section of the assessment battery. Students received one point for each item answered correctly. Possible scores for this section of the assessment battery ranged from zero to seven.

6.4.1 Syllable Segmentation Data: Pre-test

Twenty-four students completed the syllable segmentation section of the assessment battery during the pre-test phase. The data for these 24 students is discussed below.

Table 6.12

Average Pre-test Syllable Segmentation Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	100.00%	7.00	7	0.00	4
Grade 1	55.70%	3.86	0 – 7	3.13	7
Grade 2	88.6%	6.20	4 – 7	1.30	5
Grade 3	90.5%	6.33	6 – 7	0.58	3
Grade 4	91.4%	6.40	5 – 7	0.89	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Most students were able to segment syllables with ease. Still, a small number of the younger students in the study experienced difficulty with the syllable segmentation

assessment task (see Table 6.12 for participant scores). Two Grade 1 students simply repeated the whole word back to the test administrator. One Grade 1 student added an extra mono vowel syllable in between syllables (e.g. /ri:/-/i:/-/pa/ for what should have been segmented into /ri:/-/pa/ 'red clouds' and /meɪ-/a-/pal/ for what should have been segmented into /meɪ-/pal/ 'shellfish'). One Grade 2 student broke up words into Onset_{syllable1}-Rime_{syllable1}-Syllable2 (e.g. /r/-/i:/-/pa/).

The task item that generated the highest number of incorrect answers was *miyapunu* 'turtle' which should have been segmented into /mi-/ja-/pu-/nu/. Many students, including those in Grade 4, segmented this task item into /mija-/pu-/nu/. This outcome may be attributed to the semivowel status of /j/ as it hinders the sonority cues that tend to be used when identifying syllable breaks. No other linguistic features, neither word length nor syllable type, affected student performance.

Twenty-four students completed both the syllable segmentation and word recognition sections of the assessment battery during the pre-test phase. The following correlation analysis is based on the data collected from these 24 students. Syllable segmentation scores were not significantly correlated with word recognition scores. Twenty-four students completed both the syllable segmentation section and the letter knowledge section of the assessment battery during the pre-test phase. The following correlation analysis is based on the data collected from these 24 students. Syllable segmentation scores were significantly correlated with letter knowledge scores at the .05 level ($r = .422$, $p = .04$).

6.4.2 Syllable Segmentation Data: Post-test 1

Eighteen students completed the syllable segmentation section of the post-test 1 assessment battery. Their performance on the syllable segmentation questions is discussed below. Note that participants completed post-test 1 immediately after participating in the Intervention App training.

Table 6.13

Average Post-test 1 Syllable Segmentation Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	92.9%	6.5	6 – 7	0.71	2
Grade 1	88.6%	6.2	3 – 7	1.79	5
Grade 2	92.9%	6.5	6 – 7	0.58	4
Grade 3	92.9%	6.5	6 – 7	0.71	2
Grade 4	97.1%	6.8	6 – 7	0.45	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Most students were able to easily segment words into syllables (see Table 6.13 for participant scores). One student, the same Grade 1 student mentioned in the previous section, added an extra mono vowel syllable in between all three bi-syllabic words. This student was able to correctly segment longer words. The only other task item that children answered incorrectly to was the word *miyapunu* /mi/-/ja/-/pu/-/nu/ ‘turtle’. Up to one third (6 out of 18) of the students gave an incorrect response for this test item. Five of these students segmented the word into /mija/-/pu/-/nu/ and one segmented the word into

/mi/-/pu/-/nu/. As previously mentioned, I link this result to the semivowel status of /j/ as it hinders sonority cues.

Seventeen students completed both the syllable segmentation section and the word recognition section of the assessment battery during the post-test **1** phase. The following correlation analysis is based on the data collected from these 17 students. Syllable segmentation scores were not significantly correlated with word recognition scores. Seventeen students completed both the syllable segmentation section and the letter knowledge section of the assessment battery during the post-test **1** phase. The following correlation analysis is based on the data collected from these 17 students. Syllable segmentation scores were not significantly correlated with letter knowledge scores.

6.4.3 Syllable Segmentation Data: Post-test 2

Twenty students completed the syllable segmentation section of the assessment battery during the post-test **2** phase. Their performance on the syllable segmentation questions is discussed below. Note that post-test **2** was administered six months after the Intervention App training ended.

Table 6.14*Average Post-test 2 Syllable Segmentation Scores by Student Cohort.*

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Grade 1	95.2%	6.67	6 – 7	0.58	3
Grade 2	81.6%	5.71	2 – 7	1.80	7
Grade 3	95.2%	6.67	6 – 7	0.58	3
Grade 4	92.9%	6.50	6 – 7	0.71	2
Grade 5	100.0%	7.00	7	0.00	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Once again, most students were able to easily segment words into syllables (see Table 6.14 for participant scores). One outlier Grade 2 student simply repeated the whole word back to the test administrator. The rest of the incorrect responses, with one exception, were based on test items that included a syllable beginning with a semivowel. The task item yielding the largest number of incorrect responses was *miyapunu* with four students answering /mija/-/pu/-/nu/ and one student answering /mi/-/pu/-/nu/. The only other task item that yielded more than one incorrect answer was *dawu* /d̪awu/ ‘banyan tree’. Two students gave the word as a whole (/d̪awu/) as a response. *Djamarrkuli* /camarkuli/ ‘children’ was the only other target item that generated an incorrect response. One child collapsed the last two syllables of this word into one giving /ca/-/mar/-/kuli/ as a response. This last test item includes a syllable beginning with a lateral consonant. Laterals and semivowels both fall into the same category on the sonority scale: approximants. This data indicates that words including approximant initial syllables are more difficult to segment than words not including approximant initial syllables. Word length did not affect student performance.

Twenty students completed both the syllable segmentation and word recognition sections of the test battery during the post-test 2 phase. The following correlation analysis is based on the data collected from these 20 students. Syllable segmentation scores were not correlated with word recognition scores. Twenty students completed both the syllable segmentation and letter knowledge sections of the test battery during the post-test 2 phase. The following correlation analysis is based on the data collected from these 20 students. Syllable segmentation scores were not significantly correlated with letter knowledge scores.

6.4.4 Syllable Segmentation Discussion

The oral syllable segmentation task was generally easy for all participants. The vast majority of the students were able to easily and confidently segment all words or all words except those comprised of at least one syllable beginning with an approximant consonant. The current data suggests that many Dhuwaya-speaking children begin to master syllable segmentation skills naturally by the end of their Transition year. Some Grade 1 students were still fine-tuning this skill pre-Intervention App training. However, most participants had mastered it by the end of their first year of schooling after receiving explicit training. This data is consistent with existing literature, which suggests that up to 90% of children can count the number of syllables in a word by the end of kindergarten (Shaywitz, 2003). Based off this research, it can be surmised that syllable segmentation is similar to syllable blending in that it is one of the earliest phonological skills developed by young children.

The majority of incorrect answers were based on task items comprised of at least one syllable beginning with an approximant consonant. The task item that yielded the most incorrect responses was *miyapunu* (/mijapunu/) which was segmented into /mija-/ /pu-/ /nu/ or /mi-/ /pu-/ /nu/. A few students also struggled with *dawu* in which they gave /ɖawu/ as a response, *djamarrkuli* which was segmented into /ca-/ /mar-/ /kuli/, and *gulapa* which was segmented into /kula-/ /pa/. These words all have one thing in common: they each contain a syllable beginning with an approximant consonant. The approximant category sits next to the vowel category on the sonority scale. This would explain the children's difficulty in segmenting these syllables as the sonority cues that tend to be used in syllabification are minimized. Only four children gave incorrect responses for task items that did not consist of any syllables beginning with an approximant consonant. Two of these students provided unique word break downs (adding an extra mono vowel syllable in the middle of bi-syllabic words or segmenting words into Onset_{syllable1}-Rime_{syllable1}-Syllable2). The other two students could not syllabify any words at all during the pre-test phase. Thus, the [+approximant] feature seems to be the only linguistic feature affecting task item difficulty for syllable segmentation tasks.

Across all three testing times, syllable segmentation scores were not correlated with word recognition scores. Syllable segmentation scores were significantly correlated with letter knowledge in the data collected during the pre-test phase.

6.5 SYLLABLE AWARENESS

A brief summary of all the syllable level phonological awareness skills is provided in this section. First, the children's overall syllable awareness levels are discussed. To do this, syllable identification, blending, and segmentation scores were averaged together to create an average syllable awareness score for each student cohort. Then the relative difficulty of the three tasks is discussed. Each section ends with a review of each individual task's statistical relationship with word recognition ability, letter knowledge, and the two other syllable level tasks.

6.5.1 Syllable Awareness Data: Pre-test

All students earned moderate to high syllable awareness scores (see Table 6.15). A handful of the students received a perfect syllable awareness score answering all of the syllable awareness questions correctly. Interestingly, the Transition cohort obtained the highest syllable awareness average score. Amongst the syllable level tasks, students performed best on the blending task and displayed the most difficulty with the syllable identification task. Syllable level tasks did not significantly correlate with each other. Syllable level skills did not significantly correlate with word recognition ability. Syllable segmentation was the only task that correlated with letter knowledge.

Table 6.15

Average Pre-test Syllable Awareness Scores by Student Cohort.

Transition	Grade 1	Grade 2	Grade 3	Grade 4
86.7%	73.6%	80.6%	74.6%	84.2%

6.5.2 Syllable Awareness Data: Post-test 1

On average, all students received high syllable awareness scores. Scores increased with age albeit only minimally (see Table 6.16). A handful of the students received a perfect syllable awareness score answering all of the syllable awareness questions correctly. The majority of students breezed through the syllable blending and segmentation tasks with ease. Students earned lower scores on the syllable identification task. The participants' performance on the syllable level tasks did not significantly correlate with their performance on the word recognition task or with the letter knowledge task. Curiously, the three syllable level tasks did not significantly correlate with one another.

Table 6.16

Average Post-test 1 Syllable Awareness Scores by Student Cohort.

Transition	Grade 1	Grade 2	Grade 3	Grade 4
82.8%	85.1%	86.5%	86.5%	90.1%

6.5.3 Syllable Awareness Data: Post-test 2

On average, all students received moderate to high syllable awareness scores (see Table 6.17). A third of the individual students received perfect syllable awareness scores. Students performed best on the syllable blending task. Students also received high scores on the syllable segmentation task. Students received the lowest scores on the syllable identification task. Scores for the three syllable level tasks did not significantly correlate

with each other. Syllable identification scores were moderately correlated with word recognition and letter knowledge scores. Syllable blending and segmentation scores did not significantly correlate with word recognition or letter knowledge scores.

Table 6.17

Average Post-test 2 Syllable Awareness Scores by Student Cohort.

Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
90.1%	79.1%	92.8%	86.5%	95.6%

6.5.4 Syllable Awareness Discussion

All student cohorts obtained moderate to high syllable awareness scores. Students performed best on the blending task, however, performance on the segmentation task did not fall far behind. Generally, students were able to complete these tasks with ease. In fact, a ceiling effect was found on the syllable blending task and almost all student cohorts' average syllable segmentation scores reached mastery level for all three testing times. These findings indicate that Dhuwaya-speaking children acquire syllable awareness at an early age. However, a little difficulty was exhibited with the syllable identification task suggesting that syllable identification skill demonstrates a higher level of syllable awareness.

The syllable level skills did not significantly correlate with word recognition skill at any testing time with one exception: syllable identification significantly correlated with word recognition at the third testing time. I offer the following explanation to account for the disparity in syllable identification and word recognition correlation statistics: the low

word recognition scores found in the pre-test and post-test **1** data made it difficult to find any correlations between word recognition and any of the other variables measured. As a result, the relationship between syllable identification and word recognition may have been skewed in the data collected during the first two testing times. The data indicates that syllable identification is noticeably more difficult than syllable blending and syllable segmentation. This finding suggests that syllable identification requires a higher level of phonological awareness than syllable blending and syllable segmentation and therefore it may be more closely related to word recognition ability.

Few significant correlations were found between syllable level tasks and letter knowledge. Syllable segmentation scores were only significantly related with letter knowledge in the data collected during the pre-test phase. Syllable identification scores were only significantly correlated with letter knowledge in the data collected during the post-test **2** phase. Syllable blending scores did not correlate with letter knowledge scores in the data collected at any testing time. This data suggests that the relationship between syllable awareness and letter-sound knowledge is not strong. Interestingly, the three syllable level tasks did not significantly correlate with each other. Syllable identification scores did not significantly correlate with syllable blending or syllable segmentation scores and syllable blending scores did not significantly correlate with syllable segmentation scores.

6.6 PHONEME IDENTIFICATION

Phoneme identification tasks require students to identify the same phoneme in different words (Gillon, 2004). The phoneme identification section of the current project's assessment battery consisted of a sound-to-word matching task. The participants were given a list of four words corresponding to four images displayed on the iPad screen. The app's voice-over told children what word each image depicted. Participants were then asked to click on the image depicting the word that begins or ends with a given phoneme. There was a total of four phoneme identification questions: two targeting word-initial phonemes (one nasal phoneme and one stop consonant) and two targeting word-final phonemes (one lateral approximant consonant and one stop consonant). Students received one point for each item answered correctly. Possible scores for this section of the assessment battery ranged from zero to four.

6.6.1 Phoneme Identification Data: Pre-test

Twenty-nine students completed the phoneme identification section of the assessment battery during the pre-test phase. The data collected from all 29 students is discussed below.

Table 6.18*Average Pre-test Phoneme Identification Scores by Student Cohort.*

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	35.0%	1.40	0 – 2	0.89	5
Grade 1	42.5%	1.70	0 – 3	0.95	10
Grade 2	45.0%	1.80	0 – 4	1.48	5
Grade 3	58.3%	2.33	2 – 3	0.58	3
Grade 4	91.7%	3.67	3 – 4	0.52	6
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Average phoneme identification scores increased incrementally with age (see Table 6.18 for participant scores). All Transition students showed signs of guessing and earned scores of two or lower on the phoneme identification assessment. Half of the Grade 1 students showed signs of guessing on the phoneme identification questions. The other half of the Grade 1 students showed signs of focused albeit laborious thinking. One Grade 2 student displayed signs of guessing, two students worked through the questions with difficulty, and one student answered all four questions correctly with ease. Two Grade 3 students displayed signs of guessing on the phoneme identification assessment. One Grade 3 student answered all phoneme identification questions confidently. There was a significant increase between the Grade 3 students' scores and the Grade 4 students' scores. All Grade 4 students answered word-initial phoneme identification questions correctly with ease, however half of them required extra time with the word-final questions. Still, the majority of Grade 4 students were able to answer word-final phoneme identification questions correctly.

Initial phoneme identification scores were higher than final phoneme identification scores. A similar number of correct responses was given for the two initial phoneme identification task items. Nineteen out of 29 students correctly matched /c/ with /ca:ɪ/ ‘rainbow’ and 18 out of 29 students correctly matched /m/ with /mapu/ ‘egg’. This data suggests that the participants did not experience more difficulty identifying the initial stop consonant than they did identifying the initial continuant consonant. However, students did experience more difficulty identifying the final stop consonant than they did identifying the final continuant consonant. Fifteen out of 29 students correctly matched /l/ with /mi:l/ ‘eye’ and only 12 students correctly matched /k/ with /karak/ ‘sky’.

During the pre-test phase, 24 students completed both the phoneme identification and word recognition sections of the assessment battery. The following correlation analysis is based on the data collected from these 24 students. Phoneme identification scores were not significantly correlated with word recognition scores. Twenty-nine students completed both the phoneme identification and letter knowledge sections of the assessment battery. The following correlation analysis is based on the data collected from these 29 students. Phoneme identification scores were significantly correlated with letter knowledge scores at the .01 level ($r = .557$, $p = .002$).

6.6.2 Phoneme Identification Data: Post-test 1

Nineteen students completed the phoneme identification section of the assessment battery during the post-test 1 phase. Their performance on the phoneme identification questions

is discussed below. Note that participants completed post-test 1 immediately after participating in the Intervention App training.

Table 6.19

Average Post-test 1 Phoneme Identification Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	58.3%	2.33	1 – 4	1.53	3
Grade 1	65.0%	2.60	1 – 4	1.14	5
Grade 2	93.8%	3.75	3 – 4	0.50	4
Grade 3	75.0%	3	2 – 4	1.41	2
Grade 4	95.0%	3.80	3 – 4	0.45	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Two Transition students showed signs of guessing on phoneme identification questions while a third Transition student answered all four questions correctly with ease. One Grade 1 student was observed guessing on all phoneme identification questions. One Grade 1 student correctly answered word-initial phoneme identification questions with ease but struggled with the word-final phoneme identification questions and was unable to answer correctly. The remaining three Grade 1 students answered phoneme identification questions confidently scoring either a three or a perfect four. All Grade 2 through Grade 4 students confidently answered phoneme identification questions and obtained scores of three or higher – with the exception of one Grade 3 student who answered both of the word final phoneme identification questions incorrectly. It was observed and recorded in the researcher’s notes that this Grade 3 student was trying to speed through the assessment. It was noted that the student was particularly unengaged

during the phoneme identification section of the assessment. If this Grade 3 student's phoneme identification score is omitted, then the average Grade 3 score is a 100%. The data would then suggest that Dhuwaya-speaking children master phoneme identification by the end of Grade 2. See Table 6.19 for participant scores.

Initial phoneme identification scores were higher than final phoneme identification scores. A similar number of correct responses was given for the two initial phoneme identification tasks: 17 out of 19 students correctly matched /c/ with /ca:ɪ/ 'rainbow' and 16 out of 19 students correctly matched /m/ with /mapu/ 'egg'. Students displayed more difficulty identifying the final stop consonant than they did identifying the final continuant consonant. Fourteen out of 19 students correctly matched /l/ with /mi:l/ 'eye' and only 13 students correctly matched /k/ with /karak/ 'sky'.

Seventeen students completed both the phoneme identification section and the word recognition section of the assessment battery during the post-test 1 phase. The following correlation analysis is based on the data collected from these 17 students. Phoneme identification scores were not significantly correlated with word recognition scores. Nineteen students completed both the phoneme identification section and the letter knowledge section of the assessment battery during the post-test 1 phase. The following correlation analysis is based on the data collected from these 19 students. Phoneme identification scores were significantly correlated with letter knowledge scores at the .01 level ($r = .644$, $p = .003$).

6.6.3 Phoneme Identification Data: Post-test 2

Twenty-three students completed the phoneme identification section of the assessment battery during the post-test 2 phase. Their performance on the phoneme identification questions is discussed below. Note that post-test 2 was administered six months after the Intervention App training ended.

Table 6.20

Average Post-test 2 Phoneme Identification Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Grade 1	62.5%	2.50	1 – 4	1.29	4
Grade 2	72.2%	2.89	2 – 4	0.93	8
Grade 3	87.5%	3.50	3 – 4	0.58	4
Grade 4	62.5%	2.50	1 – 4	2.12	2
Grade 5	95.0%	3.80	3 – 4	0.45	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Half of the Grade 1 students and half of the Grade 2 students showed signs of guessing on the phoneme identification questions. The other half of the Grade 1 and Grade 2 students showed signs of focused thinking. Most of the Grade 1 and Grade 2 ‘focused thinkers’ were able to answer phoneme identification questions correctly. All Grade 3 through Grade 5 students answered the word-initial phoneme identification questions correctly and at least one of the two word-final phoneme identification questions correctly – with the exception of one Grade 4 student who struggled with identification questions at both the syllable and phoneme level. I suspect that the Grade 4

cohort's average score would have been higher if there were more participants in the Grade 4 cohort. As previously mentioned, one of the Grade 4 students displayed particular trouble with identification questions. This may have skewed the Grade 4 average as there were only two students in the Grade 4 cohort. It could be said that phoneme identification scores increase with age if the Grade 4 student with particular difficulty on identification tasks is considered an outlier. See Table 6.20 for participant scores.

Initial phoneme identification scores were higher than final phoneme identification scores. Twenty-two out of 24 students correctly matched /c/ with /ca:ɪ/ 'rainbow' and 19 out of 24 students correctly matched /m/ with /mapu/ 'egg'. A similar number of correct responses was supplied for the two word final phoneme identification tasks: 17 out of 24 students correctly matched /k/ with /kaɪak/ 'sky' and 16 students correctly matched /l/ with /mi:l/ 'eye'.

Twenty students completed both the phoneme identification section and the word recognition section of the test battery during the post-test 2 phase. The following correlation is based on the data collected from these 20 students. Phoneme identification scores were significantly correlated with word recognition scores at the .05 level ($r = .513$, $p = .021$). Twenty-four students completed both the phoneme identification section and letter knowledge section of the assessment battery during this testing time. The following correlation is based on the data collected from these 24 students. Phoneme identification scores were significantly correlated with letter knowledge scores at the .01 level ($r = .546$, $p = .006$).

6.6.4 Phoneme Identification Discussion

The data is not straightforward but it can be surmised that phoneme identification ability generally increases with age. During the pre-test phase, phoneme identification increased incrementally with age. During the post-test 1 and post-test 2 phases, phoneme identification scores did not increase as linearly. The Grade 3 (Grade 4 during the post-test 2 phase) cohort's average score was lower than some of the younger cohorts' average score. However, this result may be skewed by the fact that the Grade 3 (Grade 4 during post-test 2 phase) participant cohort consisted of only two students and one of these two students displayed particular trouble with identification questions. This Grade 3 student struggled with identification questions at both the syllable and phoneme level but was able to correctly answer blending and segmentation questions at both the syllable and phoneme level. This pattern suggests that the student was experiencing specific problems with identification tasks. If this student is considered an outlier, and her scores are omitted, then the data would indicate that phoneme identification scores increase with age.

Existing literature states that typically developing children are able to complete phoneme identification tasks by the age of six (Shaywitz, 2003). Data from this thesis project suggests that Dhuwaya speakers raised in remote communities begin to master phoneme identification skill by the age of ten if they are not receiving explicit training and by the age of seven if they are receiving explicit training. Results from the pre-test phase suggest that the majority of Dhuwaya-speaking children begin to naturally (without explicit training) master phoneme identification skill by the end of Grade 4. Results from

the post-test **1** phase suggest that the majority of Dhuwaya speakers begin to master phoneme identification skill by the end of Grade 2 if they are receiving explicit training.

The data strongly supports the claim that initial sounds are easier to recognize than final sounds. Students performed better on questions targeting word-initial phonemes than they did on questions targeting word-final phonemes during each of the three testing times. Interestingly, the data does not support the theory that continuant sounds are easier to identify than stop sounds. Student scores on the initial stop consonant identification question were slightly higher than the scores obtained on the initial continuant consonant identification question throughout the data. Moreover, students displayed more ease identifying a word-final stop consonant than they did identifying a word-final approximant consonant during the post-test **2** phase.

Data collected during the first two testing times suggests that phoneme identification skill is not statistically correlated with word recognition skill. However, data collected during the third testing time suggests that phoneme identification skill is significantly correlated with word recognition skill. The results from the first two testing times are not consistent with previous research. Across the literature, phoneme identification tasks are found to be significantly related to early word reading (O'Connor et al., 1995). I suspect that the statistical analysis may have been skewed by the extremely low word recognition scores obtained by the participants during the first two testing times.

Statistical analysis may have been skewed by the small participant numbers. If we look at the Table 6.21 below, we can see that all students who were able to decode words during the post-test **1** phase and/or the post-test **2** phase received a score of either three or

four on the phoneme identification assessment – with the exception of the one Grade 3 (Grade 4 during the post-test **2** phase) student who we have previously discussed as being an outlier in regard to phoneme identification ability. This data suggests that a significant relationship between phoneme identification and word recognition ability does exist in Dhuwaya speakers.

Phoneme identification scores were significantly correlated with letter knowledge scores at the .01 level across all three testing times. These findings suggest that there is a significant relationship between phoneme identification and letter knowledge in Dhuwaya.

Table 6.21*Phoneme Identification Scores Compared with Word Recognition Scores*

Pre-test		Post-test 1		Post-test 2	
Phoneme Identification Score (out of 4)	Word Recognition Score (out of 20)	Phoneme Identification Score (out of 4)	Word Recognition Score (out of 20)	Phoneme Identification Score (out of 4)	Word Recognition Score (out of 20)
4	20	4	20	4	20
4	0	4	7	4	19
4	0	4	7	4	13
4	0	4	6	4	8
4	0	4	4	4	4
3	1	4	1	4	4
3	0	4	1	4	2
3	0	4	0	3	5
3	0	4	0	3	5
2	3	3	19	3	0
2	1	3	0	3	0
2	0	3	0	3	0
2	0	2	0	3	0
2	0	2	0	2	0
2	0	2	0	2	0
2	0	2	0	2	0
2	0	1	0	2	0
2	0			2	0
2	0			1	4
1	18			1	0
1	0				
1	0				
0	0				
0	0				

6.7 PHONEME BLENDING

Phoneme blending tasks require children to blend together isolated phonemes to form recognizable words (or non-words) (Ehri & Roberts, 2006). In the current study, the participants were given a list of four words corresponding to four images displayed on the iPad screen. They were then asked to click on the image depicting the word formed when a group of isolated phonemes are blended together. There were four phoneme blending questions: two targeting monosyllabic CVC words and two targeting bi-syllabic CVCV words. Students received one point for each item answered correctly. Possible scores for this section of the assessment battery ranged from zero to four.

6.7.1 Phoneme Blending Data: Pre-test

Twenty-nine students completed the phoneme blending section of the assessment battery during the pre-test phase. The data collected from all 29 students is discussed below.

Table 6.22

Average Pre-test Phoneme Blending Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	25.0%	1.00	0 – 3	1.22	5
Grade 1	42.5%	1.70	0 – 4	1.34	10
Grade 2	50.0%	2.00	0 – 4	1.58	5
Grade 3	66.7%	2.67	1 – 4	1.53	3
Grade 4	79.2%	3.17	2 – 4	0.98	6
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Phoneme blending ability increased incrementally with age (see Table 6.22 for participant scores). A significant increase in scores was displayed between each student cohort. Most of the Transition students were observed guessing on the phoneme blending questions. All Transition students received a low score of either zero or one – with the exception of one student who received a score of three. The full range of scores was received by the Grade 1 student cohort, though scores tended to cluster around the lower end of the spectrum. The full range of scores was also displayed in the Grade 2 student cohort's data. Every possible score, from zero to four, was earned by exactly one Grade 2 student. One Grade 3 student was observed guessing and received a low score of one. The remaining two Grade 3 students answered confidently and obtained scores of three or higher. The Grade 4 students' data also displayed a range of scores, though scores clustered around the higher end of the spectrum.

The participants performed slightly better on questions targeting monosyllabic CVC words than on questions targeting bi-syllabic CVCV words. Children performed better on the monosyllabic task item comprised of continuant sounds only (17 out of 29 correct responses) than on the monosyllabic task item containing a stop consonant (15 out of 29 correct responses). A similar number of correct responses was given for the two bi-syllabic task items (14 and 13 correct responses for *ŋatha* /ŋaʈa/ 'food' and *rräma* /ra:ma/ 'clouds at sunset', respectively). Students may have experienced more difficulty with the *rräma* task item because one of the incorrect answer choices provided for this question (*wäŋa* /wa:ŋa/ 'house, homeland') contained the same vowel sounds as the target answer (*rräma* /ra:ma/).

Twenty-four students completed both the phoneme blending section and the word recognition section of the assessment battery during the pre-test phase. The following correlation analysis is based on the data collected from these 24 students. The correlation between phoneme blending scores and word recognition scores was statistically significant at the .05 level ($r = .452$, $p = .027$). Twenty-nine students completed both the phoneme blending section and the letter knowledge section of the assessment battery. The following correlation analysis is based on the data collected from these 29 students. Phoneme blending scores were significantly correlated with letter knowledge scores at the .05 level ($r = .410$, $p = .027$).

6.7.2 Phoneme Blending Data: Post-test 1

Nineteen students completed the phoneme blending section of the post-test 1 assessment battery. Their performance on the phoneme blending questions is discussed below. Note that participants completed post-test 1 immediately after participating in the Intervention App training.

Table 6.23

Average Post-test 1 Phoneme Blending Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	66.7%	2.67	1 – 4	1.53	3
Grade 1	60.0%	2.40	0 – 4	1.52	5
Grade 2	93.8%	3.75	3 – 4	0.50	4
Grade 3	37.5%	1.50	0 – 3	0.71	2
Grade 4	90.0%	3.60	3 – 4	0.55	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

One Transition student showed signs of guessing on the phoneme blending questions and received a low score of one. The other two Transition students answered the phoneme blending questions confidently and earned a score of three or higher. A similar split was displayed by the Grade 1 students. Two Grade 1 students showed signs of guessing and received low scores while the other three Grade 1 students answered confidently and obtained high scores. The data revealed a significant increase between the Grade 1 cohort's average phoneme blending score and the Grade 2 cohort's average phoneme blending score. All Grade 2 students scored a perfect four – with the exception of one student who received a score of three. One Grade 3 student scored a three on the phoneme blending questions while the other Grade 3 student obtained a score of zero. All Grade 4 students answered confidently and obtained high scores of three or four. See Table 6.23 for participant scores.

I believe that the Grade 3 students' average score of 37.5% is misleading. Only two Grade 3 students completed the phoneme blending section of the assessment battery during the post-test 1 phase. One of these students scored a three out of four. The other student answered all four incorrectly receiving a score of zero. Significant observations were recorded in the research notes for this Grade 3 student who answered all phoneme blending questions incorrectly on post-test 1. This student showed signs of focused thinking for the first 16 questions in the Assessment App but then became unengaged and rushed through the phoneme blending questions. The phoneme blending questions are the last four questions on the Assessment App. I suspect that the student answered all the phoneme blending questions incorrectly during the post-test 1 phase because she became fatigued and her attention waned. Further evidence for this speculation can be drawn

from this student's performance on the pre-test. This student answered all phoneme blending questions confidently and earned a score of three on the pre-test. If this student's score is removed from the data as an outlier, then it could be said that all Grade 2 through Grade 4 students earned scores of three or higher. Therefore, it can be concluded that Dhuwaya-speaking students begin to master phoneme blending ability by the end of Grade 2 if they have received explicit phoneme blending training.

Students performed slightly better on the questions targeting four-phoneme bisyllabic CVCV words than they did on the questions targeting three-phoneme monosyllabic CVC words. Scores were highest for the question targeting the word *rräma* /ra:ma/ 'clouds at sunset'. Sixteen out of 19 students answered the question targeting *rräma* correctly. Fifteen out of 19 students correctly blended the remaining CVCV word (*ŋatha* /ŋaʈa/ 'food'). Fifteen out of 19 students correctly blended the CVC word beginning with a stop consonant (*goŋ* /koŋ/ 'hand'). The task item that generated the least amount of correct answers was the monosyllabic word consisting of continuant sounds only (*mel* /mi:l/ 'eye'). Fourteen out of 19 students correctly blended *mel*. These findings concerning task item difficulty are interesting because they are the complete reverse of the findings formulated from the pre-test data.

Seventeen students completed both the phoneme blending section and the word recognition section of the assessment battery during the post-test 1 phase. The following correlation analysis is based on the data collected from these 17 students. Phoneme blending scores were not significantly correlated with word recognition scores. Nineteen students completed both the phoneme blending section and the letter knowledge section of the assessment battery during the post-test 1 phase. The following correlation is based

on the data collected from these 19 students. Phoneme blending scores were correlated with letter knowledge scores at the .05 level ($r = .456$, $p = .05$).

6.7.3 Phoneme Blending Data: Post-test 2

Twenty-three students completed the phoneme blending section of the assessment battery during the post-test 2 phase. Their performance on the phoneme blending questions is discussed below. Note that post-test 2 was administered six months after the Intervention App training ended.

Table 6.24

Average Post-test 2 Phoneme Blending Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Grade 1	68.8%	2.75	1 – 4	1.50	4
Grade 2	58.3%	2.33	0 – 4	1.50	8
Grade 3	87.5%	3.50	3 – 4	1.00	4
Grade 4	87.5%	3.50	3 – 4	0.71	2
Grade 5	90.0%	3.60	3 – 4	0.55	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Half of the Grade 1 students struggled with phoneme blending questions while the other half confidently answered all questions correctly. The full range of possible scores was earned by Grade 2 students. A few Grade 2 students showed signs of guessing, a few showed signs of focused albeit laborious thinking, and a few answered all questions correctly with ease. The data revealed a significant increase between the Grade 2 students' average score and the average scores of all the older student cohorts. All Grade

3 through Grade 5 students answered phoneme blending questions with ease and earned a score of three or higher. See Table 6.24 for participant scores.

The test item generating the most correct answers was the monosyllabic CVC word consisting of continuant sounds only. Twenty-two out of 24 students correctly blended the continuant initial CVC word. Both CVCV task items generated 18 correct responses. The task item generating the lowest number of correct answers was the monosyllabic CVC word beginning with a stop consonant. Thirteen students blended the stop-initial CVC word correctly.

Twenty students completed both the phoneme blending section and the word recognition section of the assessment battery during the post-test 2 phase. The following correlation is based on the data collected from these 20 students. Phoneme blending scores were moderately correlated with word recognition scores at the .05 level ($r = .515$, $p = .020$). Twenty-four students completed both the phoneme blending section and the letter knowledge section of the assessment battery during the post-test 2 phase. The following correlation analysis is based on the data collected from these 24 students. Phoneme blending scores were not significantly correlated with letter knowledge scores.

6.7.4 Phoneme Blending Discussion

Phoneme blending skill roughly increased with age⁵⁸. Still, average scores calculated from the pre-test data indicate that phoneme blending skill had not been mastered by any of the student cohorts. This finding suggests that phoneme blending

⁵⁸ Recall that the post-test 1 Grade 3 average score is skewed by the performance of the Grade 3 student considered an outlier, as discussed in section 5.7.2.

mastery is not spontaneously (without explicit instruction) acquired by the end of Grade 4 for this specific population of children. However, the post-test 1 and post-test 2 data revealed important differences. The majority of the Grade 2 through Grade 4 students showed signs of phoneme blending mastery on both post-tests. This finding suggests that Dhuwaya-speaking children begin to master phoneme blending skill by the end of Grade 2 if they are receiving explicit phoneme blending training. These findings are not consistent with existing literature. Shaywitz (2003) states that some children can successfully blend three phoneme monosyllabic words by the end of kindergarten and that the majority are able to blend longer words including those with initial and final blends by the end of Grade 1. Griffith, Beach, Ruan, & Dunn (2008) also state that most children are able to blend phonemes by the end of Grade 1.

The data is inconclusive in terms of the relationship between task item characteristics (word length and phoneme features specifically) and task difficulty. Children earned higher pre-test scores on the questions targeting words composed of three phonemes than they did on questions targeting words composed of four phonemes. The participants also performed better on questions targeting words comprised of continuant sounds only than they did on questions targeting words containing oral stops. The post-test 1 data revealed a completely reverse outcome to that found in the pre-test data – children displayed more ease with questions targeting longer words and with questions targeting words containing oral stops. The post-test 2 data revealed mixed results.

The pre-test and post-test 2 data revealed significant correlations between phoneme blending scores and word recognition scores. This finding is consistent with

previous research. The significant relationship between phoneme blending and early word reading is highlighted across studies (NICHD, 2000). The correlation between phoneme blending and letter knowledge was statistically significant in the pre-test and post-test 1 data suggesting a moderate relationship between the two skills.

6.8 PHONEME SEGMENTATION

Phoneme segmentation tasks require students to segment words into their constituent phonemes (Fellowes & Oakley, 2014). In the current study, students were given a word and then asked to orally segment the word into phonemes. The phoneme segmentation section of the assessment battery included six stimuli words of different length and type. See Appendix B for a list of words included in the phoneme segmentation assessment. Students received one point for each word comprehensively segmented into phonemes. Students did not receive partial points for segmenting a word into some, but not all, of its corresponding phonemes. Possible scores for this section of the assessment battery ranged from zero to six.

6.8.1 Phoneme Segmentation Data: Pre-test

Twenty-four students completed the phoneme segmentation section of the assessment battery during the pre-test phase. The data from these 24 students is discussed below.

Table 6.25*Average Pre-test Phoneme Segmentation Scores by Student Cohort.*

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	0.0%	0.00	0	0.00	4
Grade 1	0.0%	0.00	0	0.00	7
Grade 2	13.3%	0.80	0 – 2	1.10	5
Grade 3	5.6%	0.33	0 – 1	0.58	3
Grade 4	0.0%	0.00	0	0.00	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Scores on the phoneme segmentation task were very low for all student cohorts (see Table 6.25 for participant scores). A floor effect was detected in the phoneme segmentation data. Most students were unable to orally segment words at the phoneme level. Only three students were able to correctly segment a few of the test words. One Grade 2 student segmented the two monosyllabic CV words correctly. This same student segmented the two monosyllabic CVC words into onset and rime and segmented the two CVCV words into onset_{syllable1}-rime_{syllable1}-syllable2. Another Grade 2 student segmented one CV word and one CVC word correctly. This student was able to segment all of the other task items into onset and rime. One Grade 3 student was able to segment one of the CVC words correctly. This Grade 3 student was able to segment a few of the remaining words into phonemes but continuously added an extra phoneme into each word. The task items correctly segmented into phonemes were *ma* /ma/ ‘CONT’ (by two students), *go* /ku:/ ‘come here!’ (by one student), and *ḡāl* /ḡa:l/ ‘saliva’ (by two students).

Participant performance also varied amongst the students who were unable to segment any word into all of its constituent phonemes. A number of students showed signs of misunderstanding and confusion, indicating that they did not understand the task.

Many students would simply repeat the stimulus word if it was a monosyllabic word. The Yolŋu research assistant repeatedly tried to help students understand that they were now breaking up words into individual sounds, not syllables. Still, many students continued segmenting words into syllables, especially the last two bi-syllabic CVCV task items. Some students understood that they were being asked to break up words into smaller units of sound but they were unable to do so independently. Two Grade 1 students added an extra mono-vowel syllable in between syllables (e.g. /ŋa/-/a/-/ma/ for /ŋa/-/ma/, /ri:-/ /i:-/pa/ for /ri:-/pa/, and /meɪ/-/a/-/pal/ for /meɪ/-/pal/). A few students were able to correctly segment the initial phoneme of each word. A few of these students segmented words into onset-rime while others segmented words into initial phoneme followed by a random break up of sounds.

Twenty-four students completed both the phoneme segmentation section and word recognition section of the assessment battery during the pre-test phase. The following correlation is based on the data collected from these 24 students. Phoneme segmentation scores and word recognition scores significantly correlated at the .05 level ($r=.415$, $p=.044$). Twenty-four students completed both the phoneme segmentation section and the letter knowledge section of the assessment battery. The following correlation analysis is based on the data collected from these 24 students. Phoneme segmentation scores were not significantly correlated with letter knowledge scores.

6.8.2 Phoneme Segmentation Data: Post-test 1

Eighteen students completed the phoneme segmentation section of the post-test 1 assessment battery. Their performance on the phoneme segmentation questions is discussed below. Note that participants completed post-test 1 immediately after participating in the Intervention App training.

Table 6.26

Average Post-test 1 Phoneme Segmentation Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	50.0%	3	0 – 5	2.83	2
Grade 1	10.0%	0.6	0 – 2	0.89	5
Grade 2	33.3%	2	1 – 4	1.83	4
Grade 3	8.3%	0.5	0 – 1	0.71	2
Grade 4	66.7%	4	2 – 6	2.00	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Phoneme segmentation scores were generally low across all student cohorts (see Table 6.26 for participant scores). One Transition student was able to segment five of the six target words into phonemes. The CVCV task item consisting of a semivowel in the second syllable was the only word this Transition student was unable to correctly segment. The student segmented this task item into C-V-V (all correct), omitting only the semivowel consonant. This data suggests that the student had developed near perfect phoneme segmentation skills. One Grade 1 student was able to correctly segment one CV word and one CVC word. Another Grade 1 student was able to correctly segment one CVC word. One Grade 2 student was able to segment four of the six words, albeit with a

lot of help from the assessment administrator. The Yolŋu research assistant would say “first sound right, second sound right, what sound comes next?” Another Grade 2 student was able to segment one CVC word. One Grade 3 student was able to segment one of the CVC words correctly. All Grade 4 students were able to segment at least two of the words into phonemes. Two Grade 4 students were able to segment all six words into phonemes. The task items with the highest number of correct responses were *ŋäl* /ŋa:l/ ‘saliva’ (segmented correctly by 11 students) and *ma* /ma/ ‘CONT’ (segmented correctly by nine students). *Go*, /ku:/ ‘come here!’, *djeŋ* /ci:t/ ‘eagle’, and *nama* /ŋama/ ‘Jabiru bird’ were each segmented correctly by five students. Four students correctly segmented *dawu* /ɖawu/ ‘banyan tree’.

Participant performance also varied amongst the students who were unable to segment any of the words into all of its constituent phonemes. Some of these students did not understand the task. These students repeatedly segmented all of the words into syllables even though the Yolŋu assistant tried to help the students understand that they were now breaking up words into individual sounds, not syllables. Other students showed signs that they knew that they were being asked to break up words into smaller units of sound but they were unable to do so independently. Some students were able to segment the initial phoneme of some or all of the words. A few students segmented monosyllabic words into onset and rime while others segmented monosyllabic words into CV-C. Some students broke up C_1VC_2 words as C_1V-VC_2 (e.g. /ci:t/ was segmented as /ci/-/i:t/).

Seventeen students completed both the phoneme segmentation section and the word recognition section of the assessment battery during the post-test 1 phase. The following correlation is based on the data collected from these 17 students. Phoneme

segmentation was strongly correlated with word recognition at the .01 level ($r = .790$, $p=.0$). Seventeen students completed both the phoneme segmentation section and the letter knowledge section of the assessment battery. The following correlation analysis is based on the data collected from these 17 students. Phoneme segmentation scores were not significantly correlated with letter knowledge scores.

6.8.3 Phoneme Segmentation Data: Post-test 2

Twenty students completed the phoneme segmentation section of the assessment battery during the post-test 2 phase. Their performance on the phoneme segmentation questions is discussed below. Note that post-test 2 was administered six months after the Intervention App training ended.

Table 6.27

Average Post-test 2 Phoneme Segmentation Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Grade 1	0%	0	0	0	3
Grade 2	2.4%	0.14	0 – 1	0.38	7
Grade 3	33.3%	2.00	0 – 4	2.00	3
Grade 4	8.3%	0.50	0 – 1	0.71	2
Grade 5	50.0%	3.00	1 – 6	2.83	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Phoneme segmentation scores were generally low across all student cohorts (see Table 6.27 for participant scores). Not one of the Grade 1 students was able to segment any of the task items into phonemes. Six out of the seven Grade 2 students were unable to segment any words into phonemes. The remaining Grade 2 student was only able to

segment the continuant consonant-initial CV task item into its constituent phonemes. One Grade 3 student was unable to correctly segment any of the words into phonemes. Another Grade 3 student was able to correctly segment one of the CVC words and one of the CVCV words. A third Grade 3 student was able to correctly segment one CV word, one CVC word, and both CVCV words. One of the two Grade 4 students was unable to segment any words into phonemes and the other Grade 4 student was only able to segment the continuant consonant-initial CV task item into phonemes. One Grade 5 student was unable to correctly segment any words into phonemes. One Grade 5 student was only able to segment one of the CVC words correctly. One Grade 5 student was able to segment the CV task item and the CVC task item comprised of continuant sounds only. The remaining two Grade 5 students were able to segment all six words correctly. The task items correctly segmented into phonemes were *ma* /ma/ ‘CONT’ (by seven students), *ḡāl* /ḡa:l/ ‘saliva’ (by five students), *dawu* (by four students), *ḡama* /ḡama/ ‘Jabiru bird’ (by three students), *djeṭ* /ci:t/ ‘eagle’ (by three students), and *go* /ku:/ ‘come here!’ (by two students).

Participant performance also varied amongst the students who were unable to correctly segment any words into phonemes. Some of these students did not understand the task. These students repeatedly segmented all of the words into syllables even though the Yolḡu assistant tried to help the students understand that they were now breaking up words into individual sounds, not syllables. Other students showed signs that they knew that they were being asked to break up words into smaller units of sound but they were unable to do so independently. Some students were able to segment the initial phoneme in some or all of the words. A few students segmented monosyllabic words into onset and

rime while others segmented monosyllabic words into CV-C. Some students broke up C₁VC₂ words as C₁V-VC₂ (e.g. /ci:t/ was segmented as /ci/-/i:t/).

Twenty students completed both the phoneme segmentation section and the word recognition section of the test battery during the post-test **2** phase. The following correlation is based on the data collected from these 20 students. Phoneme segmentation was strongly correlated with word recognition at the .05 level ($r = .850$, $p = .0$). Twenty students completed both the phoneme segmentation section and the letter knowledge section of the assessment battery. The following correlation is based on the data collected from these 20 students. Phoneme segmentation scores were correlated with letter knowledge scores at the .05 level ($r = .495$, $p = .026$)

6.8.4 Phoneme Segmentation Discussion

Average phoneme segmentation scores were generally low across the board. Scores did not increase with age although the oldest student cohort did earn the highest average phoneme segmentation score on both of the post-tests. Every student cohorts' average phoneme segmentation score fell well below the level of mastery. Only three students showed signs of mastery or near mastery, two Grade 4 (Grade 5 during post-test **2** phase) students and one Transition (Grade 1 during post-test **2** phase) student. This data suggests that the majority of the Transition to Grade 5 Dhuwaya-speaking students⁵⁹ did not have the ability to complete phoneme segmentation tasks even after a few weeks of explicit training.

Studies indicate that phoneme segmentation is one of the most advanced phonological awareness skills and it can prove to be difficult for many students (Kartal & Terziyan, 2016). Nevertheless, existing research suggests that the majority of typically developing children (70-80%) are able to count the number of sounds in small two phoneme words by six years old and in three phoneme words by age seven (Shaywitz, 2003). The common consensus is that most children are able to segment words into phonemes by the end of the first grade (Griffith et al., 2008; Fellowes & Oakley, 2014; Invernizzi & Tortorelli, 2013). The current data indicates that phonemic segmentation benchmarks are markedly delayed for Dhuwaya-speaking children living in remote communities who have little literacy exposure in the home.

Across all three testing times, students displayed the most ease segmenting monosyllabic words beginning with continuant sounds. The participants experienced more difficulty segmenting stop-initial monosyllabic words and segmenting bi-syllabic words composed of four phonemes. These results suggest that word length and phoneme features affect student performance on phoneme segmentation tasks.

The data collected during each of the three testing times revealed significant correlations between phoneme segmentation scores and word recognition scores. This result supports existing research which states that phoneme segmentation skill is strongly related to word recognition ability (NICHD, 2000). Phoneme segmentation scores were significantly related to letter knowledge scores in the post-test 2 data.

6.9 PHONEMIC AWARENESS

A brief summary of the phoneme level skills is provided in this section. Phoneme identification, phoneme blending, and phoneme segmentation scores were averaged together to create an average phonemic awareness score for each participant cohort. Then, the relative difficulty of the three phoneme level tasks is discussed. Each section ends with a review of each individual task's statistical relationship with word recognition ability, letter knowledge, and the two other phoneme level tasks measured.

6.9.1 Phonemic Awareness Data: Pre-test

Average phonemic awareness scores were fairly low. Scores increase incrementally with age (see Table 6.28 below). Students earned similar scores on the phoneme blending and phoneme identification tasks. Student performance was markedly lower on the phoneme segmentation task. Phoneme identification scores and phoneme blending scores were strongly correlated. Phoneme segmentation scores did not significantly correlate with phoneme identification scores or phoneme blending scores. Phoneme blending and phoneme segmentation scores were both moderately correlated with word recognition. Phoneme identification scores did not correlate with word recognition scores. Phoneme identification and phoneme blending scores were both moderately correlated with letter knowledge scores. Phoneme segmentation scores did not significantly correlate with letter knowledge scores.

Table 6.28*Average Pre-test Phonemic Awareness Scores by Student Cohort.*

Transition	Grade 1	Grade 2	Grade 3	Grade 4
20%	26.8%	36.1%	43.5%	57%

6.9.2 Phonemic Awareness Data: Post-test 1

Average phonemic awareness scores were low to moderate (see Table 6.29 below). Average phonemic awareness scores did not increase with age. However, the Grade 4 student cohort did earn the highest average score. Students earned similar scores on the phoneme identification and phoneme blending tasks. Students' scores were much lower on the phoneme segmentation task. Phoneme identification scores and phoneme blending scores were strongly correlated. Phoneme segmentation scores did not significantly correlate with phoneme identification scores or phoneme blending scores. Phoneme segmentation scores were highly correlated with word recognition scores. Word recognition scores were not significantly correlated with phoneme identification scores or phoneme blending scores. Phoneme identification scores were strongly correlated with letter knowledge scores. Phoneme blending scores were moderately correlated with letter knowledge scores. Phoneme segmentation scores were not significantly correlated with letter knowledge scores.

Table 6.29*Average Post-test 1 Phonemic Awareness Scores by Student Cohort.*

Transition	Grade 1	Grade 2	Grade 3	Grade 4
58.3%	46.1%	73.6%	40.3%	83.9%

Note that students had undergone the Intervention App training in the six weeks leading up to post-test 1. The relatively higher average phonemic awareness scores are likely due to the training. See Chapter Six for details on Intervention App effects.

6.9.3 Phonemic Awareness Data: Post-test 2

Average phonemic awareness scores were low to moderate across the board (see Table 6.30 below). Average scores increased with age with one exception – the Grade 3 students’ average score was higher than the Grade 4 students’ average score. Phoneme blending scores were slightly higher than phoneme identification scores. Students’ scores were lowest on the phoneme segmentation task. Phoneme blending scores and phoneme segmentation scores were moderately correlated with each other. Phoneme identification scores were not significantly correlated with phoneme blending scores or phoneme segmentation scores. Phoneme blending scores and phoneme identification scores were both moderately correlated with word recognition scores. Phoneme segmentation scores highly correlated with word recognition scores. Phoneme identification scores and phoneme segmentation scores were both moderately correlated with letter knowledge scores. Phoneme blending scores did not significantly correlated with letter knowledge scores.

Table 6.30

Average Post-test 2 Phonemic Awareness Scores by Student Cohort.

Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
43.8%	44.3%	69.4%	52.8%	78.3%

6.9.4 Phonemic Awareness Discussion

Phonemic awareness averages were low for most student cohorts. All student cohorts earned average phonemic awareness scores that fell below the level of mastery⁶⁰.

The current data indicates that phonemic awareness development is delayed in Dhuwaya-speaking children living in remote communities who have little literacy exposure in the home.

Phoneme segmentation scores were significantly correlated with word recognition scores in the data collected during all three testing times. Phoneme blending scores were significantly correlated with word recognition scores in the data collected during two of the three testing times. Phoneme identification scores were correlated with word recognition scores in the data collected during one of the three testing times. These results suggest that phonemic awareness has a significant relationship with word recognition ability. Furthermore, these results suggest that phoneme segmentation is more closely related to word recognition than phoneme blending, which in turn is more closely related to word recognition than phoneme identification. The phoneme segmentation task was by far the most difficult phoneme level task for the children to complete. Therefore, it can be surmised that phoneme segmentation requires a higher level of phonemic awareness than phoneme blending and phoneme identification do. As such, it makes sense that phoneme segmentation has the most robust relationship with early word reading in Dhuwaya.

Another significant finding is that phoneme identification scores were moderately to strongly correlated with letter knowledge scores across all three testing times

⁶⁰ Recall that 90% and above is regarded as mastery level for the purposes of this thesis.

suggesting that there exists a strong relationship between phoneme identification and letter-sound knowledge. Phoneme blending scores were moderately correlated with letter knowledge scores in the data collected during the first two testing times while phoneme segmentation scores were moderately correlated with letter knowledge in the data collected during the third testing time. Taken together, these findings indicate that there is a significant relationship with letter knowledge, specifically letter-sound knowledge, and phonemic awareness. However, the strength of this relationship may be task specific.

Phoneme identification scores and phoneme blending scores were moderately correlated in the pre-test and post-test 1 data. Phoneme blending scores and phoneme segmentation scores were moderately correlated in the post-test 2 data. No further significant correlations were found amongst the phoneme level tasks.

6.10 WORD RECOGNITION

Word recognition refers to the ability to recognize and identify written words on a page (Gillon, 2004). In the current study, participants were shown individual words on a piece of paper and asked to read the words aloud. Answers were considered correct if participants automatically read the word aloud or if they sounded out and then blended the sounds together to decode the target word. Students received one point for each item answered correctly. Possible scores for this section of the assessment battery ranged from zero to 20.

6.10.1 Word Recognition Data: Pre-test

Twenty-four students completed the word recognition section of the assessment battery during the pre-test phase. The data collected from these 24 students is discussed below.

Table 6.31

Average Pre-test Word Recognition Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	0.0%	0	0	0.00	4
Grade 1	0.0%	0	0	0.00	7
Grade 2	19.0%	3.8	0 – 18	7.95	5
Grade 3	5.0%	1	0 – 3	1.73	3
Grade 4	21.0%	4.2	0 – 20	8.84	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Word recognition scores were extremely low for all student cohorts (see Table 6.31 for participant scores). The youngest student cohort obtained the lowest average score while the oldest student cohort obtained the highest average score. However, average scores did not increase in age in a straightforward manner. The majority of the participants were unable to read any words. Only five children identified words correctly and only one of these five students was able to accurately read all 20 words.

One Grade 4 student automatically read all 20 words in the assessment. One Grade 2 student showed evidence of being in the full alphabetic stage by sounding out and blending 18 words correctly. One Grade 3 student decoded three words correctly. One Grade 4 student and one Grade 1 student identified only one word: *ga* – the Dhuwaya word for ‘and.’ *Ga* is a high frequency word found in every Dhuwaya reader.

Therefore, these two students may have used rote memory, not alphabetic skills, to identify *ga*. A handful of the students could sound out the letters on the page but could not blend the sounds together to identify words. Many students were irresponsive when presented with task items and stared blankly at the page even after the assessment administrator encouraged them to try sounding out the letters.

The ability to sound out letters (but not blend them) increased with age. Only one Transition student was able to sound out letters. Only two Grade 1 students were able to sound out letters. Performance was varied amongst the Grade 2 student cohort. Two Grade 2 students accurately read a portion of the assessment words. One Grade 2 student sounded out all the letters in the assessment words but was unable to blend the sounds together to identify words. Two Grade 2 students were unable to read words or sound out their corresponding letters. The same distribution was displayed by the Grade 3 cohort with one student accurately reading a few words, one student sounding out letters but not blending them into words, and one student unable to sound out any letters. Again, the same distribution was observed with the Grade 4 cohort with two students accurately reading words (albeit only 1 word for one of them), one student sounding out letters but not blending them together, and two students unable to sound out letters.

Word recognition was found to have a statistically significant correlation with phoneme blending and phoneme segmentation at the .05 level ($r = .452$, $p = .027$ and $r = .415$, $p = .044$, respectively).

6.10.2 Word Recognition Data: Post-test 1

Eighteen students completed the word recognition section of the post-test 1 assessment battery. Their performance on the word recognition assessment is discussed below.

Table 6.32

Average Post-test 1 Word Recognition Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Transition	17.5%	3.5	0 – 7	4.95	2
Grade 1	0.0%	0	0	0.00	5
Grade 2	10.0%	2	0 – 7	3.37	4
Grade 3	10.0%	2	0 – 4	2.83	2
Grade 4	46.0%	9.2	0 – 20	9.68	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Reading scores were generally low across all student cohorts (see Table 6.32 for participant scores). Only one student was able to automatically identify all of the words on the assessment. Six students accurately read words by sounding out letters and then blending them together to identify words. One student identified only one word (*ga*). As discussed in the previous section, *ga* is a high frequency sight word which may have been read by rote memory.

The remaining 11 participants received a score of zero on the word recognition assessment section. A few of these students were irresponsive and blankly stared at the words on the paper presented to them. Other students sounded out the letters displayed on the page but were unable to blend the sounds together to identify a word. A few students

used first letter guessing strategies. First letter guessing errors occur when students match the initial letter of a word to its corresponding sound and then guess a word based on this initial sound. First letter guessing demonstrates that a child understands that letters represent sounds and that these sounds are used to access oral words. However, these children have not yet understood that ALL of the letters in a word must be sounded out and blended together (Cockrum & Shanker, 2013).

Phoneme segmentation was the only skill found to significantly correlate with word recognition ($r = .790$, $p = .0$). This finding was unexpected. Across studies, letter knowledge and phoneme level skills are found to be predictive of and correlated with later reading.

6.10.3 Word Recognition Data: Post-test 2

Twenty students completed the word recognition section of the assessment battery during the post-test 2 phase. Their performance on the word recognition assessment is discussed below.

Table 6.33

Average Post-test 2 Word Recognition Scores by Student Cohort.

Student Cohort	Mean		Range of Scores	Standard Deviation	n
Grade 1	0.0%	0.00	0	0.00	3
Grade 2	7.1%	1.43	0 – 8	2.99	7
Grade 3	30.0%	6.00	0 – 13	6.56	3
Grade 4	20.0%	4.00	4	0.00	2
Grade 5	50.0%	10.00	2 – 20	8.75	5
Note: Shaded cells indicate average percentiles while non-shaded cells indicate raw scores.					

Word recognition scores were generally low across all student cohorts (see Table 6.33 for participant scores). Average scores did not increase with age in a straightforward manner but the younger participants did obtain the lowest average scores while the older students did obtain the highest average scores. Nevertheless, even the oldest student cohort's average score was low, which indicates that the majority of the participants were still in the early stages of word recognition development. Only two Grade 5 students were able to automatically identify words. Eight students accurately recognized words by first sounding out letters and then blending them together to decode words.

Ten students received scores of zero on the word recognition assessment. A few of these students were irresponsive and blankly stared at the words on the paper presented to them. Other students sounded out the letters displayed on the page but were unable to use this information to identify words. A few students used first letter guessing strategies (see previous section for first letter guessing definition).

Letter knowledge ($r = .581, p = .007$), syllable identification ($r = .468, p = .037$), phoneme identification ($r = .513, p = .021$), phoneme blending ($r = .515, p = .02$), and phoneme segmentation ($r = .85, p = .0$) were all significantly correlated with word recognition.

6.10.4 Word Recognition Discussion

Word recognition scores were generally low across all student cohorts and all three testing times. Several students were unable to recognize any of the words used in the assessment even though all task items were comprised of only two to four phonemes. All

student cohorts displayed difficulty identifying words with even some of the older students struggling to decode two phoneme words. Furthermore, at each testing time, only two participants showed signs of word recognition mastery. These findings indicate that the majority of the participants did not possess the knowledge and skills needed to utilize the alphabetic principle.

The current data indicates that out of all the variables measured, phoneme segmentation has the strongest relationship with word recognition skill. Phoneme segmentation was the only variable significantly correlated with word recognition across all three testing times. The data also suggests that phoneme blending has a significant relationship with word recognition in Dhuwaya considering that a strong correlation was found between the two variables at two of the three testing times. Letter knowledge, phoneme identification, and syllable identification also shared a noteworthy relationship with word recognition. Scores for each of these three measures were moderately correlated with word recognition scores during the last testing time.

6.11 CHAPTER DISCUSSION

This chapter addressed the first and second research questions. The first research question is concerned with the participants' performance patterns on measures of letter knowledge, various phonological awareness skills, and on word recognition ability. Student age was also taken into account throughout the analysis of the participants' assessment performance. The second research question focuses on the relationships between the various skills assessed. The purpose of these questions was to add to the existing research

base on emergent literacy skills, which is heavily based on children coming from literate and urban communities. The current data adds information based on Indigenous children coming from an oral tradition based society and living in very remote communities. This data will better help the generalizability of existing emergent reading research. We now turn to the current project's first research question.

Various patterns were discovered in the participants' assessment battery data. In regard to Dhuwaya-speaking children's phonological awareness abilities, the evidence described in this chapter suggests that a developmental hierarchy exists along all three levels of complexity: linguistic complexity (level of awareness), cognitive demand, and target word features. Larger units of sound (syllables) were much easier to attend to and manipulate than smaller units of sound (phonemes). Task type also affected task difficulty. Students displayed more difficulty with certain tasks even if they fell under the same level of awareness (e.g. participants experienced more difficulty completing the phoneme segmentation task than they experienced completing the phoneme blending task). Linguistic features, such as word length and target phoneme characteristics, also affected task difficulty.

Overall, syllable level tasks were much easier for participants than phoneme level tasks. Amongst the syllable level tasks, blending and segmentation tasks were fairly easy for even the youngest participants. Syllable identification tasks however, proved to be difficult for even the oldest participants. Contrastively, students performed similarly well on the phoneme identification and phoneme blending tasks. Students experienced the most difficulty with phoneme segmentation tasks. These findings suggest that the interplay between task type and linguistic complexity plays a role in task difficulty. In

other words, the relationship between task type and task difficulty changes across different levels of linguistic awareness.

Various patterns were found in regard to how task item linguistic features affect task difficulty. Students displayed the most difficulty segmenting words consisting of syllables beginning with approximant consonants. At the phoneme level, participants displayed more ease segmenting shorter words (monosyllabic versus bi-syllabic) consisting of continuant sounds only. Phoneme manner also affected performance on syllable and phoneme identification task items albeit with an opposite effect. Students performed better on syllable identification tasks targeting continuant initial syllables but scored higher on phoneme identification tasks targeting stop sounds. Syllable and phoneme position also affected identification tasks. Children performed much better on identification task items targeting word initial syllables (or phonemes) than on items targeting word final syllables (or phonemes). The data was inconclusive in regard to how linguistic features affect blending tasks.

The following developmental sequence is proposed for Dhuwaya-speaking children based on this thesis project's data. See Table 6.34 and Table 6.35 below. Table 6.34 displays the average age of attainment of targeted skills for children who have not undergone intervention. Table 6.35 displays the average age of attainment of targeted skills for children who have undergone six weeks of intervention. See Appendix D to compare the Dhuwaya developmental phonological awareness continuum charts with the standard phonological awareness developmental continuum chart proposed by Kid Sense Child Development (2017). Notice that the expected age of attainment is delayed for many of the skills tested including: letter knowledge, phoneme identification, phoneme

blending, phoneme segmentation, and word recognition. Syllable blending and syllable segmentation were the only skills that the current project's participants developed at a comparable age to the existing standards. Note, it is unknown whether syllable identification was developed at a comparable rate because it is not commonly included in phonological awareness developmental charts.

Table 6.34

Age at Which Students Earn Mastery Level Scores (90% or Above) for Targeted Skills When They are Not Receiving Explicit Training.

DEVELOPMENTAL SEQUENCE OF PHONOLOGICAL SKILLS ACQUIRED BY DHUWAYA-SPEAKING CHILDREN (WITHOUT EXPLICIT TRAINING) Age at which students acquire mastery of targeted skill	
SKILL	AGE
Syllable blending	Transition*
Syllable segmentation	Grade 3
Letter knowledge	Grade 3
Phoneme identification	Grade 4
Syllable identification	Not yet acquired by the end of Grade 4.
Phoneme blending	Not yet acquired by the end of Grade 4
Phoneme segmentation	Not yet acquired by the end of Grade 4.
Word recognition	Not yet acquired by the end of Grade 4.
Note: The Grade 2 average was lower than 90%. However, two of the three Grade 2 students earned syllable blending scores of 100%. Only one student scores lower than 90%. Transition and Grade 1 students average scores were both higher than 90%. As such, Transition is marked as the age of syllable blending attainment as the vast majority of children have done so by the end of their Transition year.	

Table 6.35

Age at Which Students Earn Mastery Level Scores (90% or Above) for Targeted Skills When They are Receiving Explicit Training.

DEVELOPMENTAL SEQUENCE OF PHONOLOGICAL SKILLS ACQUIRED BY DHUWAYA-SPEAKING CHILDREN (WITH EXPLICIT TRAINING) Age at which students acquire mastery of targeted skill	
SKILL	AGE
Syllable blending	Transition*
Syllable segmentation	Transition**
Letter knowledge	Grade 3
Phoneme identification	Grade 2***
Syllable identification	Not yet acquired by the end of Grade 4.
Phoneme blending	Grade 2****
Phoneme segmentation	Not yet acquired by end of Grade 4
Word recognition	Not yet acquired by end of Grade 4
Notes: * Transition and Grade 2 average scores were lower than 90%. However, two of the three Transition students earned syllable blending scores of 100% and three of the four Grade 2 students earned scores of 100%. As such, Transition is marked as the age of syllable blending attainment as the vast majority of children have done so by the end of their Transition year. ** Note that the Grade 1 average score was just slightly under mastery level. However, only one student was unable to segment at least six of the seven words correctly. As such, Transition is marked as the age of syllable segmentation attainment as the vast majority of children have done so by the end of their Transition year. *** See section 5.6.2 for discussion about Grade 3 phoneme identification outlier skewing average Grade 3 scores. **** See section 5.7.2 for discussion about Grade 4 phoneme blending outlier skewing average Grade 3 scores.	

We now address the second research question, which focuses on the various relationships found amongst the different variables tested. The results from all three testing times taken together suggest that a certain level of phonological awareness and word recognition skill is needed in order to properly investigate the relationship between letter knowledge, phonological awareness, and word recognition. There was a noteworthy increase in the number of relationships found in the post-test 2 data when compared to the pre-test and post-test 1 data. Phoneme segmentation and phoneme blending were the only variables significantly correlated with word recognition in the pre-test data. In the post-test 1 data, phoneme segmentation was the only variable significantly correlated with word recognition skill. However, the data collected during the post-test 2 phase suggests that word recognition is significantly correlated with letter knowledge, phoneme identification, phoneme blending, phoneme segmentation, and syllable identification.

I surmise that the disparity found in the data collected during the three different testing times can be attributed to the severely low word recognition scores obtained during the first two testing times. It is difficult to investigate the relationship between variables when scores for one of the variables are so low. Word recognition scores were indeed highest on post-test 2. I argue that all of the significant relationships found in the post-test 2 data are noteworthy and that some of these relationships were masked in the data collected during the first two testing times because of low word recognition scores. Following this line of thinking, the current findings support the claim that early word reading is strongly linked to letter knowledge and phonemic awareness.

The phoneme focused tasks were markedly more related to word recognition than the syllable focused tasks. This finding supports the claim that supra-phonemic awareness

measures do not account for a significant portion of the variance in post-training reading tests (Lundberg et al., 1988; Mann & Foy, 2003). However, there is some evidence that task type measures were correlated with each other regardless of the level of linguistic complexity. At the third testing time, syllable identification was correlated with phoneme identification and syllable blending was correlated with phoneme blending. Additionally, syllable segmentation mastery was attained by all students who were able to segment words into phonemes. This data supports the claim that the same underlying capacity is drawn on to successfully complete phonological awareness tasks regardless of the size of the units of sound in question (Lerner & Lonigan, 2016). The same relationships were not found in the data for the first two testing times. The participants' low phonemic awareness skills may have masked these relationships in the pre-test and post-test 1 data. Further research is needed to establish stronger connections between syllable and phoneme level tasks.

Another noteworthy correlation was the one found between letter knowledge and phonological awareness tasks, specifically at the phoneme level. Phoneme identification was strongly correlated with letter knowledge across all three testing times. Phoneme blending was significantly correlated with letter knowledge in the data collected during the first two testing times and phoneme segmentation was significantly correlated with letter knowledge in the data collected during the third testing time. Letter knowledge was only significantly correlated with syllable level tasks on two occasions: with syllable segmentation in the data collected during the first testing time and with syllable identification in the data collected during the third testing time. These findings suggest

that letter knowledge has a significant relationship with phonological awareness, particularly at the phoneme level.

No significant correlations were found amongst the three syllable level tasks. Phoneme identification and phoneme blending significantly correlated with each other in the data collected during the first two testing times. Phoneme blending and phoneme segmentation correlated with each other in the data collected during the third testing time. The data did not reveal any other correlations amongst the phoneme level tasks. There was no instance of all three phoneme level tasks correlating with each other.

CHAPTER SEVEN

7.0 iLe12's EFFECTS ON LETTER KNOWLEDGE, PHONOLOGICAL AWARENESS, AND WORD RECOGNITION SKILLS

One of the major goals of this project was to develop a game-like iPad app that would help develop the participants' phonological awareness skills in their home language, Dhuwaya. Thus, iLe12 (the Intervention App) was created and trialled on Dhuwaya-speaking children. This chapter explores the Intervention App's effects on the participants' emergent literacy skills. The first part of the chapter discusses the effectiveness of the Intervention App training on the participants' letter knowledge and phonological awareness skills examining whether the Intervention App was successful in training the skills included in the app. The second examines whether the letter knowledge and phonological awareness improvements initiated by the intervention, if any, in turn facilitated the acquisition of word recognition skills. As previously mentioned in Chapter Three, phonological awareness training is only a means to an end. The purpose of training phonological awareness is not to increase phonological awareness per se but to give children one of the most robust tools they can use to crack the alphabetic code and begin reading. Therefore, the Intervention App is only useful insofar that the skills it trains transfer over to emergent reading ability.

This chapter explores the Intervention App's effects across all variables measured addressing the current project's third research question in section 7.2 and the fourth research question in section 7.3:

3) Does a researcher designed phonological awareness training program help increase phonological awareness and letter knowledge for Indigenous children in their home language: Dhuwaya?

4) Do improvements in phonological awareness and letter knowledge (gained through the researcher designed phonological awareness training program) in turn facilitate early word reading?

Individual participant data was included in the analysis for the third research question if two criteria were met. First, the participant needed to have completed the assessment battery section measuring the skill in question at both the pre-test phase and the post-test 1 phase. For example, the student needed to have completed the letter knowledge section of the assessment battery during both the pre-test and the post-test 1 phase. Second, the participant needed to have interacted with the Intervention App during the intervention phase. Some participants only completed part of the assessment battery (either the Assessment App or the oral assessment) during the post-test 1 phase. Their data was still included in the analysis of the Intervention App's effects on the particular skill in question if the participant met the two criteria: the participant interacted with the Intervention App during the intervention phase and the participant completed the assessment section for the skill in question at both of the first two testing times.

Individual participant data was included in the analysis for the fourth research question if two criteria were met. First, the participant needed to have completed all sections of the assessment battery during both the pre-test phase and the post-test 1 phase.

Second, the participant needed to have interacted with the Intervention App during the intervention phase.

Throughout this chapter, I point out that some students did not complete any phoneme focused Intervention App levels. This does not mean that the student did not interact with the Intervention App. Rather, the student did not complete more than eight levels. Recall that the first eight levels of the Intervention App focus on syllables while levels nine through 24 focus on phonemes.

7.1 THE INTERVENTION APP'S EFFECTS ON LETTER KNOWLEDGE AND PHONOLOGICAL AWARENESS SKILLS

The participants' post-test 1 assessment results were compared to their pre-test assessment results. Increases in scores for individual skill subsections were taken to mean that the Intervention App helped to develop the particular skill in question. Post-test 2 assessment results were used to investigate whether participants retained any of the skills developed during the intervention phase. This maintenance analysis was only conducted when possible, as not all participants were present during all three testing times.

As previously discussed in section 5.4, it was not feasible to have a control group in the current study due to constraints imposed by realities such as very low enrolment numbers and student attendance rates. Therefore, all students who participated in the study were included in the experimental group. Changes in the participants' pre-test and post-test 1 skill levels were compared to their natural skill development trends in order to establish whether increases in assessment scores were higher than expected from daily

classroom experience and child maturation. Assessments completed by 12 of the participants earlier in the school year were used to predict natural skill level development.

The assessment battery used in this study (the Assessment App and the Oral Assessment) was administered to 12 of the participants in April 2015, six months before the experimental phase began. These April assessments will be termed baseline assessments for readability purposes. The baseline and pre-test assessments were both conducted during the same school year meaning that children were in the same classrooms with the same teachers following the same curriculum. Therefore, it was surmised that scores from these two testing times could be compared in order to calculate a baseline for natural spontaneous skill development. Changes in score, if any, between the baseline and the pre-test assessments were divided by six, the number of months in between testing times. The resulting number was considered the average change in score per month expected from the participants' natural classroom experience. Post-test 1 was also conducted in the same school year that the baseline and the pre-test were conducted in. Thus, the participants were still in the same classroom environment, with the same teachers following the same curriculum. Following this line of reasoning, the size of the difference between post-test 1 and pre-test scores was compared to their natural skill level development baselines in order to investigate whether gains were higher than expected from natural maturation and scholastic growth. This double baseline analysis was only conducted with the skills that the children displayed significant gains in after Intervention App training.

Section 7.1 discusses the Intervention App's effects on letter knowledge and each of the phonological awareness skills measured. A subsection is allocated to each

individual skill beginning with letter knowledge in section 7.1.1. Sections 7.1.2 through 7.1.4 discuss the Intervention App's effects on syllable segmentation, syllable blending, and syllable identification, respectively. Section 7.1.5 discusses the Intervention App's effects on overall syllable awareness. Sections 7.1.6 through 7.1.8 discuss the Intervention App's effects on phoneme segmentation, phoneme blending, and phoneme identification, respectively while section 7.1.9 discusses the app's effects on overall phonemic awareness. Section 7.1 closes with a summary of the relevant findings regarding research question number three.

7.1.1 Intervention Effects on Letter Knowledge

Nineteen students completed both the pre-test letter knowledge assessment and the post-test 1 letter knowledge assessment. The following analysis is based on these 19 pre-test/post-test 1 data sets which include the results collected from: three Transition students, five Grade 1 students, four Grade 2 students, two Grade 3 students, and five Grade 4 students. Possible scores on the letter knowledge assessment subsection ranged from zero to six.

Table 7.1*Pre-test/Post-test 1 Letter Knowledge Score Comparisons*

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score
TB	Transition	5	2	-3
TC	Transition	6	6	=
TD	Transition	2	2	=
Transition Average		4.333	3.333	-1
1C	Grade 1	3	3	=
1D	Grade 1	5	4	-1
1E	Grade 1	6	6	=
1I	Grade 1	4	4	=
1J	Grade 1	6	6	=
Grade 1 Average		4.8	4.6	-0.2
2A	Grade 2	6	6	=
2C	Grade 2	6	6	=
2D	Grade 2	3	5	+2
2E	Grade 2	3	2	-1
Grade 2 Average		4.5	4.75	+0.25
3B	Grade 3	6	6	=
3C	Grade 3	6	6	=
Grade 3 Average		6	6	=
4A	Grade 4	6	6	=
4B	Grade 4	6	6	=
4C	Grade 4	5	6	+1
4D	Grade 4	5	6	+1
4F	Grade 4	6	5	-1
Grade 4 Average		5.6	5.8	+0.2

Average letter knowledge scores did not change significantly (see Table 7.1 for participant scores). The Transition and Grade 1 students' average letter knowledge scores slightly decreased. The Grade 2 and Grade 4 students' average letter knowledge scores minimally increased while the Grade 3 students' average score remained unchanged. Ten students answered all letter knowledge questions correctly on the pre-test and thus had no

room for improvement. However, one of these students decreased in score by one, incorrectly matching one of the letters to its corresponding sound. This student not only correctly matched this same letter-sound pair in the pre-test, but also completed the three Intervention App levels that introduce this letter-sound pair. As such, the participant's decrease in score was unexpected.

We now turn to the remaining nine students who had the opportunity to improve their letter knowledge scores. Four of these students did not complete any of the Intervention App levels introducing the letter-sound pairs that they answered incorrectly to on post-test 1. In other words, all of the letter-sound correspondences these four participants answered incorrectly to on post-test 1 had not yet been introduced to them by the Intervention App. Therefore, conclusions cannot be made regarding the Intervention App's effects on these four students' performance on the letter knowledge assessment. Two students increased their letter knowledge scores by correctly matching letter-sound pairs (that they previously answered incorrectly to in the pre-test) that were introduced in a number of the Intervention App levels completed by the students. By contrast, one student decreased in score by incorrectly matching letter-sound pairs (that she had previously answered correctly to in the pre-test) that were introduced in a number of the Intervention App levels completed by the student. Two students exhibited mixed performance. These two students correctly matched some of the letter-sound pairs (previously answered incorrectly to in the pre-test) that were introduced in the Intervention App levels they completed while incorrectly matching other letter-sound pairs (previously answered to correctly in the pre-test) that were also introduced in the Intervention App levels they completed.

The data is unclear in regard to whether or not the Intervention App was instrumental in increasing letter knowledge scores for students. However, output data from the participants' iLe12⁶¹ activity logs suggests that participants were able to complete letter knowledge activities more accurately with more practice. Recall that the same letter-sound pair is introduced for three consecutive iLe12 levels. The letter knowledge activities were different from the segmentation and blending activities in that children did not advance to the next activity until all of the targeted letters were found or until all the baby kangaroos were matched with their corresponding mother kangaroo⁶². Over half of the participants completed all of the letter knowledge activities without making any mistakes. However, some of the younger children were still developing letter knowledge skills and made anywhere between two and 21 incorrect answer choices before completing the activities. In these cases, students made far fewer mistakes (about two thirds less) the second time a letter knowledge activity targeting the same letter-sound pair was played. For example, participant TA made 21 errors on the /m/ focused letter knowledge activity in level one but only five errors on the same activity in level two.

In total, three students increased their letter knowledge scores on post-test 1. All three of these students also completed post-test 2. Two of the students retained their letter knowledge score increases while one of them did not. See Table 7.2 below.

⁶¹ Recall that iLe12 is the official name of the Intervention App. 'Assessment App' and 'Intervention App' have been used throughout the thesis to avoid confusion between 'iLe11' and 'iLe12'.

⁶² Students only had two chances to answer segmentation and blending questions correctly before the app explained the correct response and moved on to the next question.

Table 7.2
Letter Knowledge Maintenance Scores

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score	Post-test 2 Score	Maintenance
2D	Grade 2	3	5	+2	6	YES
4C	Grade 4	5	6	+1	5	NO
4D	Grade 4	5	6	+1	6	YES

7.1.2 Intervention Effects on Syllable Segmentation

Seventeen students completed both the pre-test syllable segmentation assessment and the post-test 1 syllable segmentation assessment. The following analysis is based on these 17 pre-test/post-test 1 data sets which include the results collected from: two Transition students, four Grade 1 students, four Grade 2 students, two Grade 3 students, and five Grade 4 students. Possible scores on the syllable segmentation assessment subsection ranged from zero to seven.

Table 7.3*Pre-test/Post-test 1 Syllable Segmentation Score Comparisons*

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score
TB	Transition	6	6	=
TC	Transition	7	7	=
Transition Average		6.5	6.5	=
1D	Grade 1	7	7	=
1E	Grade 1	7	7	=
1I	Grade 1	4	3	-1
1J	Grade 1	6	7	+1
Grade 1 Average		6	6	=
2A	Grade 2	7	7	=
2C	Grade 2	6	6	=
2D	Grade 2	7	7	=
2E	Grade 2	6	6	=
Grade 2 Average		6.5	6.5	=
3B	Grade 3	6	6	=
3C	Grade 3	6	7	+1
Grade 3 Average		6	6.5	+0.5
4A	Grade 4	7	7	=
4B	Grade 4	7	7	=
4D	Grade 4	6	7	+1
4E	Grade 4	5	6	+1
4F	Grade 4	7	7	=
Grade 4 Average		6.4	6.8	+0.4

Average syllable segmentation scores did not change for the three younger student cohorts and only slightly increased for the two older student cohorts (see Table 7.3 for participant scores). This minimal change in scores can be attributed to a ceiling effect. Syllable segmentation scores were relatively high on the pre-test: eight children received a perfect score of seven, seven students scored a six out of seven, one student

scored a five out of seven, and one student scored a four. The participants had little room for score growth due to their high pre-test scores.

Scores for 12 of the 17 students did not change. Eight of these students earned a perfect score on the syllable segmentation section of the pre-test leaving no room for improvement. The other four students whose scores remained unchanged scored a six out of seven on both the pre-test and post-test **1**. Five students' syllable segmentation scores changed albeit only minimally. In regard to the five students whose syllable segmentation score changed: one student's score decreased by one while the other four students' scores increased by one. No relationship was found between syllable segmentation score changes and the number of Intervention App levels completed by students.

Four students' letter knowledge scores increased on post-test **1**. Three of these students also completed post-test **2**. All three students retained their syllable segmentation score increases. See Table 7.4 below

Table 7.4
Syllable Segmentation Maintenance Scores

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score	Post-test 2 Score	Maintenance
1J	Grade 1	6	7	+1	7	YES
3C	Grade 3	6	7	+1	7	YES
4D	Grade 4	6	7	+1	7	YES

7.1.3 Intervention Effects on Syllable Blending

Nineteen students completed both the pre-test syllable blending assessment and the post-test **1** syllable blending assessment. The following analysis is based on these 19 pre-

test/post-test 1 data sets which include the results collected from: three Transition students, five Grade 1 students, four Grade 2 students, two Grade 3 students, and five Grade 4 students. Possible syllable blending assessment scores ranged from zero to three.

Table 7.5
Pre-test/Post-test 1 Syllable Blending Score Comparisons

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score
TB	Transition	3	3	=
TC	Transition	3	3	=
TD	Transition	3	2	-1
Transition Average		3	2.67	-0.33
1C	Grade 1	3	3	=
1D	Grade 1	3	3	=
1E	Grade 1	3	3	=
1I	Grade 1	3	3	=
1J	Grade 1	3	3	=
Grade 1 Average		3	3	=
2A	Grade 2	3	3	=
2C	Grade 2	3	3	=
2D	Grade 2	1	1	=
2E	Grade 2	3	3	=
Grade 2 Average		2.5	2.5	=
3B	Grade 3	3	3	=
3C	Grade 3	3	3	=
Grade 3 Average		3	3	=
4A	Grade 4	3	3	=
4B	Grade 4	3	3	=
4C	Grade 4	3	3	=
4D	Grade 4	3	3	=
4F	Grade 4	3	3	=
Grade 4 Average		3	3	=

Average syllable blending scores did not change significantly due to a ceiling effect. Seventeen students received perfect syllable blending scores on both the pre-test and post-test 1. One student received a score of one at both testing times. Syllable blending scores only changed for one of the 19 students with pre-test/post-test syllable blending data. This student's score decreased by one (see participant TD's data in Table 7.5 above). Note that this student (participant TD) only completed the first three levels of the Intervention App.

7.1.4 Intervention Effects on Syllable Identification

Nineteen students completed both the pre-test syllable identification assessment and the post-test 1 syllable identification assessment. The following analysis is based on these 19 pre-test/post-test 1 data sets which include the results collected from: three Transition students, five Grade 1 students, four Grade 2 students, two Grade 3 students, and five Grade 4 students. Possible syllable identification scores ranged from zero to three.

Table 7.6*Pre-test/Post-test 1 Syllable Identification Score Comparisons*

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score
TB	Transition	3	2	-1
TC	Transition	1	2	+1
TD	Transition	0	2	+2
Transition Average		1.33	2	+0.67
1C	Grade 1	1	2	+1
1D	Grade 1	2	2	=
1E	Grade 1	3	2	-1
1I	Grade 1	3	2	-1
1J	Grade 1	2	2	=
Grade 1 Average		2.2	2	-0.2
2A	Grade 2	3	3	=
2C	Grade 2	2	2	=
2D	Grade 2	3	3	=
2E	Grade 2	1	2	+1
Grade 2 Average		2.25	2.5	+0.25
3B	Grade 3	2	3	+1
3C	Grade 3	1	1	=
Grade 3 Average		1.5	2	+0.5
4A	Grade 4	3	3	=
4B	Grade 4	2	1	-1
4C	Grade 4	2	2	=
4D	Grade 4	1	3	+2
4F	Grade 4	2	2	=
Grade 4 Average		2	2.2	+0.2

Average syllable identification scores increased slightly for all student cohorts except for Grade 1 (see Table 7.6 for participant scores). However, scores did not improve as much as expected. Scores remained unchanged for nine students. Three of these students received perfect syllable identification scores on both the pre-test and post-

test **1**. Another six students' syllable identification scores remained unchanged even though they did have room for improvement; i.e., they did not receive perfect syllable identification scores on the pre-test and therefore had the opportunity to increase their syllable identification scores by one or two points on post-test **1** but they failed to do so.

Syllable identification scores changed for ten students. Four students' syllable identification scores decreased by one. Six students' syllable identification scores increased by one or two points. Increases in syllable identification score were not related to student age or to the number of Intervention App levels completed by the participants. Post-test **2** was completed by all six of the students who increased their syllable identification scores on post-test **1**. Four of the six students retained their score increases. See Table 7.7 below.

Table 7.7
Syllable Identification Maintenance Scores

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score	Post-test 2 Score	Maintenance
TC	Transition	1	2	+1	2	YES
TD	Transition	0	2	+2	1	NO
1C	Grade 1	1	2	+1	2	YES
2E	Grade 2	1	2	+1	2	YES
3B	Grade 3	2	3	+1	3	YES
4D	Grade 4	1	3	+2	2	NO

The purpose of testing syllable identification was to investigate whether syllable segmentation and syllable blending skill practice transferred onto other syllable level tasks. The Intervention App does not include syllable identification activities. Therefore, increases in syllable identification scores can be attributed to an overall increase in the larger construct of syllable awareness. Syllable identification scores did increase for six

children. However, many students did not display the same score gains. Further investigation indicates that overall syllable awareness scores did not increase as much as expected.

7.1.5 Intervention Effects on Syllable Awareness

Sixteen students completed the assessment sections for all three syllable level tasks on both the pre-test and post-test **1**. The following analysis is based on these 16 pre-test/post-test **1** data sets which include the results collected from: two Transition students, four Grade 1 students, four Grade 2 students, two Grade 3 students, and four Grade 4 students.

Scores for each of the three syllable level tasks were converted into percentages and then averaged together to generate overall syllable awareness scores. Pre-test/post-test **1** syllable awareness score comparisons are featured in Table 7.8. Cells highlighted in teal signify increases in syllable awareness scores. Cells highlighted in yellow signify unchanged scores. Cells highlighted in red indicate decreases in syllable awareness scores. Overall syllable awareness scores increased for only six of the 16 participants with complete syllable awareness data sets.

Table 7.8*Average Pre-test/Post-test 1 Syllable Awareness Score Comparisons*

Student	Student Cohort	Pre-test Average	Post-test 1 Average	Syllable iLe2 Levels
TB	Transition	95.24%	84.13%	8
TC	Transition	77.78%	88.89%	8
Transition Average		86.51%	86.51%	
1D	Grade 1	88.89%	88.89%	8
1E	Grade 1	100%	88.89%	7
1I	Grade 1	85.71%	69.84%	8
1J	Grade 1	84.13%	88.89%	8
Grade 1 Average		89.68%	84.13%	
2A	Grade 2	100%	100%	8
2C	Grade 2	84.13%	84.13%	8
2D	Grade 2	77.78%	77.78%	8
2E	Grade 2	72.90%	84.13%	8
Grade 2 Average		83.70%	86.51%	
3B	Grade 3	84.13%	95.24%	8
3C	Grade 3	73.01%	77.78%	8
Grade 3 Average		78.57%	86.51%	
4A	Grade 4	100%	100%	8
4B	Grade 4	88.89%	77.78%	8
4D	Grade 4	73.01%	100%	8
4F	Grade 4	88.89%	88.89%	8
Grade 4 Average		87.70%	91.67%	

7.1.6 Intervention Effects on Phoneme Segmentation

Seventeen students completed both the pre-test phoneme segmentation assessment and the post-test 1 phoneme segmentation assessment. The following analysis is based on these 17 pre-test/post-test 1 data sets which include the results collected from: two Transition students, four Grade 1 students, four Grade 2 students, two Grade 3 students,

and five Grade 4 students. Possible phoneme segmentation scores ranged from zero to six.

Table 7.9

Pre-test/Post-test 1 Phoneme Segmentation Score Comparisons

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score
TB	Transition	0	1	+1
TC	Transition	0	5	+5
Transition Average		0	3	+3
1D	Grade 1	0	0	=
1E	Grade 1	0	0	=
1I	Grade 1	0	1	+1
1J	Grade 1	0	2	+2
Grade 1 Average		0	0.75	+0.75
2A	Grade 2	0	1	+1
2C	Grade 2	2	4	+2
2D	Grade 2	0	0	=
2E	Grade 2	0	3	+3
Grade 2 Average		0.5	2	+1.5
3B	Grade 3	0	0	=
3C	Grade 3	0	1	+1
Grade 3 Average		0	0.5	+0.5
4A	Grade 4	0	6	+6
4B	Grade 4	0	6	+6
4D	Grade 4	0	4	+4
4F	Grade 4	0	2	+2
Grade 4 Average		0	4	+4.5

Average phoneme segmentation scores significantly increased for all student cohorts (see Table 7.9 for participant scores). Thirteen students increased their phoneme segmentation scores between one and six points. The amount by which scores increased

varied by student. The data did not present a straightforward relationship between phoneme segmentation score increases and the number of phoneme focused iLeve² levels completed or between phoneme segmentation score increases and participant age. Two Grade 4 students achieved the highest phoneme segmentation score growth possible (from a zero to a perfect six). All remaining Grade 4 students increased their phoneme segmentation scores by at least two points. Scores increased much less for the four younger grade level cohorts. However, a Transition student achieved the second largest increase in scores (from a zero to a five).

Four students' phoneme segmentation scores remained unchanged. These four students received phoneme segmentation scores of zero on both the pre-test and the post-test 1 assessments indicating that they did not possess the skills needed to break down words into their constituent phonemes. Two of these students did not advance beyond level eight of the Intervention App. Therefore, they did not complete any of the phoneme focused levels⁶³. The other two students with unchanged phoneme segmentation scores did complete a number of phoneme focused levels (eight to 15).

The participants' post intervention score changes were compared to the natural score changes expected from regular classroom experience. Twelve students completed the baseline, pre-test, and post-test 1 assessments. As can be seen in Table 7.10 below, phoneme segmentation scores did not increase on the pre-test when compared to the baseline scores measured six months earlier for any of the participants, with the exception of Participant 2C. Ten participants received a score of zero on both the baseline test and the pre-test indicating that phoneme segmentation ability did not improve after six

⁶³ Recall that levels one through eight focus on syllables while levels nine through 24 focus on phonemes.

months of schooling. One student's phoneme segmentation score decreased when compared to her baseline score. Participant 2C was the only student whose pre-test phoneme segmentation score increased when compared to her baseline score. However, compare the different rates of growth displayed by Participant 2C before and after the intervention. Participant 2C's phoneme segmentation score naturally increased at a rate of 0.333 per month before the intervention and at a rate of 1.333 per month after participating in the intervention. This data suggests that phoneme segmentation ability does not increase without explicit instruction for the vast majority of students. Moreover, the developmental trends suggest that phoneme segmentation assessment scores do not increase as a result of regular classroom experience. Therefore, the score increases achieved by the participants on post-test 1 are most likely an effect of the Intervention App training.

Table 7.10*Baseline/Pre-test/Post-test 1 Phoneme Segmentation Score Change Comparisons*

Student	Student Cohort	Baseline Score April 22 - 24, 2015	Pre-test Score October 18 - 21, 2015	Post-test 1 Score December 3 - 8, 2015	Change per Month before Training	Change Per Month after Training
TC	Transition	0	0	5	0	+3.33
1D	Grade 1	0	0	0	0	0
1E	Grade 1	0	0	0	0	0
1J	Grade 1	0	0	2	0	+1.33
2A	Grade 2	0	0	1	0	+0.67
2C	Grade 2	0	2	4	+0.33	+1.33
2D	Grade 2	0	0	0	0	0
2E	Grade 2	0	0	3	0	+2
3B	Grade 3	0	0	0	0	0
3C	Grade 3	0	0	1	0	+0.67
4A	Grade 4	2	0	6	-0.33	+4
4F	Grade 4	0	0	2	0	+1.33
Cells highlighted in teal indicate that the participant's phoneme segmentation growth rate was higher post intervention when compared to her baseline growth rate.						

Ten of the students whose phoneme segmentation scores increased on post-test 1 completed post-test 2. The data presented in Table 7.11 indicates that newly acquired phoneme segmentation skills were retained by 50% of these ten participants. This data suggests that more phoneme segmentation training time is needed to solidify this skill.

Table 7.11*Phoneme Segmentation Maintenance Scores*

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score	Post-test 2 Score	Maintenance
TB	Transition	0	1	+1	0	NO
1I	Grade 1	0	1	+1	1	YES
1J	Grade 1	0	2	+2	0	NO
2A	Grade 2	0	1	+1	2	YES
2E	Grade 2	0	3	+3	0	NO
3C	Grade 3	0	1	+1	1	YES
4A	Grade 4	0	6	+6	6	YES
4B	Grade 4	0	6	+6	6	YES
4D	Grade 4	0	4	+4	0	NO
4F	Grade 4	0	2	+2	1	NO

7.1.7 Intervention Effects on Phoneme Blending

Nineteen students completed both the pre-test phoneme blending assessment and the post-test 1 phoneme blending assessment. The following analysis is based on these 19 pre-test/post-test 1 data sets which include the results collected from: three Transition students, five Grade 1 students, four Grade 2 students, two Grade 3 students, and five Grade 4 students. Possible phoneme blending scores ranged from zero to four.

Table 7.12*Pre-test/Post-test 1 Phoneme Blending Score Comparisons*

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score
TB	Transition	0	3	+3
TC	Transition	1	4	+3
TD	Transition	0	1	+1
Transition Average		0.33	2.67	+2.34
1C	Grade 1	1	0	-1
1D	Grade 1	3	4	+1
1E	Grade 1	1	2	+1
1I	Grade 1	0	3	+3
1J	Grade 1	3	3	=
Grade 1 Average		1.6	2.4	+0.8
2A	Grade 2	1	4	+3
2C	Grade 2	2	4	+2
2D	Grade 2	3	3	=
2E	Grade 2	0	4	+4
Grade 2 Average		1.5	3.75	+2.25
3B	Grade 3	3	0	-3
3C	Grade 3	1	3	+2
Grade 3 Average		2	1.5	-0.5
4A	Grade 4	4	4	=
4B	Grade 4	4	4	=
4C	Grade 4	3	4	+1
4D	Grade 4	4	3	-1
4F	Grade 4	2	3	+1
Grade 4 Average		3.4	3.6	+0.2

Average phoneme blending scores increased for all student cohorts with the exception of Grade 3 (see Table 7.12 for participant scores). However, the Grade 3 average score may have been skewed by Participant 3B's outlier data (see section 6.7.2 for a discussion on the Grade 3 cohort's average phoneme blending score). Thus, average

phoneme blending scores increased for all student cohorts if Participant 3B's phoneme blending data is considered to be outlier data. Twelve participants increased their phoneme blending scores between one and four points. Four participants' phoneme blending scores remained unchanged. Note that two of the students with unchanged phoneme blending scores received perfect phoneme blending scores on the pre-test; and therefore, did not have the opportunity to increase their scores. Three participants' phoneme blending scores decreased. Two of the students whose phoneme blending scores decreased post intervention did not advance beyond level eight of the Intervention App. Therefore, these two students did not complete any of the phoneme focused levels.

Changes in phoneme blending scores were not related to student age. However, there was a relationship between phoneme blending scores and the number of Intervention App levels completed. All participants who completed two or more phoneme focused iLeveled levels scored a three or four on the post-test 1 phoneme blending subsection. Participants increased their phoneme blending scores between one and four points in order to obtain these scores of three or four. All four of the participants who did not complete any phoneme focused iLeveled levels scored between a zero and a two on the post-test 1 phoneme blending assessment.

The participants' post intervention score changes were compared to the natural score changes expected from regular classroom experience. Twelve students completed the baseline, pre-test, and post-test 1 assessments. As can be seen in Table 7.13 below, five children spontaneously improved their phoneme blending scores without explicit instruction (pre-test compared to baseline test). However, the majority of the participants increased their phoneme blending scores at a higher rate after participating in the

Intervention App training. Cells highlighted in teal signify that a participant's phoneme blending score increased after the intervention at a higher rate than expected from natural classroom experience. Participant 4A's row is highlighted in yellow to signify that the student received a perfect phoneme blending score on the pre-test. Therefore, Participant 4A did not have the opportunity to increase her phoneme blending score. Participant 3B's row is highlighted in red to signify that the student is considered an outlier. As discussed in section 6.7.2, Participant 3B noticeably rushed through the phoneme blending section of the assessment battery, randomly clicking answer choices without listening to the questions. If Participant 4A and Participant 3B are excluded, then seven out of ten students' phoneme blending scores increased after the intervention at a higher rate than expected from daily classroom experience. This data suggests that the Intervention App training was effective in facilitating phoneme blending development.

Table 7.13

Baseline/Pre-test/Post-test 1 Phoneme Blending Score Change Comparisons

Student	Student Cohort	Baseline Score April 22 - 24, 2015	Pre-test Score October 18 - 21, 2015	Post-test 1 Score December 3 - 8, 2015	Change per Month before Training	Change Per Month after Training
TC	Transition	1	1	4	0	+2
1C	Grade 1	2	1	0	-0.167	-0.667
1D	Grade 1	0	3	4	+0.5	+0.667
1J	Grade 1	1	3	3	+0.333	0
2A	Grade 2	2	1	4	-0.167	+2
2C	Grade 2	1	2	4	+0.167	+1.333
2D	Grade 2	3	3	3	0	0
2E	Grade 2	0	0	4	0	+2.667
3B	Grade 3	2	3	0	+0.167	-2
3C	Grade 3	1	1	3	0	+1.333
4A	Grade 4	3	4	4	+0.167	0
4C	Grade 4	3	3	4	0	+0.667

Twelve students' phoneme blending scores increased after participating in the intervention. Eleven of these students also completed post-test 2. Ten of the 11 students retained their phoneme blending scores (see Table 7.14 below) suggesting that the Intervention App had a lasting effect on phoneme blending ability.

Table 7.14
Phoneme Blending Maintenance Scores

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score	Post-test 2 Score	Maintenance
TB	Transition	0	3	+3	4	YES
TC	Transition	1	4	+3	4	YES
TD	Transition	0	1	+1	2	YES
1D	Grade 1	3	4	+1	4	YES
1I	Grade 1	0	3	+3	4	YES
2A	Grade 2	1	4	+3	4	YES
2C	Grade 2	2	4	+2	4	YES
2E	Grade 2	0	4	+4	2	NO
3C	Grade 3	1	3	+2	4	YES
4C	Grade 4	3	4	+1	4	YES
4F	Grade 4	2	3	+1	3	YES

7.1.8 Intervention Effects on Phoneme Identification

Nineteen students completed both the pre-test phoneme identification assessment and the post-test 1 phoneme identification assessment. The following analysis is based on these 19 pre-test/post-test 1 data sets which include the results collected from: three Transition students, five Grade 1 students, four Grade 2 students, two Grade 3 students, and five Grade 4 students. Possible phoneme identification scores ranged from zero to four.

Table 7.15*Pre-test/Post-test 1 Phoneme Identification Score Comparisons*

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score
TB	Transition	2	2	=
TC	Transition	2	4	+2
TD	Transition	0	1	+1
Transition Average		1.33	2.33	+1
1C	Grade 1	1	1	=
1D	Grade 1	2	3	+1
1E	Grade 1	3	2	-1
1I	Grade 1	0	3	+3
1J	Grade 1	3	4	+1
Grade 1 Average		1.8	2.6	+0.8
2A	Grade 2	2	4	+2
2C	Grade 2	2	4	+2
2D	Grade 2	4	4	=
2E	Grade 2	2	3	+1
Grade 2 Average		2.5	3.75	+1.25
3B	Grade 3	3	4	+1
3C	Grade 3	2	2	=
Grade 3 Average		2.5	3	+0.5
4A	Grade 4	4	3	-1
4B	Grade 4	4	4	=
4C	Grade 4	3	4	+1
4D	Grade 4	4	4	=
4F	Grade 4	3	4	+1
Grade 4 Average		3.6	3.8	+0.2

Phoneme identification scores increased for all student cohorts (see Table 7.15). Eleven participants increased their phoneme identification scores between one and three points. Six participants' phoneme identification scores remained unchanged. Three of the students with unchanged scores previously answered all phoneme identification questions

correctly on the pre-test. Therefore, these three students did not have the opportunity to increase their scores. The remaining three students with unchanged phoneme identification scores completed only three or less of the 16 Intervention App levels focused on phonemes. Two participants' phoneme identification scores decreased on post-test 1. One of these students with decreased scores did not complete any of the phoneme focused Intervention App levels.

There was a relationship between changes in phoneme identification scores and Intervention App levels completed. All students who completed five or more phoneme focused levels scored a three or a perfect four on the post-test 1 phoneme identification assessment. These students increased their phoneme identification scores between one and three points in order to obtain high scores of three or four. In contrast, students who completed three or less phoneme focused levels scored a low one or two on the post-test 1 phoneme identification subsection.

The participants' post intervention score changes were compared to the natural score changes expected from regular classroom experience. Twelve students completed the baseline, pre-test, and post-test 1 assessments. As can be seen in Table 7.16 below, nine children improved their phoneme identification scores without explicit instruction (pre-test compared to baseline test). However, the majority of the participants increased their phoneme identification scores at a higher rate after the intervention. Cells highlighted in teal signify that a participant's phoneme blending score increased after the intervention at a higher rate than expected from natural classroom experience. Participant 2D's row is highlighted in yellow to signify that the student received a perfect phoneme identification score on the pre-test. Therefore, Participant 2D did not have the opportunity

to increase her score. Eight of the 11 students (after excluding Participant 2D) increased their phoneme identification scores at higher rates post intervention. This data suggests that the Intervention App was effective in facilitating phoneme identification development.

Table 7.16

Baseline/Pre-test/Post-test 1 Phoneme Identification Score Change Comparisons

Student	Student Cohort	Baseline Score April 22 - 24, 2015	Pre-test Score October 18 - 21, 2015	Post-test 1 Score December 1 - 8, 2015	Change per Month before Training	Change Per Month after Training
TC	Transition	0	2	4	+0.333	+1.333
1C	Grade 1	0	1	1	+0.167	0
1D	Grade 1	0	2	3	+0.333	+0.667
1J	Grade 1	2	3	4	+0.167	+0.667
2A	Grade 2	4	2	4	-0.333	+1.333
2C	Grade 2	3	2	4	-0.167	+1.333
2D	Grade 2	1	4	4	+0.5	0
2E	Grade 2	1	2	3	+0.167	+0.667
3B	Grade 3	0	3	4	+0.5	+0.667
3C	Grade 3	1	2	2	+0.167	0
4A	Grade 4	4	4	3	0	-0.667
4C	Grade 4	0	3	4	+0.5	+0.667

Eleven students' phoneme identification scores increased after the intervention. All eleven of these students also completed post-test 2. Nine of these students retained their phoneme identification scores (see Table 7.17 below) suggesting that the Intervention App training had a lasting effect on phoneme identification skill.

Table 7.17*Phoneme Identification Maintenance Scores*

Student	Student Cohort	Pre-test Score	Post-test 1 Score	Change in Score	Post-test 2 Score	Maintenance
TC	Transition	2	4	+2	4	YES
TD	Transition	0	1	+1	1	YES
1D	Grade 1	2	3	+1	4	YES
1I	Grade 1	0	3	+3	2	NO
1J	Grade 1	3	4	+1	4	YES
2A	Grade 2	2	4	+2	4	YES
2C	Grade 2	2	4	+2	4	YES
2E	Grade 2	2	3	+1	3	YES
3B	Grade 3	3	4	+1	4	YES
4C	Grade 4	3	4	+1	4	YES
4F	Grade 4	3	4	+1	3	NO

The purpose of testing phoneme identification was to investigate whether phoneme segmentation and phoneme blending practice transferred onto other phoneme level tasks. The Intervention App did not include phoneme identification activities. Therefore, increases in phoneme identification scores would be attributed to an overall increase in phonemic awareness. Phoneme identification scores increased for all students who completed five or more phoneme focused iLe12 levels suggesting that the Intervention App was beneficial in bolstering an overall awareness and ability to manipulate phonemes in different ways. Further investigation indicates that overall phonemic awareness scores increased for the vast majority of the participants.

7.1.9 Intervention Effects on Phonemic Awareness

Sixteen students completed the assessment sections for all three phoneme level tasks during both the pre-test and post-test **1** phase. The following analysis is based on these 16 pre-test/post-test **1** data sets which include the results collected from: two Transition students, four Grade 1 students, four Grade 2 students, two Grade 3 students, and four Grade 4 students.

Scores for each of the three phoneme level tasks were converted into percentages and then averaged together to generate an overall phonemic awareness score. Pre-test/post-test **1** phonemic awareness score comparisons are featured in Table 7.18 below. Cells highlighted in teal indicate increases in overall phonemic awareness on post-test **1**. Cells highlighted in yellow indicate unchanged scores. Cells highlighted in red signify decreases in overall phonemic awareness scores. Average phonemic awareness scores increased for all student cohorts. Individual phonemic awareness scores increased for 13 of the 16 participants. Only two participants' overall phonemic awareness scores remained unchanged and one of these students did not complete any of the Intervention App levels that focus on phonemes. One student's overall phonemic awareness score decreased. This student did not complete any of the Intervention App levels that focus on phonemes. This data suggests that the Intervention App was effective in increasing phonemic awareness in Dhuwaya-speaking children.

Table 7.18*Average Pre-test/Post-test 1 Phonemic Awareness Score Comparisons*

Student	Student Cohort	Pre-test Average	Post-test 1 Average	Phoneme focused iLe2 Levels
TB	Transition	16.67%	47.22%	2
TC	Transition	25%	90.48%	9
Transition Average		20.84%	68.85%	
1D	Grade 1	41.67%	58.33%	8
1E	Grade 1	33.33%	33.33%	0
1I	Grade 1	0%	55.56%	14
1J	Grade 1	50%	69.44%	5
Grade 1 Average		31.25%	54.17%	
2A	Grade 2	25%	72.22%	16
2C	Grade 2	44.44%	88.89%	5
2D	Grade 2	58.33%	58.33%	15
2E	Grade 2	0%	75%	9
Grade 2 Average		31.94%	73.61%	
3B	Grade 3	50%	33.33%	0
3C	Grade 3	25%	47.22%	3
Grade 3 Average		37.50%	56.95%	
4A	Grade 4	66.67%	91.67%	13
4B	Grade 4	66.67%	100%	16
4D	Grade 4	66.67%	80.56%	13
4F	Grade 4	41.67%	69.44%	14
Grade 4 Average		60.42%	85.42%	

7.1.10 Summary of the Intervention's Effects on Letter Knowledge and Phonological Awareness

The training effect was most noticeably seen in the participants' performance on the phoneme level tasks. Phoneme segmentation and phoneme identification scores increased for all student cohorts. Phoneme blending scores also increased for all student cohorts

except Grade 3. Additionally, overall phonemic awareness scores increased for every student who completed any number of the Intervention App levels focused on phonemes with the exception of Participant 2D. Furthermore, post-test **2** results suggest that the majority of the participants were able to retain their phoneme blending and phoneme identification skill gains and that half of the participants retained their phoneme segmentation skill gains. This data suggests that participants benefited considerably from the phonemic awareness training.

The Intervention App training did not yield significant results for letter knowledge or syllable level skills. Letter knowledge, syllable segmentation, and syllable blending scores did not increase. The ceiling effect on the syllable blending subsection rendered it impossible to monitor any score changes for this task. Possible syllable segmentation score increases were also limited due to the relatively high scores earned on the pre-test. Syllable identification scores increased slightly but not as much as expected. Three quarters of the participants completed all of the syllable focused iLe12 levels but only one third increased their syllable identification scores.

The data from this project suggests that iLe12 may be a beneficial tool in the development of Dhuwaya-speaking children's phonemic awareness skills. However, the Intervention App may not be as effective for developing letter knowledge or syllable awareness skills. The data was restricted by limited time and student attendance. Only 16 of the 29 participants attended school during the post-test **1** assessment week. Furthermore, only two participants completed all 24 iLe12 levels within the given time frame. The average number of levels completed by the 16 students with complete data sets was 16. I suspect that the iLe12 training effects on letter knowledge and phonological

awareness would have been greater had all participants completed all 24 levels of the Intervention App. Further research is warranted to clarify these findings.

7.2 iLe12's EFFECTS ON WORD RECOGNITION SKILLS

Sixteen participants completed the full assessment battery during both the pre-test phase and the post-test 1 phase. This section discusses changes in these 16 participants' post-intervention word recognition scores and ties them back to letter knowledge and phonological awareness scores.

Three students accurately identified words presented in the word recognition section of the pre-test. One student confidently read all 20 words with ease. The other two students read only one word each which may have been read as sight words. One of these students recognized *ga* which is the Dhuwaya word for 'and,' a very high frequency function word. The other student recognized *rom*, the Dhuwaya word for customs and law. Posters about *rom* are displayed throughout the school and as such, the participant may have memorized this word by rote. The remaining 13 students were unable to read or decode any words. The student who read all 20 words correctly on the pre-test did not have the opportunity to increase her scores. The remaining 15 students had the opportunity to increase their word recognition scores between one and 20 points. Six of these 15 children increased their word recognition scores on post-test 1. We begin by looking at the letter knowledge and phonological awareness characteristics of these six students whose word recognition scores increased post intervention.

7.2.1 Characteristics of the Participants Whose Word Recognition Scores Increased

Table 7.19 below shows the post-test 1 scores of the six children whose word recognition scores increased after the intervention ended. These six children will be referred to as ‘*new readers*’ from now on. Numbers in regular font reveal the participant’s post-test 1 score for the particular skill labelled in the cell found on the top row of each column. The superscript numbers signify what the change in score was, if any, from the pre-test to post-test 1. For example, 3⁺² indicates that a participant obtained a score of three on post-test 1 for a certain skill and that this score was two points higher than the score earned for the same skill on the pre-test. The participant would have obtained a score of one for this particular skill on the pre-test. Cells highlighted in teal indicate that a participant’s score increased on post-test 1 for the skill labelled on the top row of the column.

Table 7.19

New readers’ Letter Knowledge and Phonological Awareness Scores.

Participant	iLel2 Levels completed	WR	LK	Syll ID	Syll Blend	Syll Seg	Ph ID	Ph Blend	Ph Seg
4A	21	19 ⁺¹⁹	6 ⁼	3 ⁼	3 ⁼	7 ⁼	3 ⁻¹	4 ⁼	6 ⁺⁶
TC	17	7 ⁺⁷	6 ⁼	2 ⁺¹	3 ⁼	7 ⁼	4 ⁺²	4 ⁺³	5 ⁺⁵
2C	13	7 ⁺⁷	6 ⁼	2 ⁼	3 ⁼	6 ⁻¹	4 ⁺²	4 ⁺²	4 ⁺²
4F	22	6 ⁺⁵	5 ⁻¹	2 ⁼	3 ⁼	7 ⁼	4 ⁺¹	3 ⁺¹	2 ⁺²
3B	8	4 ⁺⁴	6 ⁼	3 ⁺¹	3 ⁼	6 ⁼	4 ⁺¹	0 ⁻³	0 ⁼
4D	21	1 ⁺¹	6 ⁺¹	3 ⁺²	3 ⁼	7 ⁺¹	4 ⁼	3 ⁻¹	4 ⁺⁴
Total Possible Score		20	6	3	3	7	4	4	6

Note:

^{+#} indicates that a student’s score increased by that #.

⁼ indicates that a student’s score did not change.

^{-#} indicates that a student’s score decreased by that #.

Average letter knowledge scores did not increase on post-test 1. However, the current data suggests that letter knowledge mastery is crucial for the effective utilization of the alphabetic code. Five of the six new readers earned perfect letter knowledge scores on post-test 1. The sixth student new reader received a score of five (out of six). This student incorrectly matched one letter-sound pair that the student had previously answered correctly to on the pre-test. It can thus be surmised that all new readers possessed letter knowledge mastery or near mastery.

All six new readers presented high syllable awareness levels. All new readers received perfect syllable blending scores. Four new readers correctly segmented all of the words presented in the syllable segmentation assessment. Two new readers received scores of six (out of seven) on the syllable segmentation assessment. Three new readers received perfect syllable identification scores. Three new readers received scores of two (out of three) on the syllable identification assessment as they incorrectly answered the identification question targeting final sounds. Overall, the six new readers received high syllable awareness scores. Three of the new readers increased their syllable awareness score after training. The remaining three students' syllable awareness scores remained unchanged, albeit high. See Table 7.20 below for the new readers' average syllable awareness scores. Cells highlighted in teal indicate that the student's syllable awareness score increased on post-test 1. Cells highlighted in yellow signify that the student's syllable awareness score remained unchanged.

Table 7.20*New Readers' Syllable Awareness Score Comparisons*

Student	Student Cohort	Pre-test Average	Post-test 1 Average	Syllable iLeI2 Levels
4A	Grade 4	100%	100%	8
TC	Transition	77.78%	88.89%	8
2C	Grade 2	84.13%	84.13%	8
4F	Grade 4	88.89%	88.89%	8
3B	Grade 3	84.13%	95.24%	8
4D	Grade 4	73.01%	100%	8

Four of the six new readers improved their phoneme identification scores by one or two points. These score increases resulted in the students earning perfect phoneme identification scores on post-test 1. One new reader's phoneme identification score remained unchanged because the student answered all four phoneme identification questions correctly on both the pre-test and on post-test 1. One new reader incorrectly answered one phoneme identification question that the student had previously answered correctly to on the pre-test. It can be surmised that all six new readers attained proficient phoneme identification skills by the second testing time.

Three of the six new readers increased their phoneme blending scores by one to three points. These score increases resulted in the students earning perfect or near perfect phoneme blending scores. One new reader's phoneme blending score did not change because the student answered all phoneme blending questions correctly on both the pre-test and post-test 1. One new reader's phoneme blending score decreased from a four to a three. One of the new readers, Participant 3B, earned a post-test 1 phoneme blending score of zero. However, this student previously demonstrated skillful phoneme blending by answering three of the four phoneme blending questions correctly on the pre-test. As previously mentioned, Participant 3B was observed rushing through the post-test 1

phoneme blending questions, paying no attention to the questions. This participant would quickly select an answer choice and move on to the next screen before the app's voice-over had finished asking the question suggesting that the participant was not making an effort to answer correctly. Recall that the phoneme blending section is the last section presented on the Assessment App and therefore Participant 3B may have grown tired and bored with the test. I suspect that Participant 3B did not answer the phoneme blending questions to the best of her abilities as her pre-test scores indicate skilled phoneme blending abilities. Thus, all new readers displayed proficient phoneme blending skills on post-test 1 with the exception of participant 3B who is suspected of answering incorrectly despite possessing capable phoneme blending skills.

Five of the six new readers increased their phoneme segmentation scores between two and six points. All of the participants who scored a four or above on the post-test 1 phoneme segmentation task are included in the group of new readers. All of the students who increased their phoneme segmentation score by at least two points are also included in the group of new readers with the exception of participant 1J who is discussed in section 7.2.7 below. Participant 3B is the only new reader whose increase in word recognition score was not accompanied by an increase in phoneme segmentation score.

Five of the six new readers increased their overall phonemic awareness scores (see Table 7.21 below). Participant 3B was the only new reader whose overall phonemic awareness score did not increase. This student did not complete any of the phoneme focused Intervention App levels. However, the student did display emergent phonemic awareness skills. Participant 3B identified three words on post-test 1 by sounding out and then blending phonemes together to decode words. Participant 3B also read *ga* by rote

memory. All four of the words decoded by this student were two phoneme words indicating that the student was in the very early stages of word decoding development.

Table 7.21

New Readers' Phonemic Awareness Score Comparisons

Student	Student Cohort	Pre-test Average	Post-test 1 Average	Phoneme iLe12 Levels
4A	Grade 4	66.67%	91.67%	13
TC	Transition	25%	90.48%	9
2C	Grade 2	44.44%	88.89%	5
4F	Grade 4	41.67%	69.44%	14
3B	Grade 3	50%	33.33%	0
4D	Grade 4	66.67%	80.56%	13

To summarize, all new readers displayed improvements in their phonemic awareness skills on post-test 1 with the exception of participant 3B. In other words, increases in word recognition score were accompanied by increases in overall phonemic awareness scores for five of the six new readers. Syllable identification scores also increased for half of the six new readers. Syllable blending and segmentation scores did not increase significantly for the new readers, though their scores were generally high on the pre-test leaving little room for improvement. Letter knowledge scores only increased for one of the new readers. However, letter knowledge mastery seemed to be compulsory in order for students to transfer their newly acquired phonological awareness skills to word recognition tasks.

No single variable measured was sufficient on its own to create change in word recognition skills. Therefore, increases in word recognition scores cannot be neatly attributed to increases in one particular skill or to a particular set of skills. However,

some non-readers⁶⁴ increased their letter knowledge and individual phonological awareness scores at the same rate as the new readers even though their word recognition scores did not increase. For example, the majority of the participants increased their phoneme blending scores, obtaining scores of three or higher. However, only a handful of these students increased their word recognition skills. An investigation into the students whose word recognition scores did not increase alongside their letter knowledge and phonological awareness score increases may help decipher which skills are more crucial or facilitative to the participants' emergent reading ability. We now turn to each of the skills that significantly increased for the new readers, turning attention to how the non-readers performed on these tasks. We focus on the non-readers who received scores comparable to the new readers on individual tasks and then look at possible weaknesses displayed on other tasks with the intention of deciphering whether any moderator variables exist or if any skill or combination of skills has the strongest effect on word recognition ability.

The following is a recap of the new readers' scores on the letter knowledge and phonological awareness assessments. All new readers obtained a score of five or higher on the letter knowledge assessment section. All new readers received a score of two or higher on the syllable identification assessment. All new readers received a score of three or above on the phoneme identification assessment. All new readers received a score of three or above on the phoneme blending assessment with the exception of participant 3B. All new readers increased their phoneme segmentation score by at least two points and received a score of two or higher - with the exception of participant 3B. These scores are

⁶⁴ 'Non-readers' is used to refer to the participants whose word recognition score did not increase post intervention.

compared with the non-readers' scores for the same tasks. Syllable segmentation and syllable blending scores are not compared as scores for these tasks did not increase significantly for the new readers.

7.2.2 New Reader Data Compared with Non-Reader Data: Letter Knowledge

Twelve of the 16 students with complete pre-test/post-test 1 data sets scored a five or six on the letter knowledge assessment, the vast majority of these students scoring a six. Six of these 12 students also increased their word recognition scores assigning them to the group of new readers. The other six students' word recognition scores remained unchanged. One of these six students with unchanged word recognition scores was able to decode all twenty words at both of the first two testing times and thus the student's score could not increase any higher. Of the five participants remaining, two did not receive syllable identification, phoneme identification, phoneme blending, or phoneme segmentation scores comparable to the new readers' scores. Two participants received syllable identification, phoneme identification, and phoneme blending scores comparable to the new readers' scores but they did not increase their phoneme segmentation scores by at least two points. Participant 1J was the only student with comparable scores on all of the separate skills measured whose word recognition score did not increase on post-test 1. If we consider participant 1J an outlier, then this data would indicate that increases in phoneme segmentation were crucial in increasing word recognition scores.

7.2.3 New Reader Data Compared with Non-Reader Data: Syllable Identification

Fourteen of the 16 students with complete pre-test/post-test **1** data sets received a post-test **1** syllable identification score of two or three. Six of these students belong to the group of new readers. The remaining eight students with high syllable identification scores did not increase their word recognition scores. One of these eight students received low letter knowledge, phoneme identification, and phoneme segmentation scores. Another student received low scores on all three phoneme level tasks. Two students received phoneme identification and phoneme blending scores comparable to the new readers' scores but their letter knowledge and phoneme segmentation scores did not reach the same level as the new readers' scores did. Two participants received letter knowledge, phoneme identification, and phoneme blending scores comparable to the new readers' scores but they did not increase their phoneme segmentation scores by at least two points. One participant received scores comparable to the new readers' scores on all phoneme level tasks but did not receive a comparable score on the letter knowledge task. As previously mentioned, Participant 1J was the only student with comparable scores on all of the separate skills measured whose word recognition score did not increase on post-test **1**. If we consider participant 1J an outlier, then this data would indicate that letter knowledge mastery along with increases in phoneme segmentation were crucial in increasing word recognition scores.

The data does indicate whether increasing syllable identification score played a major role in increasing word recognition scores. Only two students received a score of one on the syllable identification task. One of these two students was the only student

who read all twenty words presented in the word recognition task automatically and with great ease. This student also answered all phoneme level questions correctly obtaining an overall phonemic awareness score of 100%. This data suggests that syllable identification skill might not be crucial for word recognition. One of the non-readers also received a score of one on the syllable identification task. This student also received low phoneme identification and low phoneme segmentation scores. Therefore, the student's inability to identify words is most likely attributed to low phonological awareness levels overall, low syllable identification skill may not play a major role.

7.2.4 New Reader Data Compared with Non-Reader Data: Phoneme Identification

Thirteen of the 16 students with complete pre-test/post-test **1** data sets scored a three or four on post-test **1**. Six of these students belong to the group children whose word recognition scores increased. The other seven students' word recognition scores remained unchanged. One of these seven students with unchanged word recognition scores was able to decode all twenty words at both testing times and thus this student's word recognition score did not change. All six remaining participants with high phoneme identification scores also received high phoneme blending scores. However, one of these six participants received a low letter knowledge score, two received low phoneme segmentation scores, and two received both low letter knowledge and low phoneme segmentation scores. The one student remaining, participant 1J, had letter knowledge and phonological awareness scores that matched the scores of the new readers. As previously mentioned, we are calling this student an outlier. This student's data will be discussed in

section 7.2.7. This data suggests that letter knowledge and phoneme segmentation scores were critical to increasing word recognition scores post intervention.

7.2.5 New Reader Data Compared with Non-Reader Data: Phoneme Blending

Fourteen of the 16 students with complete pre-test/post-test **1** data sets scored a three or four on the post-test **1** phoneme blending section. Five of these students belong to the group of children whose word recognition scores increased. The other nine students' word recognition scores remained unchanged. One of these nine students with unchanged word recognition scores was able to decode all twenty words at both testing times and thus there was no room for the student's score to increase. Of the eight remaining participants with high phoneme blending scores: one received a low letter knowledge score, two received low phoneme segmentation scores, two received both low letter knowledge and phoneme segmentation scores, one received low phoneme identification and phoneme segmentation scores, and one received low letter knowledge, phoneme identification, and phoneme segmentation scores. The last remaining student, participant 1J, had letter knowledge and phonological awareness scores that matched the scores of the participants whose scores increased. Participant 1J will be discussed in section 7.2.7. If we set student 1J aside for now, then the data suggests that letter knowledge and increases in phoneme segmentation scores were critical for increasing word recognition scores post intervention. Phoneme identification skill may have also been related to word recognition score increases.

7.2.6 New Reader Data Compared with Non-Reader Data: Phoneme Segmentation

Eight of the 16 students with complete pre-test/post-test 1 data sets increased their phoneme segmentation scores by at least two. Five of these students belong to the group of children whose word recognition scores increased. The other three students' word recognition scores remained unchanged. One of these three students with unchanged word recognition scores was able to decode all twenty words at both testing times and thus there was no opportunity for the student's score to increase. One student received high scores on all of the phonological awareness tasks. However, this student obtained a low score of two on the letter knowledge assessment. This finding suggests that letter knowledge mastery was critical to post intervention word recognition growth. The one remaining participant, 1J, received letter knowledge and phonological awareness scores matching the scores of the new readers.

7.2.7 Literacy Exposure and Overall Phonemic Awareness

Table 7.22 below compares the non-readers' letter knowledge and phonological awareness scores to the new readers' scores. Cells highlighted in teal indicate that the participant received a score comparable to the new readers' score for the particular skill listed on the top row of the column. Cells highlighted in red indicate that the participant's score was low for the particular skill listed when compared to the new readers' scores. Almost all non-readers' received a low score in at least one of the variables measured.

Participant 1J is the only non-reader who received scores comparable to the new readers' scores for all variables measured.

Table 7.22

Non-Readers' Data Compared With New Readers' Data

Participant	iLel2 Levels completed	WR	LK	Syll ID	Syll Blend	Syll Seg	Ph ID	Ph Blend	Ph Seg
TB	10	0 ⁼	2 ⁻³	2 ⁻¹	3 ⁼	6 ⁻¹	2 ⁼	3 ⁺³	1 ⁺¹
1D	16	0 ⁼	4 ⁻¹	2 ⁼	3 ⁼	7 ⁼	3 ⁺¹	4 ⁺¹	0 ⁼
1E	7	0 ⁼	6 ⁼	2 ⁻¹	3 ⁼	7 ⁼	2 ⁻¹	2 ⁺¹	0 ⁼
1I	22	0 ⁼	4 ⁼	2 ⁻¹	3 ⁼	3 ⁻²	3 ⁺³	3 ⁺³	1 ⁺¹
1J	13	0 ⁼	6 ⁼	2 ⁼	3 ⁼	7 ⁺¹	4 ⁺¹	3 ⁼	2 ⁺²
2A	24	1 ⁼	6 ⁼	3 ⁼	3 ⁼	7 ⁼	4 ⁺²	4 ⁺¹	1 ⁺¹
2D	23	0 ⁼	5 ⁺²	3 ⁼	1 ⁼	7 ⁼	4 ⁼	3 ⁼	0 ⁼
2E	17	0 ⁼	2 ⁻¹	2 ⁺¹	3 ⁼	6 ⁼	3 ⁺¹	4 ⁺⁴	3 ⁺³
3C	11	0 ⁼	6 ⁼	1 ⁼	3 ⁼	7 ⁺¹	2 ⁼	3 ⁺²	1 ⁺¹

Participant 1J has been considered an outlier because 1J is the only non-reader whose letter knowledge and phonological awareness scores matched those of the students whose word recognition scores increased on post-test 1. There is no straightforward answer to explain this finding. However, I offer two factors which may have played a role in this inconsistency: literacy exposure and overall phonemic awareness scores. The effects of the Intervention App training on word recognition growth were mostly displayed by Grade 2 and older students. Recall that Grade 2, Grade 3, and Grade 4 students were grouped together in one classroom. Children in the Grade 2 – Grade 4 class had more one-on-one experiences with storybooks than the students in the Transition and Grade 1 class. The majority of children in the Grades 2 – 4 class were not reading

independently. However, they did engage in literacy practices where the Indigenous teacher aid would read a story aloud while each child followed along with their own book in front of them. The younger students also engaged in literacy practices where the teacher read storybooks aloud but the children did not follow along with their own books. It is well documented that exposure to literacy events such as storybook reading helps children make the connection between spoken and written language (Konza, 2010; Lynch, Anderson, Anderson, & Shapiro, 2008). Also recall that the majority of the participants in this study were not exposed to literacy events in the home. As such, participant 1J may not have received enough literacy instruction to make the connection between her emerging pre-literacy skills and reading.

One Transition student (participant TC) displayed increases in word recognition skill post intervention. This student had only undergone one year of literacy instruction. However, further investigation showed that participant TC displayed significant growth in phonemic awareness post intervention. Participant TC's overall phonemic awareness score increased from 25% at pre-test to 90.48% at post-test 1. As such, participant TC may have needed minimal literacy instruction in order to understand and apply the alphabetic code due to the student's letter knowledge and phonemic awareness mastery. Participant 1J's overall phonemic awareness score did not increase nearly as much as participant TC's score did. Participant 1J's overall phonemic awareness score increased from 50% at pre-test to 69.44% at post-test 1. Therefore, participant 1J's overall phonemic awareness ability may not have been high enough on post-test 1 to overcome the effects of limited literacy exposure. However, participant 1J's post-test 1 letter knowledge and phonological awareness scores were predictive of later post-test 2 word

recognition scores. Participant 1J's word recognition score increased from a zero to an eight on post-test 2.

7.2.8 iLel2 Effects and Later Post-test 2 Scores

The post-test 1 letter knowledge and phonological awareness scores of the new readers was discussed in section 7.2.1. These scores were associated with word recognition score increases. As previously mentioned, participant 1J was the only non-reader with post-test 1 letter knowledge and phonological awareness scores comparable to the new readers' letter knowledge and phonological awareness scores. This student's word recognition score did increase by eight points on post-test 2. This finding provides some evidence to support the hypothesis that post-test 1 letter knowledge and phonological awareness scores would be predictive of later reading scores for the younger children. However, this hypothesis could not be investigated further because no other participant, from the group of students whose word recognition scores did not increase on post-test 1, obtained post-test 1 letter knowledge and phonological awareness scores comparable to the new readers' scores.

However, three of the participants whose word recognition scores did not increase on post-test 1 did increase their word recognition scores on post-test 2. Student 2A's word recognition score increased by 12 points, student 2C's score increased by five points, and student 3C's score increased by four points. Student 2A's word recognition score increase was accompanied by an increase in phoneme segmentation score. This student already had perfect scores on all other letter knowledge and phonological

awareness measures. Student 2C's word recognition score was accompanied by a significant increase in phoneme segmentation score (from zero to four) as well as small increases in letter knowledge, syllable blending and phoneme blending scores. The data for these two students suggest that letter knowledge and phonological awareness skills are related with word recognition skill increases. However, participant 3C's word recognition score increase was not accompanied by increases in any other skill measured. Note that participant 3C had low syllable identification, phoneme identification, and phoneme segmentation post-test scores. Therefore, this participant had the opportunity to increase her phonological awareness scores. In other words, this student's unchanged phonological awareness scores were not attributable to the student already having perfect scores on all the phonological awareness tasks.

7.3 CHAPTER DISCUSSION

The evidence described in this chapter suggests, first, that the Intervention App is effective in helping children develop phonemic awareness skills and second, that increasing phonemic awareness skills contributes to the development of word reading for Dhuwaya-speaking children. Increases in word recognition scores came alongside increases in phonemic awareness skills for most new readers. The data suggests that increases in phoneme segmentation were closely related to increases in word recognition. Additionally, letter knowledge mastery was essential for the students to be able to apply their phonological awareness skills to cracking the alphabetic code.

Only six of the 15⁶⁵ students increased their word recognition scores on post-test

1. One student's word recognition scores remained unchanged because the student had already received a perfect word recognition score on the pre-test. Ten students' word recognition scores of zero remained unchanged. I believe that the data was restricted by limited time and student attendance. Only two participants completed all 24 iLe2 (Intervention App) levels within the given time frame. The average number of levels completed by the 16 students with complete data sets was 16. Furthermore, two of the students with complete data sets did not complete any of the phoneme focused levels. I suspect that the Intervention App training effects on letter knowledge, phonological awareness, and word recognition would have been greater had all participants completed all 24 levels of the app. Further research is warranted to clarify these findings.

⁶⁵ Recall that one of the 16 students with complete pre-test/post-test 1 data sets scored a perfect 20 on the pre-test word recognition task. Therefore, this student did not have the opportunity of increasing her score.

CHAPTER EIGHT

8.0 DISCUSSION

The purpose of this study was to investigate the emergent literacy skills of Australian Indigenous students living in a very remote community. Students at Yirrkala School are initially introduced to literacy in their home language, Dhuwaya. The current study sought to fill a gap in the knowledge base by applying existing early literacy research to the creation and investigation of Dhuwaya emergent literacy assessments and interventions. Specifically, the relationship between various phonological awareness tasks, letter knowledge, and word recognition was investigated. It was expected that the study would shed light on the interplay between the code-related skills and word recognition, providing valuable information that could help educators better help remote Australian Indigenous children grasp and utilize the alphabetic code.

The first major aim of the project was to investigate the various patterns and relationships found amongst the Dhuwaya-speaking children's performance on measures of letter knowledge, phonological awareness, and word recognition. As previously mentioned, a dearth of information exists regarding the emergent literacy skills of Indigenous children living in very remote areas. Reading skills, benchmarks, and needs may be different for these populations of students as they generally tend to come from communities whose culture is primarily transmitted through oral tradition. Many of these children do not encounter literacy events until they enter formal school settings and they may not receive much literacy exposure at home, or in their communities. Therefore, their abilities may be vastly different as they begin to develop literacy skills at an older

age, and with less exposure than children in more urban settings. Furthermore, existing research suggests that letter knowledge, phonological awareness, and word recognition skills are to an extent language specific (Aidinis & Nunes, 2001; McBride-Chang, 2004; Stuart-Smith & Martin, 1999). In order to attempt to improve the reading skills of speakers of a particular language, then one must investigate the unique emergent literacy skills of speakers of that particular language. This first aim was guided by two research questions, building on the literature discussed in Chapter Three:

- 1) How do Dhuwaya-speaking children perform on measures of letter knowledge, phonological awareness, and word recognition?
- 2) What is the relationship between phonological awareness, letter knowledge, and word recognition skills in Dhuwaya-speaking Yolŋu children?

The intention of the first question was to determine which tasks were easier for the children and which tasks were more difficult with respect to task type and task item characteristics. The relationship between student age and performance on the tasks was also investigated. It was hypothesized that the participants' age of letter knowledge and phonological awareness mastery would be slightly delayed when compared to the benchmarks proposed in existing literature. It was also hypothesized that phonological awareness would develop along a developmental continuum based on linguistic complexity, task type, and target word linguistic features. In other words, there would be a tendency for participants to display more ease completing certain tasks than others, for

example, children would display more ease completing syllable level tasks than completing phoneme level tasks and they would display more ease completing tasks targeting continuant sounds, word-initial sounds, and shorter words.

For the second question, relationships between all the various tasks were investigated. Firstly, it was hypothesized that letter knowledge would be positively related to word recognition. Children with high letter knowledge scores were expected to perform better on a word recognition task than their peers with low letter knowledge skills. It was also hypothesized that phonological awareness would be positively related to word recognition. Children with high levels of phonological awareness, especially at the phoneme level, were expected to outperform their low-skilled peers on the word recognition measure. Finally, it was hypothesized that letter knowledge skill would be positively correlated with phonological awareness at the phoneme level.

The second major aim of the project was to investigate whether a researcher created phonological awareness training program was successful in helping the participants acquire phonological awareness and letter knowledge skills in their home language and whether increases in phonological awareness scores, if any, were accompanied by increases in word recognition scores. Thus, the second major aim examined whether an interactive computerized phonological awareness training program could help Dhuwaya speakers develop the skills needed to grasp and utilize the alphabetic code. This aim was also guided by two research questions:

3) Does a researcher designed phonological awareness training program help increase phonological awareness and letter knowledge for Indigenous children in their home language: Dhuwaya?

4) Do improvements in phonological awareness and letter knowledge (gained through the researcher designed phonological awareness training program) in turn facilitate early word reading?

Question 3 hypothesized that phonological awareness and letter knowledge scores would increase for students who completed the training program. In order to address the fourth research question, students' pre-test and post-test **1** word recognition scores were compared. If increases in word recognition scores were related to increases in phonological awareness or letter knowledge scores, then the results would suggest that increasing that particular skill has a facilitating effect on early word reading. It was hypothesized that post-test **1** word recognition scores would increase for participants who increased their phonemic awareness scores. However, it was hypothesized that this result would only be seen amongst the older students. It was believed that word recognition scores would increase for Grade 2, Grade 3, and Grade 4 students who completed the training program but that this result would not be seen for Transition and Grade 1 students who had not received as much reading instruction at this point. Nonetheless, it was hypothesized that phonological awareness increases (gained from the intervention) would be predictive of later reading skills for these younger students.

8.1 LIMITATIONS

Several limitations of the current study call for discussion. One main limitation of the study was the small sample size which may have lowered the statistical power of the study. Yirrkala Community School is the only school currently running a Dhuwaya-English bilingual program, and on top of that, student enrolment numbers are low. As a result, the aggregate sample size was already limited from the beginning of the study with only 29 Transition to Grade 4 students in total (all student grade levels combined). The sample size was reduced even further due to the participants' migrant patterns and very low attendance rates, as discussed in section 2.4.

Only participants who completed both the pre-test and the post-test 1 assessment battery could be included in the data analysis for the third and fourth research question. Post-test 1 was conducted during the last two weeks of the school term. Thirteen of the initial 29 students were absent during these last two weeks of the term. One of the Indigenous community members, who had been working with me as a research assistant throughout the project, and myself drove around the community in hopes of locating the participants who were not coming to school during the post-test 1 phase. Unfortunately, we were unable to track down the children as many of them had travelled to one of the surrounding homelands with their families. Therefore, post-test 1 was only completed by 16 of the original participants. As a result, the project's sample size suffered an attrition rate of almost half, reducing from the initial 29 participants to a final total of 16 participants.

The students' irregular attendance rates also limited the quality of the data collected for the current research project. As discussed in section 2.4, the overall attendance rate at Yirrkala Community School was only 42% for the term in which the study was conducted. Consequentially, participants experienced limited time in the classroom, which in turn meant that they had limited time working with the Intervention App. The training program was only completed in its entirety by two of the 16 students. Two students completed less than nine Intervention App levels, and therefore did not complete any of the training app's phoneme focused levels (recall that the first eight levels focus on syllables). Another two students completed less than a quarter of the phoneme focused levels. Three participants completed half or less of the phoneme focused levels. Another two participants completed just over half of the phoneme focused levels. Only seven students completed 75% or more of the phoneme focused levels, and as previously mentioned, only two of these seven students completed all 24 Intervention App levels. This outcome was a significant limitation to the study considering that one of the major aims of the current study was to examine whether the Intervention App was effective in helping the participants develop letter knowledge, phonological awareness, and early word recognition in Dhuwaya. Assessment of the Intervention App's effectiveness was dependent on the participants' completion or near completion of all 24 iLe12 levels. Thus, it was impossible to fully determine the effectiveness of the app due to the participants' low iLe12 completion rate.

The inability to include a control group was another major limitation of the current study. As previously mentioned in section 4.4, the potential participant pool size for each student grade level cohort made it logistically impossible to allocate students

into separate experimental and control groups. The sample size was already small at the beginning of the experimental phase with only three to eleven students in each student cohort. Randomly assigning these students into an experimental and control group per each student cohort would have meant that only one to five students would have been in each group. These group sizes would not have been large enough to overcome the effects of outlier data. Moreover, classroom teachers warned me that student attendance rates were very low and we could not anticipate which students would be present throughout the school term and which students would not. Therefore, splitting the children up into experimental and control groups would run the risk of potentially having zero students left in any particular group. As a result, all students were included in the experimental group.

The single group pre-test/post-test quasi-experimental design used in this project limited the internal validity of the results making it impossible to ascertain whether any increases in student performance could be attributed to the Intervention App training. Alternate explanations for changes in score could not be ruled out. Increases in score could theoretically be attributed to classroom experience or student maturation as educational outcomes tend to increase over time based on these two factors (Marsden & Torgesen, 2012). However, the students were not receiving phonemic awareness training in the classroom. Additionally, for some children post-test 1 was only conducted between five and six weeks after the pre-test. Six weeks is not a long time in terms of maturation and the more reduced the time between the pre-test and the post-test, the less potential for maturation effects (Marsden & Torgesen, 2012). Moreover, the double baseline analysis

explained in section 7.1 was used where applicable to ameliorate the quasi-experimental condition.

Small potential participant pools and low attendance rates are inherent to any study conducted in a small remote Australian Indigenous school and thus true experiments are often not feasible due to realistic constraints. However, I don't believe this should discourage researchers from working with these very understudied populations. Indigenous children living in remote communities are some of the most poorly performing students in the country and they tend to achieve very low rates of literacy. Therefore, this particular population of children is one of the student groups in most need of early reading screenings and interventions. In fact, researchers stress the importance of better understanding the specific phonological awareness skills of children at risk for future reading difficulties (Edwards & Taub, 2016) and as we saw in Chapter Two, many contextual factors place the participants from the current study at risk.

In scenarios such as the current project, quasi-experimental studies need to be conducted in order to provide descriptive information about the population they focus on and these quasi-experiments can lay down groundwork for future research. Hypothesis may still be explored and trends still be observed. Quasi-experimental studies are valuable in that they allow the researcher to explore whether anticipated changes are occurring, whether anticipated changes are only occurring with certain subgroups of participants, whether only some of the anticipated changes are occurring, and to what extent the anticipated changes are occurring (Moore, 2008). This information is valuable because it allows the researcher to discern whether further investigation is merited. In the case of emergent reading interventions for example, researchers and educators can

discern whether to keep working with a particular intervention style or not. If the children's phonological awareness and reading increases, then we can continue developing and working with that particular intervention. If no improvements are found, then energy can be redirected towards improving the particular intervention under study or into creating a completely new intervention.

8.2 DISCUSSION OF SIGNIFICANT FINDINGS

This section includes a discussion of the project's significant findings. A separate section is included for each research question. Each subsection discusses whether the hypotheses were supported and how the current findings fit into previous research. The implications of the current findings are also discussed.

8.2.1 Patterns Found Amongst the Participants' Performance on Measures of Letter Knowledge, Phonological Awareness, and Word Recognition

Various patterns were discovered in the participants' assessment battery data. These findings can be used to help instructors and researchers design more effective phonological awareness assessments and training programs for remote Indigenous students in home language programs. Easy tasks can be used to assess younger students with little literacy training while more difficult tasks can be used to assess students with more literacy experience. Additionally, all training programs should progress from easy to increasingly more difficult tasks and meticulous knowledge of the relative difficulty of

the different tasks is critical to the creation of well sequenced interventions. Knowledge of phonological awareness benchmarks is also critical for the proper identification of children who may be at risk for future reading difficulties.

The data partially supported the hypothesis that the participants' age of letter knowledge, phonological awareness, and word recognition mastery would be slightly delayed when compared to the benchmarks proposed in existing literature. The participants developed syllable awareness at a comparable age but letter knowledge, phonemic awareness, and word recognition benchmarks were delayed.

The data from the current project suggests that Dhuwaya-speaking children living in remote areas begin to master letter knowledge in Grade 2, and that most have mastered this skill by the end of Grade 3. The existing research suggests that many children (specifically children coming from literate homes and living in urban communities) have learned some, if not all, of the letter-sound correspondences in their language by the end of kindergarten and that all typically developing children are expected to have done so by the end of first grade (Dickinson & Neuman, 2006; NELP, 2008; Shaywitz, 2003). The findings of this study suggest that the benchmarks may be delayed for Indigenous children living in very remote communities.

Overall, the participants displayed moderate to high syllable awareness levels. Syllable blending and segmentation tasks were fairly easy for even the youngest students with all student cohorts reaching mastery or near mastery level for these two tasks. Gillon (2004) claims that syllable blending tasks can be conducted with children as young as four years old. Shaywitz (2003) also claims that the majority of children are able count, and thus segment, the syllables in a word by the end of their kindergarten year. The

current data was taken to indicate that Dhuwaya-speaking children begin developing syllable awareness at a comparatively early age. Syllable identification tasks however, proved to be difficult for even the oldest students. Note, it is unknown whether syllable identification was developed at a comparable rate because it is not commonly included in phonological awareness developmental charts. However, this latter result was taken to indicate that syllable identification displays a higher level of syllable awareness.

Phonemic awareness scores were very low across the board. Overall phonemic awareness levels did not reach a level of mastery for any student cohort. Furthermore, the expected age of attainment was delayed for all three individual phoneme level tasks. The students began spontaneously (before intervention) reaching phoneme identification mastery in Grade 4. However, phoneme blending and phoneme segmentation ability had not been spontaneously (before intervention) mastered by any of the participants by Grade 4. Post intervention benchmarks were less behind but still considerably delayed when compared to existing research. This finding stands in stark contrast to existing research which asserts that the majority of children⁶⁶ begin to acquire phonemic awareness skill by the end of kindergarten and that most have mastered this skill by the end of first grade (Chafouleas et al., 1997; Fellowes & Oakley, 2014; Gillon, 2004; Griffith et al., 2008; Shaywitz, 2003). The findings here indicate that the benchmark may be considerably delayed for Indigenous children living in very remote communities.

Word recognition scores were generally very low across all student grade levels. Many of the older students could not decode very simple words indicating that the majority of the participants had not yet acquired, mastered, and learned how to utilize the

⁶⁶ Again, these findings are based on research conducted on children coming from literate backgrounds living in urban settings.

alphabetic principle by the fourth (pre-test and post-test 1) or fifth grade (post-test 2). This result is of concern considering that existing research places the benchmark for understanding the alphabetic principle at five and a half to six years old (end of kindergarten) for typically developing children. Children can then apply the alphabetic code in order to sound out simple words. Researchers assert that most students have the ability to accurately decode easy one syllable words by the end of the first grade (six to seven years old). Children generally continue developing these early practices and by the end of second grade (eight to nine years old), most typically developing students are routinely linking letters to sounds to decode unknown words, accurately reading multisyllabic words, and beginning to read with fluency (Shaywitz, 2003). According to reading expert, Shaywitz (2003),

“you should be concerned if your second grader is not yet sounding out words, is taking wild stabs at words, is not able to read new or unfamiliar grade-level words, has not yet penetrated the inside of a word when he is reading, cannot decode most single or some easy multisyllabic words, is not building a vocabulary of words that he can read fluently, or doesn’t seem to enjoy reading” (pg. 113).

Delayed reading benchmarks can be expected for this particular group of students as the majority of these children have limited exposure to home and preschool literacy practices. However, the current data suggests that a very large gap exists between the early word reading skills of the current participants and the benchmarks set in the existing

reading research. The current data is also in stark contrast with the Australian curriculum which states that children should be sounding out or recognizing words by the first grade (ACARA, 2018).

It makes sense that the majority of the participants had not yet cracked the alphabetic code by the fifth grade considering that the majority had not mastered phonemic awareness by this age either. Moreover, the majority of students did not display letter knowledge mastery until the second or third grade. Phonemic awareness and letter knowledge are considered to be two of the most crucial skills involved in utilizing the alphabetic code (NELP, 2008). Low phonemic awareness and letter knowledge skills could be drastically contributing to the participants' low reading scores. This claim is supported by the fact that significant relationships were found between word recognition, letter knowledge, and phonemic awareness scores. These relationships are discussed in the next section.

It is not surprising that the participants from the current study displayed delayed letter knowledge, phonemic awareness, and word recognition abilities when compared to the existing data that is heavily based on culturally literate populations. Literacy skills do not develop without explicit instruction (Liberman & Liberman, 1990). Chapter Two included a discussion about the considerable role that home literacy environments and parental involvement play in children's early literacy acquisition. It was also noted that the majority of the participants in the current study experience a paucity of literacy exposure in the home. As such, they enter the formal schooling system with minimal alphabetic knowledge and few, if any, literacy experiences. On top of this, the participants' attendance rates are low which limits their encounters with literacy practices

even further (refer back to sections 2.3 and 2.4 for discussions on the participants' home literacy environments and attendance rates, respectively). The delay in Dhuwaya-speaking children's emergent literacy development that exists alongside this dearth of literacy exposure is to be expected.

Contrastively, the Dhuwaya speakers displayed syllable awareness benchmarks comparable to those suggested in the research. There are two suspected explanations for this finding. First, research suggests that syllable awareness tends to develop naturally with minimal guidance (Mann, 1986) because children do not need "to ignore the natural unity of the articulatory act" to attend to syllables as they do with phonemes (Lundberg et al., 1988, p.282). Secondly, the children practiced clapping out syllables in class with their classroom teachers. Thus, the participants already had some experience attending to syllables. Phoneme focused tasks, on the other hand, were novel to the participants. As such, it makes sense that the participants displayed age appropriate performance, when compared to existing standards, on syllable blending and syllable segmentation tasks because only the slightest of training is required for syllable awareness mastery. On the other hand, letter knowledge, phonemic awareness, and word recognition skills seem to require a much higher level of explicit instruction.

The current findings have theoretical implications for emergent reading research: the data provides further evidence that syllable awareness is naturally acquired by children at a young age (McBride-Chang, 2004), and suggests that this developmental marker is not language or culture specific. The data also provides evidence that phonemic awareness acquisition requires a certain level of explicit instruction, and suggests that the benchmarks are culture specific to some extent. Researchers have noted that some

children naturally acquire phonemic awareness skills by simply being in stimulating classrooms and home environments where rhymes, alliterations, and literacy events are enjoyed (International Reading Association, 1998), while many other children require explicit training in order to obtain phonemic awareness (McBride-Chang, 2004; Snow et al., 1998). Adams et al. (1998) found that roughly 25% of middle-class children needed explicit training in order to obtain proficient phonemic awareness, while the percentage for low socioeconomic status and minority children was even higher. The current findings suggest that nearly all Dhuwaya-speaking children need explicit phonemic awareness training. These findings may indicate that the percentage of students needing explicit instruction is very high for Indigenous children living in remote communities who come from cultures primarily transmitted through oral tradition. The current findings also highlight the considerable impact of home literacy environment on children's emergent literacy skills in that the participants' age of attainment for letter knowledge, phonemic awareness, and word recognition were significantly delayed when compared to existing research which is heavily based on children coming from literate cultures.

The current findings also have practical implications for the classroom teaching of emergent literacy skills to Indigenous children living in remote communities. Often, low phonemic awareness skills are used to identify children at risk for future reading disabilities (Shaywitz, 2003). However, we have seen that the benchmarks are delayed for the current participants. These delays do not indicate reading disorders for this particular group of children in most cases; rather, they highlight the effects of limited literacy exposure for this group of children. Assessments should be tailored to the specific skill levels of the children as determined by their cultural background.

The fact that low phonemic awareness and word recognition skills are expected for this population of children does not undermine the importance of closing the literacy gap between Indigenous and non-Indigenous children. Rather, it highlights the importance of creating effective early literacy programs for these children. As previously mentioned, the participants' reading acquisition may be critically affected by their delayed letter knowledge and phonemic awareness and so explicit and well-structured letter knowledge and phonemic awareness interventions may be the first step in closing the literacy gap.

The data supported the hypothesis that phonological awareness would develop along a developmental continuum based on linguistic complexity, task type, and target word linguistic features. The participants acquired syllable awareness skills at a much earlier age than phonemic awareness skills. Task type also played a role in task difficulty. However, task type difficulty was mediated by linguistic complexity. Syllable blending was slightly easier than syllable segmentation. Syllable segmentation, in turn, was easier than syllable identification. At the phoneme level, the identification task was the easiest task, followed closely by the phoneme blending task. Students experienced the most difficulty with the phoneme segmentation task. Existing studies have found similar developmental trends at the phoneme level; that phoneme identification⁶⁷ is easier than phoneme blending which is easier than phoneme segmentation (Chafouleas et al., 1997, Wagner, Torgesen, & Rashotte, 1994). The current data also supports previous research

⁶⁷ Phoneme identification tasks require children to recognize the same sound in different words. Chafouleas et al., 1997 used a sound categorization task which asks children to choose the word in a group that does not begin with the same sound that the rest of the words do. Sound categorization tasks are thus phoneme identification tasks since children need to recognize the same sound in most words in order to choose the odd one out.

findings which suggest that phoneme segmentation is the most difficult of these three phonemic awareness tasks⁶⁸ (Murray, 1998; Vloedgraven & Verhoeven, 2009).

Various patterns were found in regards to how the linguistic features of task items affect task difficulty. The different tasks were unique in how they were affected by the linguistic features of task items supporting Chafouleas et al.'s (2001) claim that the effects of linguistic manipulations on task difficulty are idiosyncratic in that they vary depending on the task type. For example, word length affected phoneme segmentation but not syllable segmentation. Phoneme manner also affected the tasks in different ways. The approximant versus non-approximant feature affected syllable segmentation while the continuant vs. non-continuant feature affected phoneme segmentation. The continuant vs. non-continuant feature also affected performance on syllable and phoneme identification task items albeit with an opposite effect. Students performed better on syllable identification tasks targeting continuant initial syllables but curiously scored higher on phoneme identification tasks targeting stop sounds. The latter finding was not expected as the majority of researchers find that children are better able to attend to continuant sounds (McBride-Chang, 1995; McKenna et al., 2010). One possible explanation is that children were simply attracted to the stop-initial target word and thus were better able to make the connection. The stop-initial target word was the Dhuwaya word for rainbow and the vast majority of students were immediately drawn to the rainbow image. Many children smiled as they pointed to and named the rainbow image as soon as it appeared on the iPad screen which may have helped draw attention to the target word's sound structure. The children did not display similar reactions to any of the images depicting continuant-initial/final target words. Thus, the continuant-initial target

⁶⁸ Phoneme identification, phoneme blending, and phoneme segmentation.

word did not receive the same advantage as did the stop-initial target word. Further research is needed to investigate this finding.

Syllable and phoneme position also affected identification tasks. Children performed much better on identification task items targeting word initial syllables or phonemes than on task items targeting word final syllables or phonemes. This finding supports the claim that initial sounds are easier to attend to than final sounds (Gillon, 2004; Perez, 2008) and disputes the claim that the reverse, that final sounds are easier to attend to than initial sounds, is true (McBride-Chang, 1995). However, position did not play a role in segmentation or blending activities which characteristically include all parts of the target word.

The major implication here is that it is important to take the interplay between linguistic complexity, task type, and target word characteristics into consideration when creating phonological awareness assessments and training programs. Easier tasks can be used to assess and train children with less developed phonological awareness while more difficult tasks can be used to assess and train children with more developed levels of phonological awareness. The data from the current project suggests that task difficulty is affected by manipulating task items along any of the three levels of difficulties: linguistic complexity, task type, or target word characteristics. Furthermore, the same manipulation does not affect all tasks in the same way. For example, the relative difficulty of task type changes along different levels of linguistic complexity. The identification task was the most difficult task at the syllable level while the segmentation task was the most difficult at the phoneme level. We have also discussed the idiosyncrasies of target word characteristic manipulations. As such, educators must be cautious and meticulous when

choosing phonological awareness tasks to ensure that intervention programs increase in difficulty in a precise manner.

Phoneme manner also affected the participants' performance on letter knowledge questions. The data suggests that Dhuwaya-speaking children exhibit the most ease recognizing trill sounds, followed by vowel sounds, followed by nasal sounds and that they display the most difficulty recognizing approximant and stop consonant sounds. This data supports the finding that children find plosives and lateral approximants challenging to master (Kartal & Terziyan, 2016). Therefore, trill, vowel, and nasal sounds can be introduced before approximant and stop sounds in order to create letter knowledge assessments and training programs that sequentially increase in difficulty. Additionally, using words consisting of trills, nasals, and vowels as target words in phonological awareness tasks before using words consisting of approximants and stops may help create phonological awareness assessments and training programs that sequentially increase in difficulty.

8.2.2 Relationships Found Amongst the Participants' Performance on Measures of Letter Knowledge, Phonological Awareness, and Word Recognition

To some extent, the data supported the hypothesis that children with high letter knowledge skills would perform better on a word recognition task than children with low letter knowledge skills. The data collected during the third testing time revealed a statistical correlation between letter knowledge and word recognition while the data collected during the first two testing times did not. However, further investigation

revealed that there was a relationship between word recognition ability and letter knowledge. Across all three testing times, only students with high letter knowledge scores were able to read words presented in the word recognition task. At each testing time, one student who received a five out of six on the letter knowledge task was able to recognize words presented in the word recognition task. All remaining students who were able to read words obtained perfect letter knowledge scores. Not one participant with low letter knowledge scores was able to decode any of the words presented in the assessment. This finding supports existing research stating that letter knowledge has a sizeable relationship with early reading (Adams, 1990; Dickinson & Neuman, 2006; NELP, 2008).

The data partially supported the hypothesis that children with high levels of phonological awareness, especially at the phoneme level, would outperform their low-skilled peers on reading measures. Performance on the syllable level tasks was not statistically correlated with performance on the word recognition task with one exception (the data collected during the third testing time revealed a moderate correlation between syllable identification scores and word recognition scores). Further investigation of the data collected during the first two testing times did not suggest a significant relationship between syllable identification and word recognition. Previous researchers have also found that sub-phonemic awareness measures do not account for a significant portion of the variance in post-training reading tests (Lundberg et al., 1988; Mann & Foy, 2003).

All three phoneme level tasks statistically correlated with word recognition albeit at different rates. Phoneme segmentation scores were moderately correlated with word recognition scores in the pre-test data, strongly correlated with word recognition scores in

the post-test 1 data, and very strongly correlated with word recognition scores in the post-test 2 data. Phoneme blending scores were moderately correlated with word recognition scores in the data collected during two of the three testing times while phoneme identification scores were moderately correlated with word recognition scores in the data collected during the third testing time. Taken together, these findings suggest that phonemic awareness is robustly related to early word reading ability in Dhuwaya supporting the large body of research highlighting the close relationship between phonemic awareness and early literacy skills (International Reading Association, 1998).

Another interesting finding is that phoneme segmentation is more closely related to word recognition than phoneme blending or phoneme identification tasks. The research is unclear in regards to which tasks are more closely related to early reading. Mixed conclusions have been generated from the small body of research focused on comparing the relative contributions of different phonological awareness tasks on early reading. Helfgott (1976) found that segmentation tasks are more closely related to reading than blending tasks while others have found that phoneme segmentation accounts for significantly less variance than phoneme blending (Kilpatrick, 2012; Perfetti et al., 1987; Swank & Catts, 1994). There is also research suggesting that phoneme identification training is more beneficial than segmentation and/or blending training (Byrne & Fielding-Barnsley, 1989; 1990; Høien, et al., 1995; Murray, 1998).

The hypothesis that letter knowledge would be correlated with phonemic awareness was also supported. At all three testing times, letter knowledge was significantly correlated with two of the three phoneme level tasks. These findings indicate that there is a significant relationship with letter knowledge, specifically letter-

sound knowledge, and phonemic awareness in Dhuwaya. This finding supports the widely-reported belief that letter knowledge is associated with, and may play an influential role in the development of phonemic awareness skills (Blaiklock, 2004; Bowey, 1994; Carroll, 2004; Foorman et al., 2003; Johnston et al., 1996; Lonigan, 2006; Stahl & Murray, 1994). However, the strength of this relationship may be task specific.

Phoneme identification scores were moderately to strongly correlated with letter knowledge scores across all three testing times. Phoneme blending scores were moderately correlated with letter knowledge scores in the data collected during the first two testing times while phoneme segmentation scores were moderately correlated with letter knowledge in the data collected during the third testing time. These findings indicate a particularly strong relationship between phoneme identification and letter-sound knowledge providing further evidence for the claim that phoneme identification ability is a requisite for acquiring letter-sound correspondences (Murray, 1998).

Interestingly, the three syllable level tasks did not all correlate with each other nor did the three phoneme level tasks all correlate with each other⁶⁹. This result was found across all three testing times and was unexpected. Gillon (2004) claims that phonological awareness tasks within the same level of linguistic complexity (syllable/phoneme) closely relate with each other. Researchers argue that although the differing tasks have different cognitive demands and thus different levels of difficulty, they still fall under one underlying construct of either syllable awareness or phonemic awareness (Stahl & Murray, 1994; Stanovich, Cunningham, & Cramer, 1984; Yopp, 1988). A possible explanation for this finding is that the participants had not yet developed syllable and

⁶⁹ Phoneme identification correlated with phoneme blending in the data collected during the first two testing times and phoneme blending correlated with phoneme segmentation in the data collected during the third testing time. However, the three separate tasks did not all correlate with each other in any of the data.

phonemic awareness mastery. Lonigan, Burgess, Anthony, and Baker (1998) found that “estimates of internal consistency and correlations between tasks indicated that phonological sensitivity becomes more cohesive as a construct as children mature and their level of performance on tasks designed to measure phonological sensitivity increased” (Burgess, 2006, p. 92).

The data did provide some support for the theory that syllable and phonemic awareness tap into the unitary construct of phonological awareness (Lonigan, 2006). There was some evidence that task type measures correlate with each other regardless of the level of linguistic complexity. That is, syllable identification scores were correlated with phoneme identification scores and syllable blending scores were correlated with phoneme blending scores. The finding that performance on a specific task at one level of linguistic complexity correlates with performance on the same task at a different level of linguistic complexity may suggest that children are calling on the same global ability to complete the task.

Theoretical implications have been discussed throughout this section thus far. For example, the current data supports the theory that phonemic awareness is closely related to word recognition while syllable awareness is not. The data strongly supports the theory that phonemic awareness is the crucial level of phonological awareness for emergent readers (Gillon, 2004; Juel, 1988). However, the data also provides some support for the theory that syllable awareness and phonemic awareness tap into a unitary construct (Lonigan, 2006). These findings have practical implications. Lonigan (2006) argues that syllable level tasks can be used to help younger children complete tasks targeting chunks of sound that they can penetrate. Data from the current study also indicates that it may be

practical to use syllable level tasks to introduce young children to the practice of manipulating the sounds in words being that the majority of the participants were able to complete syllable segmentation and blending tasks while they struggled with phoneme level tasks. Thus, syllable awareness tasks can be used to introduce phonological awareness training but the focus should progress to phonemic awareness training as soon as children show signs of readiness.

Phonemic awareness, the more highly developed level of phonological awareness, seems to be the skill that critically facilitates acquisition of the alphabetic principle for Dhuwaya speakers⁷⁰. In fact, the current data suggests that the more difficult a task, the more closely related to word recognition. For example, syllable identification was the most difficult task at the syllable level and also the only syllable level task found to correlate with word recognition scores (albeit only in the data collected at one of the three testing times). Phoneme segmentation was the most difficult task to complete and also the only task to correlate with word recognition scores across all three testing times. The phoneme identification task was slightly easier for the participants to complete than the phoneme blending task. In accordance, phoneme identification scores only correlated with recognition scores in the post-test 2 data while phoneme blending scores correlated with word recognition scores in the data collected at two testing times. This finding gives further evidence that the more fully developed a child's phonological awareness, the more beneficial for their acquisition of literacy. The practical implication here is that phonological awareness interventions should progress to more difficult tasks as soon as

⁷⁰ It is important to remember here that the current finding is only relevant to readers of alphabetic languages. Researchers have found that syllable awareness may be more beneficial for children learning how to read other orthographies such as Chinese (McBride-Chang, 2004).

students are ready. Syllable awareness tasks can be used as a scaffold for phonemic awareness tasks but phonemic awareness should be the focus of interventions.

Another practical implication for classroom teaching here is that phoneme segmentation deserves special attention in Dhuwaya phonemic awareness interventions. Moreover, phoneme blending should be given more attention than phoneme identification. However, we have seen that this finding does not fit with existing research. As previously mentioned, some researchers have found evidence that phoneme blending or phoneme identification have a larger transfer to reading. One explanation for this disparity is that transfer effects may be language-specific. This explanation is weakened by the fact that mixed results have been found across studies focusing on the same language. Recall that Kilpatrick (2012), Perfetti et al. (1987), and Swank and Catts (1994) all found word recognition to be more closely related to phoneme blending than it was to phoneme segmentation while Helfgott (1976) found the opposite result. All four studies were conducted in English. Another reason for the disparity in findings is that researchers carry out the tasks in different ways. For example, children may be asked to simply pronounce the sounds they hear in a word during a segmentation task or they may be asked to move a counter as they pronounce each sound. Whatever the reason, the clear message from the current data is that some tasks do seem to share a closer relationship with early reading than others.

Emergent reading education would benefit from further investigations into the relative transferability of the different phonological awareness tasks. Educators could allocate their time more efficiently if they knew which tasks had the most facilitative effect on early reading. For example, the current data suggests that word recognition is

more closely related to phoneme segmentation than it is to phoneme blending or phoneme identification in Dhuwaya. Therefore, intervention programs may want to place a stronger focus on phoneme segmentation activities.

The current study provides further support that letter knowledge is closely related to both phonemic awareness and word recognition. The implication for phonological awareness training is that letter knowledge tasks should be included in any code related intervention as the two skills (phonemic awareness and letter knowledge) both facilitate literacy development. Children may not be able to apply phonological awareness skills to early word decoding if they lack letter knowledge skills and vice versa. Moreover, it may be the case that letter knowledge growth bolsters phonemic awareness and vice versa. It is clear that letter knowledge is closely related to phonemic awareness but further research is needed to establish causality.

The implication for phonological awareness research is that scientists should always consider the effects of one code related skill on the other. The data suggests that phonemic awareness and letter knowledge are closely related with each other and with word reading in Dhuwaya. The intricate relationship between letter knowledge, phonemic awareness, and word recognition was discussed in section 3.5. It is possible that phonemic awareness and letter knowledge each individually impact early reading directly. It is also possible that letter knowledge and phonological awareness effects interact in such a way that the effect of each skill cannot be considered separately (Hulme, Snowling, et al., 2005). One code related skill may mediate the effects of the other skill on word reading. For example, the current data suggests that students cannot apply their phonemic awareness skills to the utilization of the alphabetic code if they

have not developed letter knowledge mastery. Intervention effects may be the result of increases in phonemic awareness, increases in letter knowledge, or increases in both. A better understanding of the relationship between the two code related skills may lead to the creation of more effective early literacy interventions that make use of the interaction between the two skills. Interventions can organize tasks and task items in a way that helps the two skills strengthen and build upon each other.

8.2.3 The Effects of iLel2 (Intervention App) Training on Measures of Letter Knowledge and Phonological Awareness

The purpose of the third research question was to investigate whether the Intervention App had any effects on the participants' letter knowledge and phonological awareness skills. The Intervention App would be considered a beneficial early literacy tool for Dhuwaya speakers if the participants' letter knowledge and phonological awareness scores improved after interacting with the app. Unchanged scores would imply that the app was not as effective as intended. In the latter case, the activities in the app could be modified and retested in order to create a product that better serves the students' literacy development.

The data partially supported the hypothesis that post-test phonological awareness and letter knowledge scores would increase for students who completed the training program. As discussed in Chapter Six, iLel2 training did not yield significant results for letter knowledge or syllable level skills. However, a training effect was noticeable with the phoneme level tasks. These results, as well as their implications, are discussed below.

Average letter knowledge scores did not increase which was unexpected as research suggests that computerized training is effective in increasing letter knowledge skill (Wolgemuth et al., 2013). There are a few possible explanations for this finding. Many of the students received high letter knowledge scores on the pre-test leaving little room for improvement⁷¹. Still, some of the participants had the opportunity to increase their letter knowledge scores. It is possible that the participants simply needed more practice with the app being that most participants did not complete all 24 levels of the program. More practice may have resulted in increases in score. It is also possible that the specific activities chosen for letter knowledge training were not effective. Further research is warranted to determine how to best train Dhuwaya letter knowledge with computerized software.

Average syllable blending and syllable segmentation scores did not increase. The ceiling effect on the syllable blending subsection rendered it impossible to monitor any changes for this task. Syllable segmentation scores were also close to reaching a ceiling effect which limited the extent to which scores could increase. This finding suggests that Dhuwaya-speaking children of this age do not benefit greatly from syllable segmentation and blending training as they have already reached a level of mastery for these skills.

In contrast, the data suggests that participants benefited considerably from the phonemic awareness training. Phoneme segmentation scores increased for all student cohorts while phoneme blending scores increased for all student cohorts except for the Grade 3 cohort. Recall that the Grade 3 average phoneme blending score was skewed by one participant who was not paying attention to the phoneme blending questions

⁷¹ Ten of the participants had a perfect letter knowledge score of six at the pre-test phase meaning that their score could not increase anymore. Four more students received a pre-test letter knowledge score of five meaning that they could only increase their letter knowledge score by one point (or 16.67%).

presented in post-test 1. The remaining Grade 3 participant increased her phoneme blending score. Therefore, if we exclude the Grade 3 outlier, then the data would indicate that the Intervention App was successful in training the phoneme level tasks included in the app (segmentation and blending).

Phoneme identification scores also increased for all student cohorts suggesting that the Intervention App was successful in increasing overall phonemic awareness and that this awareness could be transferred to different tasks. A look at the participants' average phonemic awareness scores⁷² also suggests that the intervention was successful in increasing overall phonemic awareness skills. Average phonemic awareness scores increased significantly for all student cohorts. The Transition cohort's average phonemic awareness score even tripled. On an individual level, average phonemic awareness scores increased for every participant that completed any number of phoneme focused iLe12 levels with one exception⁷³ (see Table 7.18).

These findings support the theory that computerized training is effective in training phonemic awareness skills (Foster et al., 1994; Hecht & Close, 2002; Kartal & Terziyan, 2016; Macaruso & Rodman, 2011; Mioduser, Tur-Kaspa, & Leitner, 2000; Mitchell & Fox, 2001; Wolgemuth et al., 2013). Still, only three of the participants displayed phonemic awareness mastery (average phonemic awareness scores of 90% or higher). It is likely that the iLe12 training effects on phonemic awareness would have been greater had all participants completed all 24 levels of the app, but as previously mentioned, only two participants completed all 24 iLe12 levels within the given time

⁷² Scores for each of the three phoneme level tasks converted into percentages and then averaged together to generate an overall phonemic awareness score.

⁷³ Participant 2D's overall phonemic awareness score remained unchanged even though the participant completed 15 phoneme focused iLe12 levels.

frame. Two of the 16 participants with full data sets did not progress passed level eight meaning that they did not complete any phoneme focused levels. Participants may have benefited more from the Intervention App had they been able to complete more phoneme focused levels. Nevertheless, the findings from this project do suggest that Dhuwaya phonemic awareness training can be successfully delivered via an iPad app. The findings give rationale for the continued development of interactive phonological awareness apps for remote Indigenous students.

The current findings can be used to inform any future developments of interactive Dhuwaya language phonological awareness training programs. For example, we have seen that the participants did not really benefit from the syllable awareness training because the majority of the students already possessed well developed syllable segmentation and blending skills at the start of the intervention. However, average phonemic awareness scores increased for 13 of the 14 students who completed any number of the phoneme focused iLe12 levels. We have also seen that performance on the phoneme level tasks was more closely related to performance on the word recognition task. A practical implication of these findings is that children should be able to advance to the phoneme focused levels at an earlier stage. The app could be improved by adding a feature that allows students to advance to the phoneme focused levels if they answer all questions correctly on a syllable focused level. Syllable level tasks may then be reserved for younger or less phonologically developed children.

Another informative finding revolves around task type. Participants made larger gains in phoneme blending than in phoneme segmentation. Average phoneme segmentation scores did increase for all student cohorts. However, average phoneme

blending scores increased at a higher rate for Transition to Grade 2 students. The Grade 4 students' phoneme segmentation score increased much more than their phoneme blending score but only because the average pre-test phoneme blending score for the Grade 4 cohort was moderately high (85%) while their average pre-test phoneme segmentation score was extremely low (0%, all Grade 4 students received a zero on the phoneme segmentation task). Therefore, the Grade 4 students' average phoneme blending score could only increase by 15% while their phoneme segmentation score could increase by 100%. Moreover, average post-test phoneme blending percentages were higher than average post-test phoneme segmentation scores for all student cohorts indicating that students' phoneme blending skills were more developed than their phoneme segmentation skills. This finding may simply be due to phoneme segmentation being a more advanced skill. Therefore, children require more time and practice to advance the skill. It is also possible that oral segmentation practice is more beneficial than the auditory practice delivered through the app. This would align with Foster et al.'s (1994) claim that segmentation tasks are complicated by computer capabilities. Further suggestions are discussed in section 8.4.

8.2.4 iLe12 Effects on Word Recognition

The fourth research question was designed to investigate whether any changes in letter knowledge and phonological awareness skills (obtained from interacting with the Intervention App) coincided with changes in word recognition ability. As previously mentioned, the intention behind iLe12 (the Intervention App) was to create an app that

facilitated the acquisition of letter knowledge and phonological awareness skills in Dhuwaya-speaking children. However, phonological awareness training is only a means to an end, and is only beneficial if the training transfers over into and facilitates the development of early word reading. Therefore, it could be surmised that iLe12 is a beneficial early literacy tool if improvements in the participants' letter knowledge and phonological awareness skills correlated with improvements in their word recognition skills.

It was hypothesized that the children who completed the training program, crucially the phoneme-focused levels, would outperform the children who did not complete the training program on post-test measures of word reading. This hypothesis was neither fully supported or refuted. Firstly, only two participants completed the entire training program. Secondly, increases in word recognition scores could not easily be attributed to increases in one particular skill. However, an examination of the skills obtained by the new readers⁷⁴ suggested that certain levels of letter knowledge and phonemic awareness were needed in order for children to begin grasping and utilizing the alphabetic code. Each new reader increased his or her scores at different rates in order to attain these necessary letter knowledge and phonemic awareness levels with one exception⁷⁵ (see Table 7.19). A comparison between the participants whose word recognition scores increased and the participants whose word recognition scores did not increase also helped shed light on the intervention's effect on word recognition.

⁷⁴ 'New readers' is the term used for participants who increased their word recognition score from zero on the pre-test to any number higher than zero on post-test 1.

⁷⁵ See section 6.2.1 for a discussion on the one new reader whose phonemic awareness scores did not improve alongside her word recognition score increases.

The evidence suggests that increasing phonemic awareness skills may have contributed to the development of early word reading for these Dhuwaya speakers. Increases in word recognition scores came alongside increases in phonemic awareness skills for five of the six new readers. This finding further supports the claim that phonemic awareness training has a facilitative effect on early word reading skills (NICHD, 2000). Moreover, this finding adds to the body of research indicating that computerized phonemic awareness training programs can help facilitate the development of word recognition skills (Olson, Wise, Ring, & Johnson; 1997).

The data suggests that out of the three phoneme level sub-skills, phonemic segmentation ability had the biggest impact on word recognition, again supporting the finding that segmentation tasks are more closely related to reading than blending tasks (Helfgott, 1976) and disputing the claim that phoneme segmentation accounts for significantly less variance than phoneme blending (Kilpatrick, 2012; Perfetti et al., 1987; Swank & Catts, 1994). Recall that the phoneme segmentation task was the most difficult task for all participants. This finding suggests that phoneme segmentation mastery is a sign of more advanced phonemic awareness ability and may explain why phoneme segmentation scores were more closely related to word recognition scores. Advanced phonemic awareness tasks require higher levels of awareness and it is these higher levels of awareness that facilitate early reading development.

The data also provides further support for the theory that children need to develop proficient letter knowledge in order for them to successfully apply the alphabetic code to early word reading (Fellowes & Oakley, 2014; Huang et al., 2014; Hulme, Snowling, et al. 2005). All new readers displayed letter knowledge mastery. Further evidence for this

claim was presented by one of the participants whose drastic increase in phonemic awareness was not accompanied with an increase in word recognition score. This student increased her phonemic awareness scores at a similar rate as the new readers. However, she obtained very low letter knowledge scores. It was surmised that the student's low letter knowledge score prevented her from successfully applying her newly acquired phonemic awareness skills to utilizing the alphabetic code.

It was hypothesized that the training-effects on word reading would only be seen amongst the Grade 2 through Grade 4 students. The data did not support this hypothesis. A Transition student made the second largest word recognition gains. The remaining five new readers did, however, belong to the older student cohorts including one Grade 2 student, one Grade 3 student, and three Grade 4 students. Still, the data supports the hypothesis that phonological awareness increases (gained from the intervention) would be predictive of later reading skills for the younger students. One Grade 1 participant increased her post-test 1 letter knowledge and phonemic awareness scores at a similar rate to the new readers without simultaneously increasing her post-test 1 word recognition score. This student's increased letter knowledge and phonemic awareness scores did predict her performance on later reading skills as the student successfully applied the alphabetic code to word reading on post-test 2, six months after the training period.

Taken together, these findings suggest that the Intervention App was beneficial for some of the participants. Many students' letter knowledge and phonological awareness skills improved by the end of the intervention. One third of the participants were able to use these newly acquired skills to crack the alphabetic code. These six

students were able to decode words after the intervention that they were previously unable to read and I believe that the training effects would have been greater had all participants completed all 24 iLe12 levels. Although the current study does not establish causality, it does provide rationale for further investigation into the use of interactive computerized phonological awareness training for Indigenous children living in remote areas. The study also provides information that can be used to create more effective early literacy tools (see section 8.3.2). We now turn to a discussion on the future of Dhuwaya literacy apps.

8.3 FUTURE RESEARCH

As discussed above, the current project was not without its limitations. Various insights and observations were made over the course of the experimental phase that can be reflected upon in order to better replicate the study with the aim of collecting more robust data. In this section, I will review these observations, discussing both the issues that presented themselves over the course of the experiment and also suggestions for how to ameliorate these problems. I will first discuss issues and improvements for assessments. Then, I will discuss issues and their respective improvements for the intervention phase. The section will end with a discussion on technical issues.

8.3.1. Assessment Improvements

I tried to extend the intervention phase for as long as was available so that the participants could complete as many Intervention App levels as possible. Therefore, post-test 1 was conducted during the last seven school days of the school year. However, this turned out to be problematic for a few reasons, the most problematic being that only 16 of the 29 participants attended school during the post-test 1 assessment phase. Including more than one week in the post-test phase would have increased the chances of participants being present during this testing time. The participants' motivation was also weakened by the timing of the post-test. Teachers did not teach curriculum content during this week as it was the last week of the school year. Instead children watched movies, made arts and crafts, and played games. As such, the students were very rowdy and unfocused. Moreover, they wanted to finish testing as quickly as possible so they could return to their leisure activities. I believe that children would have performed better on post-test 1 had the testing been conducted before the last week of the school year. This issue could easily be ameliorated by conducting the post-test before the last week of any school term. However, a corollary of this suggestion is that more time be allotted for the experimental phase so that children could complete all levels of iLe12 before the last week of school.

During the Analysis phase, I came to realize that sometimes children answered incorrectly to questions on the post-test that they had previously answered correctly to on the pre-test. It was impossible to tell whether the participants had guessed correctly on the pre-test or were simply unfocused during the post-test. The data would have been clearer had there been more questions for each variable measured. A larger number of

questions would have helped prevent the data being skewed by guessing or children simply becoming unfocused for a minute. Additionally, various linguistic manipulations could be made to task items which would also help evaluate students' developmental levels. Moreover, the ceiling effect displayed on the syllable blending task could be avoided by including questions targeting longer words and words with more linguistically complicated syllables.

The assessment was designed so that participants would not become tired and unmotivated from lengthy testing, especially since some of the participants were as young as five years old. My suggestion for future research would be to break up assessments into separate sections and to administer the separate sections on different days. More questions could be made per task without running the risk of exhausting young students. Recall that the Assessment App was created as a template that does not operate unless audio files, image files, and an answer key file are correctly stored in the app via iTunes (refer back to section 5.5.1.1 for a detailed explanation of the app development process). These files are all placed in one folder which is labelled with the name of the assessment. The app can store various folders, and therefore various sets of 20 questions assessments. The app was originally programmed this way so that different languages could be added to the app, as educators from other Indigenous community schools expressed interest in using the app in their own community language. This specificity of the app, however, also allows for the inclusion of different twenty word assessments targeting the same language. Therefore, it is possible to have one assessment for Dhuwaya letter knowledge, one assessment for Dhuwaya syllable and phoneme identification, and one assessment for Dhuwaya syllable and phoneme blending. An

assessment administrator must simply click on the drop-down box located on the Assessment App's login screen and then click on the name of the assessment desired. The oral assessment can also be broken up into separate assessments: one syllable and phoneme segmentation assessment and one word recognition assessment.

The segmentation section of the assessment battery was the most difficult for the participants. The students might have been more motivated if the assessment was delivered in a more game-like fashion. For example, Kartal and Terziyan (2016) framed their segmentation task as a game-like activity revolving around space travel and alien encounters. Children were told that they were going to travel to another planet where they would encounter aliens who spoke their own language. "Alienese" involved separating words into individual phonemes and the only way to befriend the aliens was to speak like them. Children were further engaged by toys such as two planets and a spaceship. This assessment activity could be adapted to Dhuwaya-speaking Yolŋu children's cultural surroundings in an attempt to engage and motivate students further.

8.3.2. Intervention Improvements

We have seen that the study could have been improved by extending the time ascribed to the experimental phase as the data was restricted by limited time and poor student attendance. Recall that only two participants completed all 24 iLeL2 levels. Therefore, extending the experimental phase to an entire school semester, i.e., two school terms rather than one would be beneficial and ideally, this would be the first two school terms

or the last two school terms as these terms only have a week break between them in the Northern Territory.

Another unforeseen limitation to the project was the students' waning motivation. I hypothesized that students would be engaged and motivated by the interactive gaming style of the phonological awareness training iPad app. However, participants seemed to grow disinterested with the app half way through the training. The children were excited about playing with the iPads and with playing other academic games on the iPads so the problem was not the use of technology itself. Students would not give critical feedback but I believe that their waning interest in the app was due to its repetitive nature (the same activities were played on each level and the app did not provide an overall storyline or goal). Including a host of activities aimed at training the same skill may be confusing for children. Perhaps using a storyline in which students needed to complete academic tasks in order to achieve some other goal would have been more motivating and competitive. An example of this type of program is DaisyQuest discussed in section 3.5.3. This computerized program motivates children by giving them the goal of finding Daisy the dragon which they can only do by mastering academic activities, which in turn awards them with clues to Daisy's whereabouts. Another example of a program which motivates children to complete activities in order to advance a storyline is Kartal and Terziyan's (2016) JerenAli. The narrative behind JerenAli is that a city girl named Jeren goes to the countryside to visit her grandmother who lives next door to a boy named Ali. Throughout the game, Jeren and Ali go on various adventures together but they can only complete the adventures by answering task questions correctly.

Another factor which may have affected children's motivation was the intensity of the training. Children interacted with the Intervention App every day that they came to school. Furthermore, participants were encouraged to complete more than one level per day, by both the classroom teachers and myself, as soon as it became clear that the participants were not likely to complete all 24 levels of the app due to their attendance rates. Foster et al. (1994) also discussed training intensity being problematic in their study. This is another problem that could be ameliorated by extending the experimental phase over two rather than one school term.

8.4 THE FUTURE OF iLe1 AND iLe2

The apps were installed on twenty of the school's iPads giving teachers and students the option of using the app at their discretion. Additionally, teachers from two separate Northern Territory Indigenous schools have expressed interest in using the apps at their schools. Different Indigenous languages are used at these two schools but recall that different languages and pictures can be inserted into the apps. As discussed in section 5.5, both the Assessment App and the Intervention App were created as templates that do not operate without audio, image, and answer key files being stored into the app via iTunes. Section 8.3.1 discussed how different sets of audio, image, and answer key files can be added to the Assessment App. Different sets of audio, image, and answer key files can be inserted into the Intervention App in a similar way. Researchers and educators can work with community members from different communities to translate the apps' audio from

Dhuwaya (or English⁷⁶) into the Indigenous languages used at their respective schools. They can then create the corresponding audio, image, and answer key files and insert them into the apps. As such, there is a possibility that iLe11 and iLe12 will be used across different Indigenous schools.

The creation of iLe11 and iLe12 was an impetus to the creation of a more in depth Dhuwaya language early literacy app. Staff at Yirrkala school were excited about the idea of creating and using emergent literacy apps and so they reached out for funding and support to further develop Dhuwaya language apps. Researchers from The University of Melbourne, AU, including myself, are currently working with Yirrkala School staff members to create a more in depth letter knowledge, phonological awareness, and word recognition training app. Findings from the current project were taken into consideration when designing the structure of the new app. Different bits and pieces were also taken from iLe12. Almost all iLe12 task items⁷⁷ have been included in the planning for the new app.

8.5 CLOSING REMARKS

Literacy events are difficult to avoid in today's modern society. Proficient readers crucially use literacy skills to attain academic and career goals, to accomplish everyday tasks (such as reading instructions), and to enjoy leisure reading. Strong literacy skills

⁷⁶ The script for both of the apps' audio was written in English before it was translated into Dhuwaya. Therefore, researchers can use either the Dhuwaya script or the English script as a reference when creating the audio files needed to insert another language in iLe11 or iLe12.

⁷⁷ Task items refer to the specific words and sounds used in each stimulus. For example, 'fish', 'dog', 'cat', and 'snake' and /s/ are the task items for the following stimulus: "These words are fish, dog, cat, and snake. Which word begins with the /s/ sound?"

help proficient readers live more fulfilled lives. In contrast, poor literacy skills can lead to major distress as poor readers struggle to complete school tasks and to take meaning out of text. Indigenous Australian children, specifically those living in remote communities, tend to fall into the category of poor readers as they achieve well below the expected reading outcomes. The majority of the participants in the current study were unable to read even the simplest of words. Improving emergent literacy instruction for remote Indigenous Australian children is critical as Indigenous children deserve the same opportunities and resources that children speaking more commonly spoken languages receive. The aim of the current project was to examine the emergent literacy skills of remote Indigenous children with the intention of understanding how to better facilitate reading acquisition for this specific population of children.

The current project adds to our knowledge of the nature of emergent reading skills for children learning to read alphabetic languages. This project further adds to the generalizability of the current knowledgebase on emergent literacy by shedding light on the emergent literacy skills of Dhuwaya-speaking children, a population of under-studied children, in their home language. Data from the current study can be used to advise future research and to create more effective literacy programs for Indigenous Australian children living in remote communities.

To summarize, data from the current study highlights the close relationship between letter knowledge, phonemic awareness, and word recognition in Dhuwaya. However, the participants achieved low scores on measures of these three skills when compared to the benchmarks discussed in previous early reading research as well as to the benchmarks set in the Australian curriculum. The majority of the participants in the

current study had not yet fully cracked the alphabetic code by the end of fourth grade (or fifth grade at Post-test 2) and were unable to read even the simplest of words. Poor phonemic awareness and letter knowledge skills are likely to be seriously contributing to the participants' poor reading levels. However, data from the current study suggests that phonemic awareness skills develop more rapidly when Dhuwaya-speaking children receive explicit instruction. Moreover, data from the current study provides some evidence that effective phonemic awareness training leads to gains in Dhuwaya word recognition skill. Thus, language appropriate phonological awareness training may be one way to begin closing the literacy gap between remote Indigenous and urban mainstream Australian children.

The current study lays the groundwork for the development and investigation of Dhuwaya phonological awareness training programs. The current findings may help expand and shape future interventions. For example, the current data indicates that the different phonological awareness tasks measured vary greatly in difficulty. This finding stresses the importance of meticulous attention to detail when designing interventions (and assessments) that are appropriate for students' skill levels and that systematically progress from easier to more difficult tasks. The relative difficulty of the different tasks, discussed in detail in Chapter Six, can be used as a guideline when creating Dhuwaya phonological awareness studies and interventions. The current data also indicates that certain tasks, phoneme segmentation in particular, seem to be more closely related to word recognition in Dhuwaya. Future interventions can emphasize these more closely related tasks to allocate instruction time more effectively. The current findings also suggest that computerized interventions may effectively train phonemic awareness skills

in Dhuwaya-speaking children. This finding is noteworthy. As discussed in Chapter Two, there are many reasons why computerized interventions may be especially beneficial for Indigenous children living in remote communities⁷⁸.

The current project is only the beginning for Dhuwaya (and all traditional Australian languages more generally) phonological awareness research. Further research is needed to strengthen guidelines for implementing effective interventions. Still, this study provides strong rationale for the further creation and investigation of Dhuwaya phonological awareness interventions.

⁷⁸ Indigenous teachers being absent often leaving the children without a home language instructor. Children's attendance rates and mixed level classes leaving teachers with students at many different skill levels. See sections 2.3 – 2.5 for discussion on the benefits of computerized instruction for remote Indigenous children.

References

- Adams, M. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.
- Adams, M. J., Foorman, B. R., Lundberg, I., & Beeler, T. (1998a). *Phonemic awareness in young children: A classroom curriculum*. Baltimore, MD: Paul H. Brookes Publishing.
- Adams, M. J., Foorman, B. R., Lundberg, I., & Beeler, T. (1998b). The elusive phoneme: Why phonemic awareness is so important and how to help children develop it. *American Educator*, 22(1-2), 18-29.
- Adams, M. J., Treiman, R., & Pressley, M. (1998). Reading, writing, and literacy. In W. Damon, I. E. Sigel, & K. A. Renninger (Eds.), *Handbook of child psychology: Child psychology in practice* (5th ed., Vol. 4, pp. 275-355). Hoboken, NJ: John Wiley & Sons Inc.
- Adamson, P. (1998). Speech to Northern Territory of Australia Legislative Assembly. Parliamentary record of the eighth assembly first session 01/12/2000 parliamentary record no. 13.
- Aidinis, A., & Nunes, T. (2001). The role of different levels of phonological awareness in the development of reading and spelling in Greek. *Reading and Writing*, 14(1-2), 145-177.
- Alexander, A.W., Andersen, H. G., Heilman, P. C., Voeller, K. K., & Torgesen, J. K. (1991). Phonological awareness training and remediation of analytic decoding deficits in a group of severe dyslexics. *Annals of Dyslexia*, 41(1), 193-206.

- Amery, R. (1985). *A new diglossia: Contemporary speech varieties at Yirrkala in North East Arnhemland*. (Unpublished doctoral dissertation). Australian National University, Canberra, ACT.
- Amery, R. (1993). An Australian koine: Dhuwaya, a variety of Yolŋu Matha spoken at Yirrkala in North East Arnhemland. *International Journal of the Sociology of Language*, 99(1), 45-64.
- Aro, M., & Wimmer, H. (2003). Learning to read: English in comparison to six more regular orthographies. *Applied Psycholinguistics*, 24, 621–635.
- August, D., & Hakuta, K. (1997). *Improving schooling for language-minority children: A research agenda*. Washington, DC: National Academy Press.
- August, D., & Shanahan, T. (Eds.). (2006). *Developing literacy in second-language learners: Report of the National Literacy Panel on language minority children and youth*. Mahwah, NJ: Lawrence Erlbaum.
- Australian Curriculum, Assessment and Reporting Authority (ACARA). (2008). *NAPLAN Achievement in reading, writing, language conventions and numeracy: National report for 2008*. Sydney, NSW: ACARA.
- Australian Curriculum, Assessment and Reporting Authority (ACARA). (2015). *NAPLAN Achievement in reading, persuasive writing, language conventions and numeracy: National report for 2015*. Sydney, NSW: ACARA.
- Australian Curriculum, Assessment and Reporting Authority (ACARA). (2018). Information for parents: The Australian curriculum years 1 and 2. [Data file] Sydney, NSW: ACARA. Retrieved from http://docs.acara.edu.au/resources/Information_for_parents_years_1_-_2.pdf

- Australian Department of Education, Northern Territory Division, Bilingual Education Section. (1975) Handbook for teachers in bilingual schools in the Northern Territory of Australia [2nd ed.]. Darwin, N.T.: Australian Department of Education.
- Australian Law Reform Commission (1986 (updated 2010). Aboriginal societies: The experience of contact: Changing policies towards Aboriginal people (Recognition of Aboriginal customary laws, ALRC Report 31). Canberra: Australian Government. Retrieved from: <https://www.alrc.gov.au/publication/recognition-of-aboriginal-customary-laws-alrc-report-31/3-aboriginal-societies-the-experience-of-contact/changing-policies-towards-aboriginal-people/>
- Baker, C. (1988). *Key issues in bilingualism and bilingual education*. Clevedon, England: Multilingual Matters.
- Baker, C. (2011). *Foundations of bilingual education and bilingualism* (5th ed.). Bristol, UK: Multilingual Matters.
- Ball, E. (1993). Assessing phoneme awareness. *Language, Speech, and Hearing Services in Schools*, 24(3), 130-139.
- Ball, E. (1997). Phonological awareness: Implications for whole language and emergent literacy programs. *Topics in Language Disorders*, 17(3), 14-24.
- Ball, E., & Blachman, B. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Reading Research Quarterly*, 26(1), 49-66.
- Barnett, W.S., Yarosz, D., Thomas, J., Jung, K., & Blanco, D. (2007). Two-way and monolingual English immersion in preschool education: An experimental

- comparison. *Early Childhood Research Quarterly*, 22(3), 277-293.
- Bavin, E. (1993). Language and culture: Socialisation in a Warlpiri community. In M. Walsh & C. Yallop (Eds.), *Language and culture in aboriginal Australia* (pp. 85-96). Canberra, ACT: Aboriginal Studies Press.
- Bay Area Reading Task Force. (1997). *A Reading- writing- language source book for the primary grades*. San Francisco, CA: San Francisco State University.
- Bialystok, E. (1987). Influences of bilingualism on metalinguistic development. *Second Language Research*, 3(2), 154-166.
- Blachman B. (1991). Getting ready to read: Learning how print maps to speech. In J. Kavanagh (Ed.), *The language continuum: From infancy to literacy*. Parkton, MD: York Press.
- Blachman, B. A., Ball, E. W., Black, R. S., & Tangel, D. M. (1994). Kindergarten teachers develop phoneme awareness in low-income, inner-city classrooms. *Reading and Writing*, 6(1), 1-18.
- Blachman, B. A., Ball, E. W., Black, R. S., & Tangel, D. M. (2000). *Road to the code: A phonological awareness program for young children*. Baltimore, MD: Paul H. Brookes Publishing.
- Blaiklock, K. E. (2004). The importance of letter knowledge in the relationship between phonological awareness and reading. *Journal of Research in Reading*, 27(1), 36-57.
- Borgwaldt, S., & Joyce, T. (2013). *Typology of writing systems*. Amsterdam: John Benjamins.
- Borstrom, I., & Elbro, C. (1997). Prevention of dyslexia in kindergarten: Effects of

- phoneme awareness training with children of dyslexic parents. In C. Hulme & M. J. Snowling (Eds.), *Dyslexia: Biology, cognition, and intervention* (pp. 235-253). San Diego, CA: Singular Publishing Group.
- Bossers, B. (1991). On thresholds, ceilings and short-circuits: The relation between L1 reading, L2 reading and L2 knowledge. In J. H. Hulstijn & J. F. Matter (Eds.), *Reading in two languages. AILA Review*, 8, 45-60. Amsterdam, Netherlands: Free University Press.
- Bowey, J. A. (1994). Phonological sensitivity in novice readers and nonreaders. *Journal of Experimental Child Psychology*, 58(1), 134-159.
- Bradley, L., & Bryant, P.E. (1978). Difficulties in auditory organisation as a possible cause of reading backwardness. *Nature*, 271, 746-747.
- Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read, A causal connection. *Nature*, 301(3), 419-421.
- Bradley, L., and Bryant, P.E. (1985). *Rhyme and reason in reading and spelling*. Ann Arbor, MI: University of Michigan Press.
- Brady, S., & Shankweiler, D. (Eds.). (1991). *Phonological processes in literacy: A tribute to Isabelle Y. Liberman*. Hillsdale, NJ: Erlbaum Associates.
- Brennan, F., & Ireson, J. (1997). Training phonological awareness: A study to evaluate the effects of a program of meta-linguistic games in kindergarten. *Reading and Writing*, 9(4), 241-263.
- Brisk, M. E. (2006). *Bilingual education from compensatory to quality schooling*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Bruck, M. (1992). Persistence of dyslexics' phonological awareness deficits.

Developmental Psychology, 28(5), 874-886.

- Burgess, S. R. (2006). The development of phonological sensitivity. In D. K. Dickinson & S. B. Neuman (Eds.), *Handbook of early literacy research* (Vol. 2, pp. 90-100). New York, NY: Guilford Press.
- Bus, A., & van IJzendoorn, M. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology*, 91(3), 403-414.
- Bus, A., van IJzendoorn, M., & Pellegrini, A. (1995). Joint book reading makes for success in learning to read: A meta-analysis on intergenerational transmission of literacy. *Review of Educational Research*, 65(1), 1-21.
- Butcher, A. (2006). Australian Aboriginal languages: Consonant-salient phonologies and the "Place-of-Articulation Imperative". In J. Harrington & M. Tabain (Eds.), *Speech production: Models, phonetic processes, and techniques* (pp. 187-210). Hoboken: Taylor and Francis.
- Butcher, A. (2013, October 1). The sounds of Aboriginal languages and the hearing profiles of their speakers. *2013 Australian Linguistic Society Conference*. Lecture conducted at University of Melbourne, Melbourne, AU.
- Byrd, D., & Mintz, T. H. (2010). *Discovering speech, words, and mind*. Chichester, UK: Wiley-Blackwell.
- Byrne, B., & Fielding-Barnsley, R. (1989). Phonemic awareness and letter knowledge in the child's acquisition of the alphabetic principle. *Journal of Educational Psychology*, 81(3), 313-321.
- Byrne, B., & Fielding-Barnsley, R. (1990). Acquiring the alphabetic principle: A case for

- teaching recognition of phoneme identity. *Journal of Educational Psychology*, 82(4), 805-812.
- Callaghan, G., & Madelaine, A. (2012). Levelling the playing field for kindergarten entry: Research implications for preschool early literacy instruction. *Australasian Journal of Early Childhood*, 37(1), 13-23.
- Caravolas, M., & Bruck, M. (1993). The effect of oral and written language input on children's phonological awareness: A cross-linguistic study. *Journal of Experimental Child Psychology*, 55(1), 1-30.
- Caravolas, M., Hulme, C., & Snowling, M. J. (2001). The foundations of spelling ability: Evidence from a 3-year longitudinal study. *Journal of Memory and Language*, 45(4), 751-774.
- Carrell, P. L. (1991). Second language reading: Reading ability or language proficiency? *Applied Linguistics*, 12(2), 159-179.
- Carroll, J. M. (2004). Letter knowledge precipitates phoneme segmentation, but not phoneme invariance. *Journal of Research in Reading*, 27(3), 212-225.
- Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition*, 91(1), 77-111.
- Castles, A., Coltheart, M., Wilson, K., Valpied, J., & Wedgwood, J. (2009). The genesis of reading ability: What helps children learn letter-sound correspondences? *Journal of Experimental Child Psychology*, 104(1), 68-88.
- Chafouleas, S. M., Lewandowski, L. J., Smith, C. R., & Blachman, B. A. (1997). Phonological awareness skills in children: Examining performance across tasks and ages. *Journal of Psychoeducational Assessment*, 15(4), 334-347.

- Chafouleas, S. M., & Martens, B. K. (2002). Accuracy-based phonological awareness tasks: Are they reliable, efficient, and sensitive to growth? *School Psychology Quarterly*, 17(2), 128-147.
- Chafouleas, S. M., VanAuken, T. L., & Dunham, K. (2001). Not all phonemes are created equal: The effects of linguistic manipulations on phonological awareness tasks. *Journal of Psychoeducational Assessment*, 19(3), 216-226.
- Chai, Z., Ayres, K. M., & Vail, C. O. (2016). Using an iPad app to improve phonological awareness skills in young English-language learners with disabilities. *Journal of Special Education Technology*, 31(1), 14-25.
- Chaney, C. (1989). I pledge a legiance tothe flag: Three studies in word segmentation. *Applied Psycholinguistics*, 10(3), 261-281.
- Chard, D., & Osborn, J. (1999). Phonics and word recognition instruction in early reading programs: Guidelines for accessibility. *Learning Disabilities Research and Practice*, 14(2), 107-117.
- Chiappe, P., Siegel, L. S., & Gottardo, A. (2002). Reading-related skills of kindergartners from diverse linguistic backgrounds. *Applied Psycholinguistics*, 23(1), 95-116.
- Chlanda, E. (1999, June 23). Alice may get joint campus. Alice springs news. Retrieved from www.alicespringsnews.com.au/0621.html.
- Chong, A.J. (2011). *Continuant-stop alternations in Australian languages: A look at Yolngu and Wubuy* (Honours thesis). University of Melbourne, Melbourne, VIC.
- Christie, M. J. (1985). *Aboriginal perspectives on experience and learning: The role of language in Aboriginal education*. Waurin Ponds, VIC: Deakin University.
- Clarke, M. A. (1980). The short circuit hypothesis of ESL reading-Or when language

- competence interferes with reading performance. *The Modern Language Journal*, 64(2), 203-209.
- Cockrum, W. A., & Shanker, J. L. (2013). *Locating and correcting reading difficulties*. Boston, MA: Pearson.
- Cole, J. (2011). A research review: The importance of families and the home environment. Originally written by Angelica Bonci, 2008, revised June 2010 by Emily Mottram and Emily McCoy and in March 2011 by Jennifer Cole. National Literacy Trust. Retrieved from: www.literacytrust.org.uk/assets/0000/7901/Research_review-importance_of_families_and_home.pdf
- Collins, B. (1999) *Learning lessons: An independent review of Indigenous education in the Northern Territory*. Darwin: NT Department of Education.
- Comasky, E. M., Savage, R. S., & Abrami, P. C. (2009). A randomised efficacy study of web-based synthetic and analytic programmes among disadvantaged urban kindergarten children. *Journal of Research in Reading*, 32(1), 92-108.
- Commonwealth Department of Health and Aged Care. (2001). Measuring remoteness: Accessibility/Remoteness Index of Australia (ARIA) (Revised edition). Occasional Papers: New Series Number 14.
- Crystal, D. (1991). *A dictionary of linguistics and phonetics* (3rd edition). Cambridge, MA: Basil Blackwell.
- Cummins, J. (1981a). The role of primary language development in promoting educational success for language minority students. In *Schooling and language minority students: A theoretical framework* (pp. 3-49). Los Angeles, CA:

- Evaluation, Dissemination and Assessment Center, California State University, Los Angeles.
- Cummins, J. (1981b). Age on arrival and immigrant second language learning in Canada: A reassessment. *Applied Linguistics*, 2(2), 132-149.
- Cummins, J. (2000). *Language, power, and pedagogy: Bilingual children in the crossfire*. Clevedon, England: Multilingual Matters.
- Davidson, M., & Jenkins, J. (1994). Effects of phonemic processes on word reading and spelling. *The Journal of Educational Research*, 87(3), 148-157.
- Deault, L., Savage, R. S., & Abrami, P. C. (2009). Inattention and response to the ABRACADABRA web-based literacy intervention. *Journal of Research on Educational Effectiveness*, 2(3), 250-286.
- Department of Education. (1974). Second progress report on the Bilingual Education Program in schools in the Northern Territory. Darwin: Australian Department of Education, Northern Territory Division, Bilingual Education Section. ERIC no: ED126683.
- Devlin, B. (1995). The evaluation of bilingual programs in the Northern Territory, Australia, 1973-1993. *International Journal of the Sociology of Language*, 113(1), 23-36.
- Devlin, B. (2007). *Bilingual education guidelines*. Berrimah, NT: Catholic Education Office NT.
- Devlin, B. (2017a) A glimmer of possibility. In B. Devlin, S. Disbray, & N. Devlin (Eds.), *History of bilingual education in the Northern Territory* (pp.13-25). Language Policy, volume 12. Singapore: Springer.
- Devlin, B. (2017b). Threatened closure: Resistance and compromise (1998-2000). In B.

- Devlin, S. Disbray, & N. Devlin (Eds.), *History of bilingual education in the Northern Territory (pp.165-178)*. Language Policy, volume 12. Singapore: Springer.
- Dickinson, D. K., & Neuman, S. B. (2006) *Handbook of early literacy research*. New York, NY: Guilford Press.
- Dijkstra, J. E., Kuikem, F., Jorna, R. J., & Klinkenberg, E. L. (2014). The early bilingual acquisition of a minority and a majority Language. *Us Wurk. Tydskrift foar frisistyk*, 63(1-2), 10-30.
- Disbray, S. (2016). Spaces for learning: Policy and practice for indigenous languages in a remote context. *Language and Education*, 30(4), 317-336.
- Di Stasio, M. R., Savage, R. S., & Abrami, P. C. (2012). A follow-up study of the ABRACADABRA web-based literacy intervention in Grade 1. *Journal of Research in Reading*, 35(1), 69-86.
- Droop, M., & Verhoeven, L. (1998). Background knowledge, linguistic complexity, and second-language reading comprehension. *Journal of Literacy Research*, 30(2), 253-271.
- Durkin, D. (1993). *Teaching them to read* (6th ed.). Boston, MA: Allyn and Bacon.
- Edwards, O. W., & Taub, G. E. (2016). The influence of specific phonemic awareness processes on the reading comprehension of African American students. *Journal of Research in Childhood Education*, 30(1), 74-84.
- Eedle, J. (1976). Matters arising from Minister's visit to the Northern Territory.
- Attachment A: Goals for immediate action.
- Ehri, L., Nunes, S., Willows, D., Schuster, B. V., Yaghoub-Zadeh, Z., & Shanahan, T.

- (2001). Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly*, 36(3), 250-287.
- Ehri, L. C., & Roberts, T. (2006). The roots of learning to read and write: Acquisition of letters and phonemic awareness. In D. K. Dickinson & S. B. Neuman (Eds.), *Handbook of early literacy research* (Vol. 2, pp. 113-131). New York, NY: Guilford Press.
- Eisenchlas, S. A., Schalley, A. C., & Guillemin, D. (2013). The importance of literacy in the home language: The view from Australia. *SAGE Open*, 3(4), 1-14
- Erickson, G. C., Foster, K. C., Foster, D. F., Torgesen, J. K., & Packer, S. (1992). *Daisy Quest*. Scotts Valley, CA: Great Wave Software.
- Farrall, M. L. (2012). *Reading assessment: Linking language, literacy, and cognition*. Hoboken, NJ: John Wiley and Sons, Inc.
- Farver, J., Lonigan, C., & Eppe, S. (2009). Effective early literacy skill development for young Spanish-speaking English language learners: An experimental study of two methods. *Child Development*, 80(3), 703-719.
- Fawcett, A. & Nicholson, R. (1995). Persistence of phonological awareness deficits in older children with dyslexia. *Reading and Writing*, 7(4), 361-376.
- Feinauer, E., Hall-Kenyon, K. M., Davison, K. C. (2013). Cross-language transfer of early literacy skills: An examination of young learners in a Two-Way Bilingual Immersion elementary school. *Reading Psychology*, 34(5), 436-460.
- Fellowes, J., & Oakley, G. (2014). *Language, literacy and early childhood education*. Melbourne, VIC: Oxford University Press.

- Finegan, E. (2014). *Language: Its structure and use* (7th ed.). Boston, MA: Cengage Learning.
- Fitzgerald, G., & Koury, K. (1996). Empirical advances in technology-assisted instruction for students with mild and moderate disabilities. *Journal of Research on Computing in Education*, 28(4), 526-553.
- Foorman, B. R., Chen, D-T., Carlson, C., Moats, L., Francis, D. J., & Fletcher, J. M. (2003). The necessity of the alphabetic principle to phonemic awareness instruction. *Reading and Writing*, 16(4), 289-324.
- Foorman, B. R., Francis, D. J., Beeler, T., Winikates, D., and Fletcher, J. M. (1997). Early interventions for children with reading problems: Study designs and preliminary findings. *Learning Disabilities*, 8(1), 63-71.
- Foster, K. C., Erickson, G. C., Foster, D. F., Brinkman, D., & Torgesen, J. K. (1994). Computer-administered instruction in phonological awareness: Evaluation of the Daisy Quest program. *Journal of Research and Development in Education*, 27(2), 126-137.
- Fox, B., & Routh, D. K. (1976). Phonemic analysis and synthesis as word-attack skills. *Journal of Educational Psychology*, 68(1), 70-74.
- Fox, B., & Routh, D. K. (1984). Phonemic analysis and synthesis as word attack skills: Revisited. *Journal of Educational Psychology*, 76(6), 1059-1064.
- Foy, J. G., & Mann, V. (2006). Changes in letter-sound knowledge are associated with development of phonological awareness in pre-school children. *Journal of Research in Reading*, 29(2), 143-161.
- Freeman, L. A., & Staley, B. (2018). The positioning of Aboriginal students and their

- languages within Australia's education system: A human rights perspective. *International Journal of Speech-Language Pathology*, 20(1), 174-181.
- Frith, U., Wimmer, H., & Landerl, K. (1998). Differences in phonological recoding in German- and english-speaking children. *Scientific Studies of Reading*, 2(1), 31–54.
- Frost, R. (1994). Prelexical and postlexical strategies in reading: Evidence from a deep and shallow orthography. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 20(1), 116–129.
- Frost, R. (2005). Orthographic systems and skilled word recognition processes in reading. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (272-295). Oxford: Blackwell.
- Galloway, A. (2008). Indigenous children and conductive hearing loss. In J. Simpson & G. Wigglesworth (Eds), *Children's language and multilingualism: indigenous language use at home and school* (pp. 216-236). London: Continuum.
- Ganambarr-Stubbs, M. (2016). Personal recorded interview.
- Garcia, O. (2009). *Bilingual education in the 21st century: a global perspective*. Malden, MA: Wiley-Blackwell.
- Gass, S., & Mackey, A. (2007). *Data elicitation for second and foreign language research*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Genesee, F. (1994). *Educating second language children: The whole child, the whole curriculum, the whole community*. Cambridge, England: Cambridge University Press.
- Gillon, G. (2004). *Phonological awareness: From research to practice*. New York, NY:

Guilford Press.

Good, R. H., Simmons, D. C., & Smith, S. B. (1998). Effective academic intervention in the United States: Evaluating and enhancing the acquisition of early reading skills. *School Psychology Review*, 27(1), 45-56.

Goodman, K. (1986). *What's whole in whole language?* Portsmouth, NH: Heinemann.

Goswami, U. (2005). Synthetic phonics and learning to read: A cross-language perspective. *Educational Psychology in Practice*, 21(4), 273-282.

Goswami, U. (2016). Orthography, phonology, and reading development: A cross-linguistic perspective. In Joshi, R.M. & Aaron, P.G. (Eds.). *Handbook of orthography and literacy* (pp. 463-480). New Jersey: Lawrence Erlbaum Associates, Inc.

Goswami, U., & Bryant, P. E. (1990). *Phonological skills and learning to read*. Hove, UK: Lawrence Erlbaum.

Goswami, U., & Mead, F. (1992). Onset and rime awareness and analogies in reading. *Reading Research Quarterly*, 27(2), 152-162.

Graham, Beth (2015). Personal phone interviews and email correspondence.

Graham, Beth (2016). Email correspondence.

Gray, W. S. (1948). *On their own in reading*. Glenview, IL: Scott, Foresman and Company.

Greene, J. (1997). A meta-analysis of the Rossell and Baker review of bilingual education research. *Bilingual Research Journal*, 21(2-3), 103-122.

Griffith, P. L., Beach, S. A., Ruan, J., & Dunn, L. (2008). *Literacy for young children: A guide for early childhood educators*. Thousand Oaks, CA: Corwin Press.

- Gunning, T. (2000). *Phonological awareness and primary phonics*. Boston, MA: Allyn and Bacon.
- Hakuta, K., Butler, Y. G., & Witt, D. (2000). *How long does it take English learners to attain proficiency?* Santa Barbara, CA: University of California Linguistic Minority Research Institute.
- Hall, K. (2006). How children learn to read and how phonics helps. In M. Lewis & S. Ellis (Eds.), *Phonics: Practice, research and policy* (pp. 1-12). London, UK: SAGE Publications Ltd.
- Hancock, D. R. (2002). The effects of native language books on the pre-literacy skill development of language minority kindergartners. *Journal of Research in Childhood Education*, 17(1), 62-68.
- Hansard, N. T. (1999). Eighth assembly, first session 04/20/1999, parliamentary record no. 15. Petition: Bilingual education.
- Harris, S. (1984). Aboriginal learning styles and formal schooling. *Aboriginal Child at School*, 12(4), 3-23.
- Harris, S. (1990). *Two-way aboriginal schooling: education and cultural survival*. Canberra, ACT: Aboriginal Studies Press.
- Heath, S. B. (1982a). Protean shapes in literacy events: Ever-shifting oral and literate traditions. In D. Tannen (Ed.), *Spoken and written language: Exploring orality and literacy*. Norwood, NJ: ALEX.
- Heath, S. B. (1982b). What no bedtime story means: Narrative skills at home and school. *Language in Society*, 11(1), 49-76.
- Hecht, S. A., & Close, L. (2002). Emergent literacy skills and training time uniquely

- predict variability in responses to phonemic awareness training in disadvantaged kindergarteners. *Journal of Experimental Child Psychology*, 82(2), 93-115.
- Helfgott, J. A. (1976). Phonemic segmentation and blending skills of kindergarten children: Implications for beginning reading acquisition. *Contemporary Educational Psychology*, 1(2), 157-169.
- Hill, S. (2006). *Developing early literacy: Assessment and teaching*. Prahran, VIC: Eleanor Curtain Publishing.
- Hohn, W. E., and Ehri, L. C. (1983). Do alphabetic letters help prereaders acquire phonemic segmentation skill? *Journal of Educational Psychology*, 75(5), 752-762.
- Høien, T., Lundberg, I., Stanovich, K., & Bjaalid, I-K. (1995). Components of phonological awareness. *Reading and Writing*, 7(2), 171-188.
- Hook, P. E., & Jones, S. D. (2004). The importance of automaticity and fluency for efficient reading comprehension. *Perspectives: International Dyslexia Association*, 24(2), 16-21.
- Human Rights and Equal Opportunity Commission (HREOC) (2000). *International review of Indigenous issues in 2000: Australia*. Canberra: Commonwealth of Australia. Retrieved from <https://www.humanrights.gov.au/publications/international-review-indigenous-issues-2000-australia-5-failure-provide-adequate#edu>
- Huang, F. L., Tortorelli, L. S., & Invernizzi, M. A. (2014). An investigation of factors associated with letter-sound knowledge at kindergarten entry. *Early Childhood Research Quarterly*, 29(2), 182-192.

- Hughes, H. (2008). Indigenous education in the Northern Territory, Centre for Independent Studies. Retrieved from:
<https://www.cis.org.au/app/uploads/2015/07/pm83.pdf?>
- Huijser, H., Ober, R., O'Sullivan, S. McRae-Williams, E. & Elvin, R. (Ed.) (2015). *Finding the common ground: Narratives, provocations and reflections from the 40 year celebration of Batchelor Institute*. Batchelor, NT: Batchelor Press.
- Hulme, C., Caravolas, M., Málková, G., & Brigstocke, S. (2005). Phoneme isolation ability is not simply a consequence of letter-sound knowledge. *Cognition*, 97(1), B1-B11.
- Hulme, C., Snowling, M., Caravolas, M., Carroll, J. (2005). Phonological skills are (probably) one cause of success in learning to read: A comment on Castles and Coltheart. *Scientific Studies of Reading*, 9(4), 351-365.
- International Reading Association (1998). *Phonemic awareness and the teaching of reading: A position statement from the Board of Directors of the International Reading Association*. Newark, DE: International Reading Association.
- Invernizzi, M., & Tortorelli, L. S. (2013). Phonological awareness and alphabet knowledge: The foundations of early reading. In D. M. Barone & M. H. Mallette (Eds.), *Best Practices in Early Literacy Instruction* (pp. 155-174). New York, NY: Guilford Press.
- Jepson, K. M. (2019). Prosody, prominence & segments in Djambarrpuyŋu (PhD thesis). University of Melbourne, Australia.
- Johnston, R. S., Andersen, M., Holligan, C. (1996). Knowledge of the alphabet and explicit awareness of phonemes in pre-readers: The nature of the relationship.

- Reading and Writing*, 8(3), 217-234.
- Jones, G., Ostojic, D., Menard, J., Picard, E. & Miller C. J. (2017). Primary prevention of reading failure: Effect of universal peer tutoring in the early grades. *The Journal of Educational Research*, 110(2), 171-176.
- Juel, C. (1988). Learning to read and write: A longitudinal study of 54 children from first through fourth grades. *Journal of Educational Psychology*, 80(4), 437-447.
- Kartal, G., & Terziyan, T. (2016). Development and evaluation of game-like phonological awareness software for kindergarteners: JerenAli. *Journal of Educational Computing Research*. 53(4), 519-539.
- Kid Sense Child Development (2017). [Data File] Retrieved from <https://childdevelopment.com.au/resources/child-development-charts/phonological-sound-awareness-developmental-chart-2/?print=pdf>
- Kilpatrick, D. A. (2012). Phonological segmentation assessment is not enough: A comparison of three phonological awareness tests with first and second graders. *Canadian Journal of School Psychology*, 27(2), 150-165.
- Kim, J. (2008). Research and the reading wars. In F. M. Hess (Ed.), *When Research Matters: How Scholarship Influences Education Policy* (pp. 89-111). Cambridge, MA: Harvard Education Press.
- Kim, Y., Petscher, Y., Foorman, B. R., & Zhou, C. (2010). The contributions of phonological awareness and letter-name knowledge to letter-sound acquisition – a cross-classified multilevel model approach. *Journal of Educational Psychology*, 102(2), 313-326.

- Kinslow-Harris, J. (1968). Linguistics and Aboriginal education: A practical use of linguistic research in Aboriginal education in the Northern Territory. *Australian Territories*, 8(1), 24-34.
- Konza, D. (2010). *Research into practice: Understanding the reading process*. [Data file]. Retrieved from:
http://www.ecu.edu.au/__data/assets/pdf_file/0009/663696/SA-DECS_-Understanding-the-Reading-Process.pdf
- Kormilda College Yearbook (1973). p.19. Berrimah, N.T.: Kormilda College
- Kozminsky, L., & Kozminsky, E. (1995). The effects of early phonological awareness training on reading success. *Learning and Instruction*, 5(3), 187-201.
- Kronemann, M. (2007). *Education is the key: An educational future for Indigenous communities in the Northern Territory*. Melbourne, VIC: Australian Education Union.
- Kulik, J. A., Banger, R. L., & Williams, G. W. (1983). Effects of computer-based teaching on secondary school students. *Journal of Educational Psychology*, 75(1), 19-126.
- Kyle, F., Kujala, J., Richardson, U., Lyytinen, H., & Goswami, U. (2013). Assessing the effectiveness of two theoretically motivated computer-assisted reading interventions in the United Kingdom: GGrime and GG phoneme. *Reading Research Quarterly*, 48(1), 61-76.
- Landerl, K. (2016). Reading Acquisition in Different Orthographies: Evidence from Direct Comparisons. In Joshi, R.M. & Aaron, P.G. (Eds.). *Handbook of*

- orthography and literacy*. (pp. 513 – 530). New Jersey: Lawrence Erlbaum Associates, Inc.
- Lane, H., Pullen, P., Eisele, M., & Jordan, L. (2002). Preventing reading failure: Phonological awareness assessment and instruction. *Preventing School Failure: Alternative Education for Children and Youth*, 46(3), 101-110.
- Law, J. M., Vandermosten, M., Ghesquiere, P., & Wouters, J. (2014). The relationship of phonological ability, speech perception, and auditory perception in adults with dyslexia. *Frontiers in Human Neuroscience*, 8, Article ID 482.
- Lee, J., & Schallert, D. L. (1997). The relative contribution of L2 language proficiency and L1 reading ability to L2 reading performance: A test of the threshold hypothesis in an EFL context. *TESOL Quarterly*, 31(4), 713-737.
- Lerner, M. D., & Lonigan, C. J. (2016). Bidirectional relations between phonological awareness and letter knowledge in preschool revisited: A growth curve analysis of the relation between two code-related skills. *Journal of Experimental Child Psychology*, 144, 166-183.
- Lewkowicz, N. K. (1980). Phonemic awareness training: What to teach and how to teach it. *Journal of Educational Psychology*, 72(5), 686-700.
- Li, G. (2010). *Phonological processing abilities and reading competence: Theory and evidence*. Bern, Switzerland: Peter Lang.
- Liberman, I., & Liberman, A. (1990). Whole Language vs. Code Emphasis: Underlying assumptions and their implications for reading instruction. *Annals of Dyslexia*, 40(1), 51-76.
- Lonigan, C. J. (2006). Conceptualizing phonological processing skills in prereaders. In D.

- K. Dickinson & S. B. Neuman (Eds.), *Handbook of early literacy research* (Vol. 2, pp. 77-89). New York, NY: Guilford Press.
- Lonigan, C. J., Burgess, S. R., & Anthony, J. L. (2000). Development of emergent literacy and early reading skills in preschool children: Evidence from a latent-variable longitudinal study. *Developmental Psychology*, 36(5), 596-613.
- Lonigan, C. J., Burgess, S. R., Anthony, J. L., & Barker, T. A. (1998). Development of phonological sensitivity in 2- to 5-year-old children. *Journal of Educational Psychology*, 90(2), 294-311.
- Lonigan, C. J., Driscoll, K., Phillips, B. M., Cantor, B. G., Anthony, J. L., & Goldstein, H. (2003). A computer-assisted instruction phonological sensitivity program for preschool children at-risk for reading problems. *Journal of Early Intervention*, 25(4), 248-262.
- Lotharington, H. (2000). *What's bilingual education all about? A guide to language learning in today's schools*. Melbourne, VIC: Language Australia.
- Lowe, B. (2004). *Yolngu – English Dictionary*. Winnellie: ARDS. Retrieved from: <https://www.goveonline.com.au/wp-content/uploads/2016/12/yolgnu-english-dictionary.pdf>
- Lundberg, I., Frost, J., & Petersen, O. (1988). Effects of an extensive program for stimulating phonological awareness in preschool children. *Reading Research Quarterly*, 23(3), 263-284.
- Lynch, J., Anderson, J., Anderson, A., & Shapiro, J. (2008). Parents and preschool children interacting with storybooks: Children's early literacy achievement. *Reading Horizons*, 48(4), 227-242.

- Macaruso, P., & Rodman, A. (2011). Efficacy of computer-assisted instruction for the development of early literacy skills in young children. *Reading Psychology*, 32(2), 172-196.
- Macdonald, G., & Cornwall, A. (1995). The relationship between phonological awareness and reading and spelling achievement eleven years later. *Journal of Learning Disabilities*, 28(8), 523-527.
- Mann, V. A. (1984). Longitudinal prediction and prevention of early reading difficulty. *Annals of Dyslexia*, 34(1), 117-136.
- Mann, V. A. (1986). Phonological awareness: The role of reading experience. *Cognition*, 24(1-2), 65-92.
- Mann, V., & Foy, J. (2003). Phonological awareness, speech development, and letter knowledge in preschool children. *Annals of Dyslexia*, 53(1), 149-173.
- Manolitsis, G., & Tafa, E. (2011). Letter-name letter-sound and phonological awareness: Evidence from Greek-speaking kindergarten children. *Reading and Writing*, 24(1), 27-53.
- Marika, D. (2009). *Going Back to Lajamanu – Interview with D. Marika* [Video file]. (2009, September 14). Retrieved from <http://www.abc.net.au/4corners/going-back-to-lajamanu/1426470>
- Marika, R. (2000). Milthun Latju Wäna Romgu Yolŋu: Valuing Yolŋu knowledge in the education system. *TESOL in Context*, 10(2), 45-52.
- Marika-Munungiritj, R., Maymuru, B., Mununggurr, M., Munyarryun, B., Durruwutthun, G., & Yunupingu, Y. (1990). The history of the Yirrkala community school: Yolŋu thinking about education in the Laynha and Yirrkala area. *Ngoonjook*, 3,

32-52.

Marsden, E., & Torgerson, C. J. (2012). Single group, pre- and post-test research designs:

Some methodological concerns. *Oxford Review of Education*, 38(5), 583-616.

Matas, A., & Rodríguez, J.L. (2014). The education of English learners in California

following the passage of proposition 227: A case study of an urban school

district. *Perspectives on Urban Education*, 11(2), 44-56.

May, S., Hill, R., & Tiakiwai, S. (2004). *Bilingual/immersion education: Indicators of good practice: Final report to the Ministry of Education*. Wellington, NZ:

Ministry of Education.

McBride-Chang, C. (1995). What is phonological awareness? *Journal of Educational Psychology*, 87(2), 179-192.

McBride-Chang, C. (1999). The ABCs of the ABCs: The development of letter-name and letter-sound knowledge. *Merrill-Palmer Quarterly*, 45(2), 285-308.

McBride-Chang, C. (2004). *Children's literacy development*. London, UK: Arnold.

McCarthy, J. (2008). *Doing optimality theory: Applying theory to data*. Malden, MA: Blackwell Pub.

McDougall, S., Brunswick, N., & de Mornay Davies, P. (2010). *Reading and dyslexia in different orthographies*. Hove, East Sussex: Psychology Press.

McKenna, M., Walpole, S., & Conradi, K. (2010). *Promoting early reading: Research, resources, and best practices*. New York, NY: Guilford Press.

Miller, R. (2019). English orthography and reading. In J.I. Lontas (Ed.), *The TESOL encyclopedia of English language teaching*. Hoboken, NJ: John Wiley & Sons, Inc.

Retrieved from:

https://www.researchgate.net/publication/330399369_English_Orthography_and_Reading

Mioduser, D., Tur-Kaspa, H., & Leitner, I. (2000). The learning value of computer-based instruction of early reading skills. *Journal of Computer Assisted Learning*, 16(1), 54-63.

Mitchell, M. J., & Fox, B. J. (2001). The effects of computer software for developing phonological awareness in low-progress readers. *Reading Research and Instruction*, 40(4), 315-332.

Moats, L. (1999). Teaching reading is rocket science: What expert teachers of reading should know and be able to do. [paper] Washington, DC: American Federation of Teachers.

Moats, L. (2005). *The speech sounds of English: Phonetics, phonology, and phoneme awareness [Module 2]*. Longmont, CO: Sopris West Educational Services.

Moats, L. (2007). *Whole-language high jinks: How to tell when "scientifically-based research" isn't*. [paper]. Washington, DC: Thomas B. Fordham Institute.

Moore, K.A. (2008). Quasi-experimental evaluations: Part 6 in a series on practical evaluation methods. Washington, DC: Child Trends.

Morais, J., Bertelson, P., Cary, L., & Alegria, J. (1986). Literacy training and speech segmentation. *Cognition*, 24(1-2), 45-64.

Morales, G., Vaughan, J., & Ganambarr-Stubbs, M. (2018). From home to school in multilingual Arnhem Land: The development of Yirrkala school's bilingual curriculum. In G. Wigglesworth, J. Simpson, & J. Vaughan (Eds.), *Language practices of Indigenous children and youth: The transition from home to school*

- (pp.69-98). London, UK: Palgrave Macmillan.
- Morphy, F. (1983). Djapu, a Yolngu dialect. In B. J. Blake & R. M. W. Dixon (Eds.), *Handbook of Australian languages* (3rd ed., pp. 1-88). Amsterdam: John Benjamins.
- Moses, K., & Wigglesworth, G. (2008). The silence of the frogs: Dysfunctional discourse in the 'English-only' Aboriginal classroom. In J. Simpson & G. Wigglesworth (Eds.), *Children's language and multilingualism: Indigenous language use at home and school* (pp. 129-153). London, UK: Continuum.
- Murray, B. A. (1998). Gaining alphabetic insight: Is phoneme manipulation skill or identity knowledge causal? *Journal of Educational Psychology*, 90(3), 461-475.
- Muter, V., & Diethelm, K. (2001). The contribution of phonological skills and letter knowledge to early reading development in a multilingual population. *Language Learning*, 51(2), 187-219.
- Durruwutthun, D. (1991). The Garma project. In R. Bunbury, W. Hastings, J. Henry, & R. McTaggart (Eds.), *Aboriginal pedagogy: Aboriginal teachers speak out*. Geelong: Deakin University Press.
- Naslund, J. C., & Schneider, W. (1996). Kindergarten letter knowledge, phonological skills, and memory processes: Relative effects on early literacy. *Journal of Experimental Child Psychology*, 62(1), 30-59.
- Nation, K., & Hulme, C. (1997). Phoneme segmentation, not onset-rime segmentation, predicts early reading and spelling skills. *Reading Research Quarterly*, 32(2), 154-167.
- National Early Literacy Panel (NELP). (2008). *Developing early literacy: Report of the*

- National Early Literacy Panel*. Washington, DC: National Institute for Literacy.
- National Institute of Child Health and Human Development (NICHD). (2000). *Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups (NIH Publication No. 00-4754)*. Washington, DC: U.S. Government Printing Office.
- Nicholls, C. (2005). Death by a thousand cuts: Indigenous language bilingual education programmes in the Northern Territory of Australia, 1972-1998. *International Journal of Bilingual Education and Bilingualism*, 8(2-3), 160-177.
- Nicholson, T. (2005). *At the cutting edge: The importance of phonemic awareness in learning to read and spell* (2nd ed.). Wellington, NZ: New Zealand Council for Educational Research.
- Northern Territory Department of Education. (1980). *Handbook for teachers in bilingual schools in the Northern Territory of Australia* [3rd ed.]. Darwin: Northern Territory Department of Education.
- Northern Territory Government: Department of Education. (2016). *2016 enrolment and attendance statistics*. [Data file]. Retrieved from <https://education.nt.gov.au/education/statistics-research-and-strategies/enrolment-and-attendance/2016-enrolment-and-attendance-statistics>
- Ochs, E., & Schieffelin, B. B. (2011). The theory of language socialization. In A. Duranti, E. Ochs, & B. B. Schieffelin (Eds.), *The handbook of language socialization* (pp. 1-21). Oxford: Blackwell.

- O'Connor, R., Jenkins, J., & Slocum, T. (1995). Transfer among phonological tasks in kindergarten: Essential instructional content. *Journal of Educational Psychology*, 87(2), 202-217.
- O'Connor, R., Notari-Syverson, A., & Vadasy, P. (1996). Ladders to literacy: The effects of teacher-led phonological activities for kindergarten children. *Exceptional Children*, 63(1), 117-130.
- O'Grady, G., & Hale, K. (1974). *Recommendations concerning bilingual education in the Northern Territory*. Parliamentary Paper No 329. Darwin, NT: Department of Education.
- Oates, L. (1999). The Summer Institute of Linguistics and Aboriginal-Islander research. *Aboriginal History Journal*, 23.
- Olson, R. K., Wise, B., Ring, J., & Johnson, M. (1997). Computer-based remedial training in phoneme awareness and phonological decoding: Effects on the posttraining development of word recognition, *Scientific Studies of Reading*, 1(3), 235-253.
- Ovando, C. J., Combs, M. C., & Collier, V. P. (2006). *Bilingual and ESL classrooms: Teaching in multicultural contexts* (4th ed.). Boston: McGraw-Hill.
- Papandropoulou, I., & Sinclair, H. (1974). What is a word? Experimental study of children's ideas on grammar. *Human Development*, 17(4), 241-258.
- Papen, U. (2016). *Literacy and education: Policy, practice, and public opinion*. New York, NY: Routledge.
- Pardo, L. (2004). What every teacher needs to know about comprehension. *The Reading Teacher*, 58(3), 272-280.

- Pearson, N. (2007). 'Noel Pearson: Native tongues imperilled'. *The Australian*. 10 March 2007.
- Perez, I. (2008). *Phonemic awareness: A step by step approach for success in early reading*. Lanham, MD: Rowman & Littlefield Education.
- Perfetti, C. A., Beck, I., Bell, L., & Hughes, C. (1987). Phoneme knowledge and learning to read are reciprocal: A longitudinal study of first grade children. *Merrill-Palmer Quarterly*, 33(3), 283-319.
- Perfetti, C. A., & Lesgold, A. M. (1979). Discourse comprehension and sources of individual differences. In P. A. Carpenter & M. A. Just (Eds.), *Cognitive processes in comprehension* (pp. 141–183). Hillsdale, NJ: Erlbaum.
- Phillips, B. M., Clancy-Menchetti, J., & Lonigan, C. J. (2008). Successful phonological awareness instruction with preschool children. *Topics in Early Childhood Special Education*, 28(1), 3-17.
- Phillips, B. M., Flynn, K. S., Tabulda, G. A., Jangra, S., & Lonigan, C. J. (2013). Parent involvement supporting early literacy achievement: Best practices for building the home and school environments. In D.M. Barone, & M. H. Mallette. (Eds.), *Best Practices in Early Literacy Instruction* (pp. 3 – 25). New York, NY: Guilford Press.
- Phillips, B. M., & Lonigan, C. J. (2009). Variations in the home literacy environment of preschool children: A cluster analytic approach. *Scientific Studies of Reading*, 13(2), 146-174.
- Phillips, B. M., & Torgesen, J. T. (2006). Phonemic awareness and reading: Beyond the growth of initial reading accuracy. In D. K. Dickinson & S. B. Neuman (Eds.),

- Handbook of early literacy research*. (Vol. 2. pp. 101-112) New York, NY: Guilford Press.
- Piasta, S. B., Phillips, B. M., Williams, J. M., Bowles, R. P., & Anthony, J. L. (2016). Measuring young children's alphabet knowledge: Development and validation of brief letter-sound knowledge assessments. *The Elementary School Journal*, 116(4), 524-548.
- Piasta, S. B., Purpura, D. J., & Wagner, R. K. (2010). Fostering alphabet knowledge development: A comparison of two instructional approaches. *Reading and Writing Quarterly*, 23(6), 607-626.
- Piasta, S. B., & Wagner, R. K. (2010). Learning letter names and sounds: Effects of instruction, letter type, and phonological processing skill. *Journal of Experimental Child Psychology*, 105(4), 324-344.
- Porter, R. P. (1990). *Forked tongue: The politics of bilingual education*. New York, NY: Basic Books.
- Powell, D. R., & Diamond, K. E. (2012). Promoting early literacy and language development. In R.C. Pianta, W. S. Barnett, L. M. Justice, & S. M. Sheridan (Eds.), *Handbook of early childhood education* (pp. 194-216). New York, NY: Guilford Press.
- Ramirez, J. D., Yuen, S., & Ramey, D. (1991). *Final report, longitudinal study of immersion strategy, early-exit and late-exit transitional bilingual education programs for language-minority children*. San Mateo, CA: Aguirre International.
- Ramsey, G. (2003) *Report on future directions for secondary education in the Northern Territory*. Darwin: Department of Employment, Education and Training, Northern

- Territory. Retrieved from: <https://www.nintione.com.au/resources/rao/report-on-future-directions-for-secondary-education-in-the-northern-territory/>
- Read, C., Zhang, Y.-N., Nie, H.-Y., & Ding, B.-Q. (1986). The ability to manipulate speech sounds depends on knowing alphabetic writing. *Cognition*, 24(1-2), 31-44.
- Reeders, E. (2008). The collaborative construction of knowledge in a traditional context. In J. Simpson & G. Wigglesworth (Eds.), *Children's language and multilingualism: Indigenous language use at home and school* (pp. 103-128). London, UK: Continuum.
- Reid, M. (1998). *Ministerial statement to the Northern Territory of Australia Legislative Assembly*. Parliamentary record of the eighth assembly first session 01/12/2000 parliamentary record no. 13.
- Reitsma, P., & Wesseling, R. (1998). Effects of computer-assisted training of blending skills in kindergartners. *Scientific Studies of Reading*, 2(4), 301-320.
- Rochdale Metropolitan Borough Council (2006). *Literacy changes lives: Rochdale Borough literacy policy*. Rochdale, England: Rochdale Council.
- Rowe, K. (1991). The influence of reading activity at home on students' attitudes towards reading, classroom attentiveness and reading achievement: An application of structural equation modelling. *British Journal of Educational Psychology*, 61(1), 19-35.
- Ruiz, R. (1984). Orientations in language planning. *NABE Journal*, 8(2), 15-34.
- Sampson, G. (1985). *Writing systems*. Stanford, CA: Stanford University Press.
- Santi, K., Menchetti, B., & Edwards, B. (2004). A comparison of eight kindergarten

- phonemic awareness programs based on empirically validated instructional principles. *Remedial and Special Education*, 25(3), 189-196.
- Savage, R. S., Abrami, P. C., Hipps, G., & Deault, L. (2009). A randomized controlled trial study of the ABRACADABRA reading intervention program in Grade 1. *Journal of Educational Psychology*, 101(3), 590-604.
- Savage, R. S., Abrami, P. C., Piquette, N., Wood, E., Deleveaux, G., Sanghera-Sidhu, S., & Burgos, G. (2013). A (Pan-Canadian) cluster randomized control effectiveness trial of the ABRACADABRA web-based literacy program. *Journal of Educational Psychology*, 105(2), 310-328.
- Schebeck, B. (1976). Ergative, locative and instrumental case inflections in Yuulngu. In R.M.W. Dixon (ed.) *Grammatical categories in Australian languages* (pp. 352-382). Canberra, Australia: Australian Institute of Aboriginal Studies Press.
- Schieffelin, B. B., & Ochs, E. (1986). *Language socialization across cultures*. New York, NY: Cambridge University Press.
- Schmalz, X., Marinus, E., Coltheart, M. & Castles, A. (2015). Getting to the bottom of orthographic depth. *Psychonomic Bulletin & Review*, 22(6), 1614-1629.
- Schmalz, X., Marinus, E., Robidoux, S., Palethorpe, S., Castles, A., & Coltheart, M. (2014). Quantifying the reliance on different sublexical correspondences in German and English. *Journal of Cognitive Psychology*, 26(8), 831–852.
- Schneider, W., Küspert, P., Roth, E., Visé, M., Marx, H. (1997). Short- and long- term effects of training phonological awareness in kindergarten: Evidence from two German studies. *Journal of Experimental Child Psychology*, 66(3), 311-340.
- Schuele, C., & Boudreau, D. (2008). Phonological awareness intervention: Beyond the

- basics. *Language, Speech, and Hearing Services in Schools*, 39(1), 3-20.
- Scrymgour, M. (2008a). Education restructure includes greater emphasis on English. *Northern Territory Government media release*. 14 October 2008. Retrieved from http://www.territorystories.nt.gov.au/jspui/bitstream/10070/216220/1/Scrymgour-141008-Education_restructure_includes_greater_emphasis_on_English.pdf
- Scrymgour, M. (2008b). '*Transforming Indigenous education*', (media release, 30 April 2008). Retrieved from: <http://newsroom.nt.gov.au/index.cfm?fuseaction=viewRelease&id=3989&d=5>
- Segers, E., & Verhoeven, L. (2005). Long-term effects of computer training of phonological awareness in kindergarten. *Journal of Computer Assisted Learning*, 21(1), 17-27.
- Seymour, P.H.K. (2005). Theoretical framework for beginning reading in different orthographies. In Joshi, R.M. & Aaron, P.G. (Eds.). *Handbook of orthography and literacy* (pp. 543-569). New Jersey: Lawrence Erlbaum Associates, Inc.
- Shankweiler, D., Crain, S., Katz, L., Fowler, A. E., Liberman, A. M., Brady, S. A., ... & Shaywitz, B. A. (1995). Cognitive profiles of reading-disabled children: Comparison of language skills in phonology, morphology, and syntax. *Psychological Science*, 6(3), 149-156.
- Share, D. L. (2004). Knowing letter names and learning letter sounds: A causal connection. *Journal of Experimental Child Psychology*, 88(3), 213-233.

- Share, D. L. (2008). On the Anglocentricities of current reading research and practice: The perils of overreliance on an “outlier” orthography. *Psychological Bulletin*, 134(4), 584–615.
- Share, D. L., Jorm, A. F., Maclean, R., & Matthews, R. (1984). Sources of individual differences in reading acquisition. *Journal of Educational Psychology*, 76(6), 1309-1324.
- Shaywitz, S. E. (2003). *Overcoming dyslexia: A new and complete science-based program for reading problems at any level*. New York, NY: Vintage Books.
- Siegel, J. (1985). Koines and koineization. *Language in Society*, 14(3), 357-378.
- Simpson, J., Caffery, J., & McConvell, P. (2009). Gaps in Australia's Indigenous language policy: Dismantling bilingual education in the Northern Territory. *AIATSIS Research Discussion*, 1(1), 1-47. Retrieved November 18, 2013, from the AIATSIS database.
- Skutnabb-Kangas, T. (2015). Language rights. In W. E. Wright, S. Boun, & O. Garcia (Eds.), *The handbook of bilingual and multilingual education* (pp. 185-202). Malden, MA: Wiley-Blackwell.
- Skutnabb-Kangas, T., & Toukomaa, P. (1976). *Teaching migrant children's mother tongue and learning the language of the host country in the context of the socio-cultural situation of the migrant family*. Helsinki, Finland: The Finnish National Commission for UNESCO.
- Slavin, R., & Cheung, A. (2005). A synthesis of research on language of reading instruction for English language learners. *Review of Educational Research*, 75(2), 247-284.

- Smith, S., Simmons, D., & Kameenui, E. (1998). Phonological awareness: Instructional and curricular basics and implications. In D. C. Simmons & E. J. Kameenui (Eds.), *What reading research tells us about children with diverse learning needs: Bases and basics* (pp. 129 -140). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Snellings, P., Leij, A., Blok, H., & Jong, P. (2010). Reading fluency and speech perception speed of beginning readers with persistent reading problems: The perception of initial stop consonants and consonant clusters. *Annals of Dyslexia*, 60(2), 151-174.
- Snow, C. E., Burns, M. S., & Griffin, P. (Eds.) (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.
- Snowling, M. J., Adams, J. W., Bishop, D. V., & Stothard, S. E. (2001). Educational attainments of school leavers with a preschool history of speech-language impairments. *International Journal of Language and Communication Disorders*, 36(2), 173-183.
- Stage, S., & Wagner, R. (1992). Development of young children's phonological and orthographic knowledge as revealed by their spellings. *Developmental Psychology*, 28(2), 287-296.
- Stahl, S. (1992). Saying the “p” word: Nine guidelines for exemplary phonics instruction. *The Reading Teacher*, 45(8), 618- 625.
- Stahl, S., & Murray, B. (1994). Defining phonological awareness and its relationship to early reading. *Journal of Educational Psychology*, 86(2), 221-234.
- Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual

- differences in the acquisition of literacy. *Reading Research Quarterly*, 21(4), 360-407.
- Stanovich, K. E. (1993). Romance and reality. *The Reading Teacher*, 47(4), 280-291.
- Stanovich, K. E., Cunningham, A. E., & Cramer, B. B. (1984). Assessing phonological awareness in kindergarten children: Issues of task comparability. *Journal of Experimental Child Psychology*, 38(2), 175-190.
- Stuart-Smith, J., & Martin, D. (1999). Developing assessment procedures for phonological awareness for use with Panjabi-English bilingual children. *The International Journal of Bilingualism*, 3(1), 55-80.
- Swank, L. K., & Catts, H. W. (1994). Phonological awareness and written word decoding. *Language, Speech, and Hearing Services in Schools*, 25(1), 9-14.
- Swanson, T., Hodson, B., & Schommer-Aikins, M. (2005). An examination of phonological awareness treatment outcomes for seventh-grade poor readers from a bilingual community. *Language, Speech, and Hearing Services in Schools*, 36(4), 336-345.
- Tam, V. C., & Chan, R. M. (2009). Parental involvement in primary children's homework in Hong Kong. *The School Community Journal*, 19(2), 81-100.
- Thomas, W. P., & Collier, V. (1997). *School Effectiveness of Language Minority Students*. Washington, DC: National Clearinghouse for Bilingual Education.
- Torgerson, C., Brooks, G., & Hall, J. (2006). *A systematic review of the research literature on the use of phonics in the teaching of reading and spelling*. Research Report No. 711. London: Department of Education and Skills.
- Torgesen, J. K., Morgan, S. T., & Davis, C. (1992). Effects of two types of phonological

- awareness training on word learning in kindergarten children. *Journal of Educational Psychology*, 84(3), 364-370.
- Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1994). Longitudinal studies of phonological processing and reading. *Journal of Learning Disabilities*, 27(5), 276-286.
- Torgesen, J. K., Wagner, R. K., Rashotte, C. A., Rose, E., Lindamood, P., Conway, T., & Garvan, C. (1999). Preventing reading failure in young children with phonological processing disabilities: Group and individual responses to instruction. *Journal of Educational Psychology*, 91(4), 579-593.
- Trehearne, M., & Healy, L. (2003). *Comprehensive literacy resource for kindergarten teachers*. Vernon Hills, IL: ERA Cuisenaire.
- Treiman, R., Tincoff, R., & Richmond-Welty, E. D. (1996). Letter names help children to connect print and speech. *Developmental Psychology*, 32(3), 505-514.
- Troia, G. A. (2016). Phonological processing deficits and literacy learning: Current evidence and future directions. In C. A. Stone, E. R. Silliman, B. J. Ehren, & G. P. Wallach (Eds.), *Handbook of language and literacy: Development and disorders*. New York, NY: Guilford Press.
- Troyer, A. (2011). Serial position effects. In J. Kreutzer, J. DeLuca, & B. Caplan (Eds.), *Encyclopedia of clinical neuropsychology* (pp. 2263-2264). New York, NY: Springer.
- Tunmer, W. E., Pratt, C. E., & Herriman, M. L. (Eds.) (1984). *Metalinguistic awareness in children: Theory, research, and implications*. New York, NY: Springer-Verlag.

- U.S. Bureau of Labor Statistics (2018). *Unemployment rates and earnings by educational attainment 2017*. [Data file]. Retrieved from <https://www.bls.gov/emp/tables/unemployment-earnings-education.htm>
- Uibo, M. (1993). The development of Batchelor College 1972–1990: An historical account (Unpublished MEd Project). Faculty of Education, Northern Territory University. Retrieved from espace.cdu.edu.au/eserv/cdu:13185/Thesis_CDUE_13185_Uibo_M.pdf.
- UNESCO (1953). *The use of the vernacular languages in education*. Monographs on Foundations of Education, No. 8. Paris: UNESCO.
- Vacca, J. L., Vacca, R. T., Gove, M. K., Burkey, L. C., Lenhart, L. A., & McKeon, C. A. (2012). *Reading and learning to read* (8th ed.). Boston, MA: Pearson.
- Verhoeven, L. (1991). Acquisition of biliteracy: Reading in two languages. *AILA Review*, 8, 61-74.
- Vloedgraven, J., & Verhoeven, L. (2009). The nature of phonological awareness throughout the elementary grades: An item response theory perspective. *Learning and Individual Differences*, 19(2), 161-169.
- Wagner, R. K., Torgesen, J. K., Laughon, P., Simmons, K., & Rashotte, C. A. (1993). Development of young readers' phonological processing abilities. *Journal of Educational Psychology*, 85(1), 83-103.
- Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (1994). Development of reading-related phonological processing abilities: New evidence of bidirectional causality from a latent variable longitudinal study. *Developmental Psychology*, 30(1), 73-87.

Walker, A.T. (1984). *The Yolngu stop controversy: Wood's prosodic hypothesis revisited.*

In the collection of 1984 A.L.S. Pre-circulation Conference Papers: 109-120.

Alice Springs.

Watson-Verran, H. (1992). *We've heard that you teach maths through kinship? A Garma maths course of study in the Yirrkala and Laynhapuy schools community.*

Yirrkala: Literature Production Centre.

Watts, B. (Ed.). (1971). *Report of the National Workshop on Aboriginal education:*

Priorities for action and research. Brisbane: Department of Education and the University of Queensland.

Watts, B., Gallacher, J., & Aust. Dept. of Territories (1964). *Report on an investigation into the curriculum and teaching methods used in Aboriginal schools in the Northern Territory to C. E. Barnes, Minister of State for Territories.* Darwin, N.T.: Government Printer.

Watts, B., McGrath, W., & Tandy, J. (1973a). Extracts from – Bilingual Education in Aboriginal Communities in the Northern Territory. Canberra: Department of Education. In *Aboriginal Child School* 1(1): 46-51.

Watts, B., McGrath, W., & Tandy, J. (1973b). Further extracts from – Bilingual Education in Aboriginal Communities in the Northern Territory. Canberra: Department of Education. In *Aboriginal Child School* 1(2): 46-52.

Weinberger, J. (1996). A longitudinal study of children's early literacy experiences at home and later literacy development at home and school. *Journal of Research in Reading*, 19(1), 14-24.

White, Leon. (2015). Personal Interview.

- Whitehead, Banbapuy (2015). Personal Interview.
- Whitlam, G. (1972). Aboriginal education assistance. [Prime minister's press statement, no. 16, December 14, 1972]. Retrieved December 18, 2019 from <https://pmtranscripts.pmc.gov.au/release/transcript-2748>
- Wigglesworth, G., & Simpson, J. (2018). Going to school in a different world. In G. Wigglesworth, J. Simpson, & J. Vaughan (Eds.), *Language practices of Indigenous children and youth: The transition from home to school* (pp. 1-20). London, UK: Palgrave Macmillan.
- Wigglesworth, G., Simpson, J., & Loakes, D. (2011). NAPLAN language assessments for Indigenous children in remote communities: Issues and problems. *Australian Review of Applied Linguistics*, 34(3), 320-343.
- Wild, M. (2009). Using computer-aided instruction to support the systematic practice of phonological skills in beginning readers. *Journal of Research in Reading*, 32(4), 413-432.
- Wild, R., & Anderson, P. (2007). Ampe akelyernemane meke mekarle 'Little children are Sacred': Report of the Northern Territory Board of Inquiry into the Protection of Aboriginal Children from Sexual Abuse. Darwin: Government Printer.
- Wilkinson, M. (1991). *Djambarrpuyŋu: A Yolŋu variety of Northern Australia* (PhD thesis). University of Sydney, Sydney, Australia.
- Wolgemuth, J. R., Savage, R., Helmer, J., Harper, H., Lea, T., Abrami, P. C., ... Loudon, W. (2013). ABRACADABRA aids Indigenous and non-Indigenous early literacy in Australia: Evidence from a multisite randomized controlled trial. *Computers and Education*, 67, 250-264.

- Wood, R. (1978). *Some Yuulngu phonological patterns*. In Papers in Australian Linguistics No. 11 (pp. 53-118). Canberra, Australia: Pacific Linguistics.
- Woolley, G. (2011). *Reading comprehension: Assisting children with learning difficulties*. Dordrecht: Springer.
- Worden, P. E., & Boettcher, W. (1990). Young children's acquisition of alphabet knowledge. *Journal of Reading Behavior*, 22(3), 277-295.
- Yirrkala Literature Production Centre (Yirrkala LPC) (1991). *Yirrkala Community School: A report on the bilingual program for the 1990 bilingual evaluation*. Yirrkala: Literature Production Centre.
- Yirrkala Literature Production Centre (Yirrkala LPC) (2014). *Yirrkala school induction handbook*. Yirrkala: Literature Production Centre.
- Yopp, H. K. (1988). The validity and reliability of phonemic awareness tests. *Reading Research Quarterly*, 23(2), 159–177.
- Yunupingu, Y. (2010). Bilingual Works. *Australian Educator*, 66, 24-25.
- Yunupingu, Y. (2015, December). *Yalmay's story*. Video presented as an assessment requirement for the Australian Graduate Teacher Standards, Yirrkala, NT.
- Zmyvalova, E. A. (2015). Indigenous children's right to learn their mother tongue at school: Implementation and realization in Russia. *Arctic Review of Law and Politics*, 6(2), 151-174.

APPENDIX A

iLe11 QUESTIONS & WORD GLOSS

The following is a list of the 20 questions asked in iLe11 (the Assessment App). Note that the app's audio is entirely delivered in Dhuwaya. However, English translations are given here for readability purposes. Task items (target words and distractor words) are left in Dhuwaya.

1. Find the letter that makes the /a/ sound.
2. Find the letter that makes the /l/ sound.
3. Find the letter that makes the /ŋ/ sound.
4. Find the letter that makes the /i/ sound.
5. Find the letter that makes the /r/ sound.
6. Find the letter that makes the /k/ sound.
7. These pictures are guya, bāpi, waṭu, and māṇa. Find the one that starts with /gu/.
8. These pictures are bathi, ḍowu, mapu, and lorri. Find the one that starts with /ma/.
9. These pictures are gara, bolu, raŋi, and ṇaku. Find the one that ends with /ku/.
10. These pictures are yalu, mapu, buku, and ṇāṭi. Find the one that starts with /m/.
11. These pictures are wāṇa, lorri, ḍjāri, and ṇaku. Find the one that starts with /dj/.
12. These pictures are bārr, mel, ḍjeṭ, and goṇ. Find the one that ends with /l/.
13. These pictures are borum, dawurr, ḷikan, and gārak. Find the one that ends with /k/.
14. These pictures are bāru, weṭi, guya, and rupu. Find what you get when you put bā...pause...ru together. Find bā...pause...ru.
15. The pictures are ḍjuku, māṇa, ḷalu, and weṭi. Find what you get when you put we...pause...ṭi together. Find we...pause...ṭi.
16. These pictures are daruma, muthali, djitama, and yiḍaki. Find what you get when you put mu...pause...tha...pause...li together. Find mu...pause...tha...pause...li.
17. These pictures are ḍjeṭ, mel, bārr, and goṇ. Find what you get when you put /m/...pause.../e/...pause.../l/ together. Find /m/...pause.../e/...pause.../l/.
18. These pictures are goṇ, ḍetj, ḍjät, and ṇäl. Find what you get when you put /g/...pause.../o/...pause.../ŋ/ together. Find /g/...pause.../o/...pause.../ŋ/.
19. These pictures are raŋi, retja, rrāma, and wāṇa. Find what you get when you put /r/...pause.../a/...pause.../m/...pause.../a/ together. Find /r/...pause.../a/...pause.../m/...pause.../a/.
20. These pictures are yothu, ḍowu, yiki, and ṇatha. Find what you get when you put /ŋ/...pause.../a/...pause.../th/...pause.../a/ together. Find /ŋ/...pause.../a/...pause.../th/...pause.../a/.

Gloss

- guya: generic term for fish
- bāpi: generic term for snake
- watu: dog
- māna: shark
- bathi: basket
- dowu: wave
- mapu: egg
- lorri: truck
- yalu: nest
- buku: face
- ŋāti: ant
- wāna: home
- djāri: rainbow
- ŋaku: canoe
- bārr: scar
- mel: eye
- djet: white breasted eagle
- goŋ: hand
- borum: fruit
- dawurr: street, road, path
- likan: elbow
- gārak: sky
- bāru: crocodile
- weti: kangaroo
- rupu: possum
- djuku: head lice
- lalu: parrot fish
- daruma: seashell
- muthali: duck
- djitama: yam
- yidaki: didgeridoo
- detj: grasshopper
- djāt: T-shirt
- ŋāl: saliva
- raŋi: beach
- retja: jungle
- rrāma: clouds at sunset
- yothu: baby, child
- yiki: knife
- ŋatha: food

APPENDIX B

ORAL ASSESSMENT TEST ITEMS

List of test items presented in the syllable segmentation task:

1.	r <u>r</u> epa	red color of clouds or trees at sunset
2.	ḍ <u>a</u> wu	Banyan tree
3.	ma <u>y</u> pal	shellfish
4.	g <u>u</u> lapa	tea
5.	djiny <u>d</u> jalma	crab
6.	mi <u>y</u> apunu	turtle, sea mammal meat or flesh
7.	d <u>j</u> amarrkuli	children

List of test items presented in the phoneme segmentation task:

1.	ma	okay
2.	go	come here, come on
3.	ṇ <u>ä</u> l	saliva
4.	d <u>j</u> eṭ	white breasted sea eagle
5.	ṇ <u>a</u> ma	Jabiru bird
6.	ḍ <u>a</u> wu	Banyan tree

Word Recognition Task - List One

1.	ṇ <u>e</u>	yes
2.	y <u>o</u>	yes
3.	ma	okay
4.	me <u>l</u>	eye
5.	y <u>o</u> l	who?
6.	g <u>a</u>	and
7.	nh <u>ä</u>	what?
8.	dh <u>ä</u>	mouth
9.	ḍ <u>ä</u> l	break, crack, hit
10.	ro <u>m</u>	law, culture

Word Recognition Task - List Two

1.	nyäl	lies, lying, untrue, make-believe
2.	djäl	like, want
3.	mala	group
4.	ḍawu	Banyan tree
5.	ṇama	Jabiru bird
6.	ḍetj	grasshopper
7.	gol	school
8.	ṇatha	food
9.	rrepa	red color of clouds or trees at sunset
10.	buku	face

APPENDIX C

ileL2 ACTIVITY DESCRIPTIONS

C.1 THE SEGMENTATION ACTIVITY

Every time the game is played, the first screen that appears gives instructions for the activity. Then, the app's voice over demonstrates how to play the game by talking the children through two examples. In the examples, the app presents the stimulus and then models the correct way to answer questions. The following is an example of the script for the instructions and the two demonstrating examples. Note that all of the app's audio is in Dhuwaya. English translations are used here to better help the reader understand.

1. "Let's play a game. Tuck the crocodile is hungry. Feed him one fish for each sound you hear. Drag the fish from the bucket to Tuck the crocodile's bowl." Press on Tuck if you want to hear the sounds again. Press the green button when you are finished feeding the crocodile."
2. "Let's try one together."
3. /m/
4. "I heard one sound, /m/, so I will drag one fish into Tuck the crocodile's bowl." *One fish is dragged from the bucket of fish to the crocodile's bowl.*
5. "I am pressing the green button because I am finished feeding Tuck." *The app shows the green button being pressed.*
6. That's right. You heard one sound: /m/." *As the sound /m/ is heard the fish in the crocodile's bowl is highlighted. Then, the crocodile eats the fish.*
7. "Let's try another one."
8. 'goŋ'
9. "I want to hear that again so I am pressing Tuck the crocodile." *The crocodile is clicked and highlighted. The stimulus is repeated.*
10. "I heard three sounds: [g].../u:/.../ŋ/, so I will drag three fish into Tuck the crocodile's bowl." *Three fish are dragged from the bucket of fish into the crocodile's bowl. The green button is clicked and highlighted.*
11. "That's right! You heard three sounds: [g].../u:/.../ŋ/." *One fish in the bowl is highlighted as each sound is heard. Then the crocodile eats the fish.*
12. "Now you try some on your own."

After the two examples, there are 6 stimuli for this activity on each level. For every response given by the child, whether correct or incorrect, the app gives feedback (once

the green button is pressed):

-If the children answer correctly (they feed the crocodile two fish after hearing ‘ma’ for example): then the voice-over says “great job, you heard two sounds: /m/.../a/.”

One fish from the croc’s bowl lights up for each sound as the stimulus is repeated. One fish lights up for the /m/ sound and another for the /a/ sound. Then the crocodile eats the fish. The next question appears

-If the children answer incorrectly: then the voice-over says “no you did not hear one/two/three/four (depending on what they answered) sound/s. Listen carefully and try again.”

-The children only get two chances to answer correctly. If they answer correctly the second time: the same feedback previously explained for a correct answer is heard.

- If the children answer incorrectly a second time: then the voice-over says “No you did not hear X amount of sounds. You heard two sounds: /m/.../a/. *One fish from the croc’s bowl lights up for each sound as the stimulus is repeated. One fish lights up for the /m/ sound and another for the /a/ sound. Any missing fish are added to the bowl. Any extra fish are returned to the bucket (see below). The crocodile eats the fish. The next question appears.*

During the final feedback (after a correct answer or the second incorrect answer), for levels 1 – 16, one fish is highlighted as each sound is heard:

-If the correct number of fish is in the croc’s bowl: One fish from the crocodile’s bowl is highlighted as /m/ is heard and another fish is highlighted when /a/ is heard. Then the crocodile eats the fish. Next question appears.

-If there aren’t enough fish in the croc’s bowl: Fish in the bucket are highlighted during the feedback so that one fish is still highlighted for each sound. Then those

fish are dragged into the croc's bowl before he eats them; e.g. If the stimuli is 'ma' and there is only one fish in the crocodile's bowl, then the fish in the bowl lights up for /m/ and one fish from the bucket lights up when the /a/ is heard. That fish is then dragged into the croc's bowl. Then the crocodile eats the fish. Next question appears.

- If there are too many fish in the croc's bowl: One fish in the croc's bowl lights up for each sound. Any extra fish are dragged back into the bucket. Then the crocodile eats the fish left in the bowl. Next question appears.

For levels 17-24, the letter that represents the sound appears on the fish as each sound is heard. When the /m/ sound is heard, the letter M appears on one of the fish in the crocodile's bowl. When the /a/ sound is heard, the letter A appears on one fish in the bowl. If there are not enough fish in the bowl then the letter appears on one of the fish in the bucket. That fish is then dragged into the crocodile's bowl. Then the crocodile eats the fish. The next question appears. If there are too many fish in the croc's bowl, then the fish that did not receive a letter are returned to the bucket. Then the crocodile eats the fish and the next question appears.

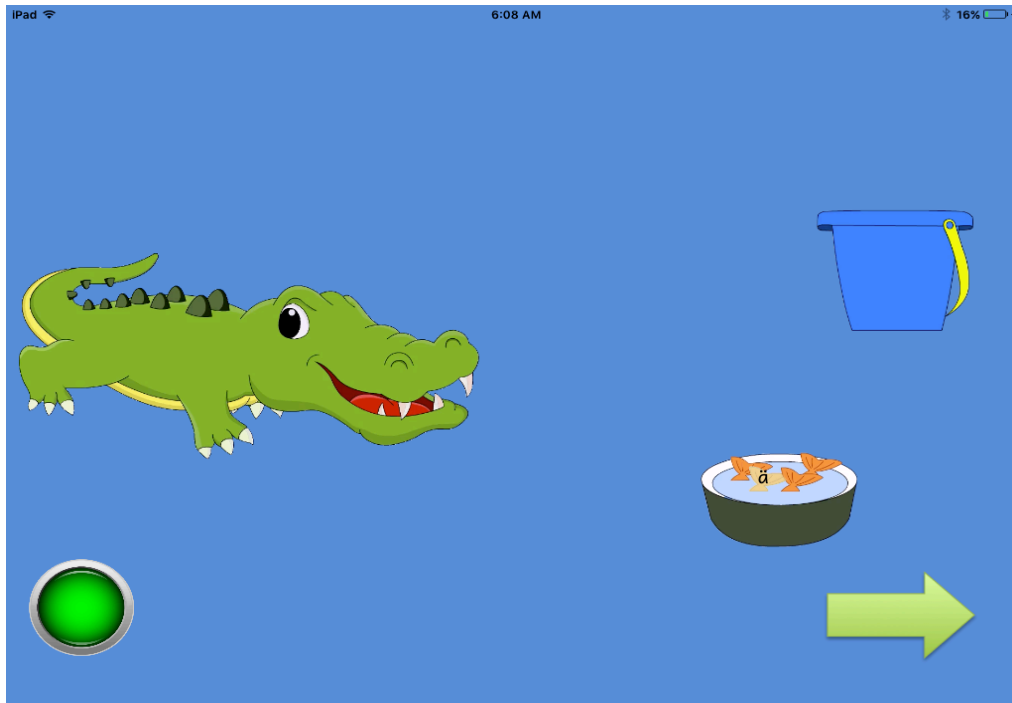


Figure C.1 – Screenshot of iLel2’s segmentation activity with letter appearing on fish during feedback.

For levels 1-8 there are two fish in the bucket for the children to choose from.
 For levels 9- 16 there are three fish in the bucket for the children to choose from.
 For levels 17- 24 there are four fish in the bucket for the children to choose from.
 The bucket of fish is replenished for each new question.

C.2 THE LETTER KNOWLEDGE ACTIVITY

The same letter-sound pair is practiced for three consecutive levels but the activity presented after the letter introduction screen is recursive:

Levels 1-3 introduce the same letter.
 Levels 4-6 introduce the same letter.
 Levels 7-9 introduce the same letter.
 Levels 10-12 introduce the same letter.
 Levels 13-15 introduce the same letter.
 Levels 16-18 introduce the same letter.
 Levels 19-21 introduce the same letter.
 Levels 22-24 will introduce the same letter.

Levels 1, 4, 7, 10, 13, 16, 19, and 22 present the “Find all the Letter Xs” letter search activity.

Levels 2, 5, 8, 11, 14, 17, 20 and 23 present the “Find all the letters that make the sound x” activity.

Levels 3, 6, 9, 12, 15, 18, 21 and 24 present the kangaroo activity.

C.3 THE BLENDING ACTIVITY

The first screen for this activity on each level shows the instructions for the activity followed by two demonstrations of how to play the game. The following is an example of the script for the instructions and the two demonstrations. Note that all of the app’s audio is in Dhuwaya. English translations are used here to better help the reader understand.

1. “Let’s play a game. Spotty the turtle speaks really slowly. Can you guess what word he is saying? Listen to the word and then press on the picture of the word you think Spotty the turtle is saying. Press Spotty the turtle if you want to listen to him again. Press the green button when you are finished choosing a picture.”

2. “Let’s try one together.”

3. “These pictures are *bäpi*, *gara*, *ṇaku*, and *guya*⁷⁹. Find what you get when you put /ba:/ ... (pause)... and /pi/ together. Find /ba:/ (pause) /pi/.”

4. “/ba:/ (pause) /pi/. *bäpi*. I think Spotty the turtle is saying *bäpi* so I am pressing the picture of the *bäpi*.” *The picture of the bäpi (a snake) is highlighted.*

5. “I am pressing the green button because I am finished choosing a picture.” *The green picture is highlighted.*

6. “Great Job! Let’s try another one.”

7. “These pictures are *buku*, *weṭi*, *ṇatha* and *ḷuku*⁸⁰. Find what you get when you put /ṇa/ ... (pause)... and /ṭa/ together. Find /ṇa/ (pause) /ṭa/.”

8. “I am pressing the turtle because I want to listen to the turtle again.” *The turtle is highlighted while this audio clip is heard. The stimulus is repeated.*

9. “/ṇa/ (pause) /ṭa/. *ṇatha*. I think Spotty the turtle is saying *ṇatha* so I am pressing the picture of *ṇatha*.” *The picture of ṇatha (food) is highlighted when this audio clip is heard. The green button is highlighted.*

10. “Great job! Now you try some on your own.”

After the two examples, there are 6 stimuli for this activity on each level. For every response given by the child, whether correct or incorrect, the app’s voice-over gives feedback:

- If the children answer correctly on the first try they hear: “Great Job. /ba:/ (pause)

⁷⁹ *bäpi* = generic term for snake, *gara* = spear, *ṇaku* = canoe, *guya* = generic term for fish.

⁸⁰ *buku* = face, *weṭi* = kangaroo, *ṇatha* = food, *ḷuku* = foot, toe, footprints

/ɪu/. bäru. Spotty the turtle said bäru.” *The next question appears.*

-If they answer incorrectly they hear: “incorrect, listen carefully and try again.”

- If they answer correctly the second time, they hear the same feedback given for correct responses.

- Children only get two tries to respond correctly. If they answer incorrectly a second time they hear: incorrect, /ba:/ (pause) /ɪu/. bäru. Spotty the turtle said bäru.

The correct picture is highlighted. The next picture appears.

For levels 17-24, letters begin to appear on the screen **when the stimulus is first given.**

The letters are then highlighted every time they are repeated. For example:

“These pictures are bäpi, gara, naku, and guya⁸¹. Find what you get when you put [b] *[the letter b appears on the top of the screen]* ... pause... /a:/ *[the letter ä appears on the top of the screen]* ... pause... /p/ *[the letter p appears on the top of the screen]* ...pause...and /i/ *[the letter i appears on the top of the screen]* together. Find [b] *[the letter b is highlighted]* ... pause... /a:/ *[the letter ä is highlighted]* ... pause... /p/ *[the letter p is highlighted]* ...pause...and /i/ *[the letter i is highlighted]* together.”

⁸¹ *bäpi* = generic term for snake, *gara* = spear, *naku* = canoe, *guya* = generic term for fish



Figure C.2 – Screenshot of iLel2’s blending activity with letters appearing on screen after stimulus is first given.

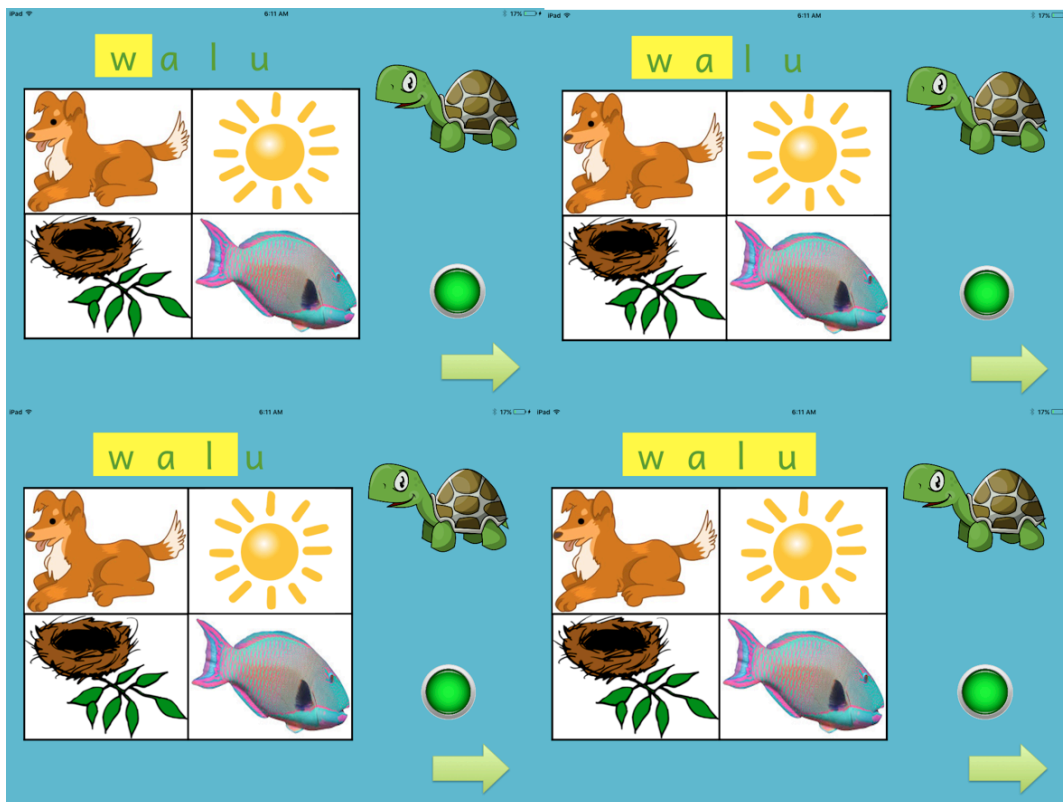


Figure C.3 – Screenshots of iLel2’s blending activity with letters being highlighted as their corresponding sounds are heard for a second time.

C.4 LEVEL DESIGN

The following table lists some iLe12 level details that should be noted but have not yet been discussed.

Segmentation Activity Column:

The segmentation activity gets more difficult as it moves from syllables to phonemes. The segmentation activity column lists whether the level targets syllables or phonemes. Throughout the levels, the app offers a different number of fish to move from the bucket. The more fish in the bucket, the harder it is for children to guess the correct answer. This column lists how many fish are displayed in the bucket. Finally, this column takes note if letters are presented on the fish during the feedback (see section C.1).

Letter Knowledge Activity Column:

The letter knowledge activity column lists what letter is introduced in each level and which activity is presented.

Blending Activity Column:

The blending activity column lists whether the level targets syllables or phonemes. This column also takes note if letters are presented on the top of the screen as each sound is heard when the question and feedback are heard (see section C.3).

Table C.1*iLel2 Activity Characteristics by Level*

Level	Segmentation/ Crocodile Activity	Letter Knowledge	Blending/ Turtle Activity
1	-Segmenting syllables -2 fish in bucket	-Introduces M -Letter search: name	-Blending syllables
2	-Segmenting syllables -2 fish in bucket	-Introduces M -Letter search: sound	-Blending syllables
3	-Segmenting syllables -2 fish in bucket	-Introduces M -Kangaroo activity	-Blending syllables
4	-Segmenting syllables -3 fish in bucket	-Introduces A -Letter search: name	-Blending syllables
5	-Segmenting syllables -3 fish in bucket	-Introduces A -Letter search: sound	-Blending syllables
6	-Segmenting syllables -4 fish in bucket	-Introduces A -Kangaroo Activity	-Blending syllables
7	-Segmenting syllables -4 fish in bucket	-Introduces D -Letter search: name	-Blending syllables
8	-Segmenting syllables -4 fish in bucket	-Introduces D -Letter search: sound	-Blending syllables
9	-Segmenting phonemes -2 fish in bucket	-Introduces D -Kangaroo Activity	-Blending phonemes
10	Segmenting phonemes -2 fish in bucket	-Introduces I -Letter search: name	-Blending phonemes
11	Segmenting phonemes -2 fish in bucket	-Introduces I -Letter search: sound	-Blending phonemes
12	Segmenting phonemes -2 fish in bucket	-Introduces I -Kangaroo activity	-Blending phonemes
13	Segmenting phonemes -3 fish in bucket	-Introduces RR -Letter search: name	-Blending phonemes
14	Segmenting phonemes -3 fish in bucket	-Introduces RR -Letter search: sound	-Blending phonemes
15	Segmenting phonemes -3 fish in bucket	-Introduces RR -Kangaroo activity	-Blending phonemes
16	Segmenting phonemes -3 fish in bucket	-Introduces U -Letter search: name	-Blending phonemes
17	-Segmenting phonemes -3 fish in bucket - Letters appear on fish during feedback	-Introduces U -Letter search: sound	-Blending phonemes -Letters appear on top of screen when stimulus is played

18	-Segmenting phonemes -3 fish in bucket - Letters appear on fish during feedback	-Introduces U -Kangaroo activity	-Blending phonemes -Letters appear on top of screen when stimulus is played
19	-Segmenting phonemes -3 fish in bucket - Letters appear on fish during feedback	-Introduces G -Letter search: name	-Blending phonemes -Letters appear on top of screen when stimulus is played
20	-Segmenting phonemes -3 fish in bucket - Letters appear on fish during feedback	-Introduces G -Letter search: sound	-Blending phonemes -Letters appear on top of screen when stimulus is played
21	-Segmenting phonemes -3 fish in bucket - Letters appear on fish during feedback	-Introduces G -Kangaroo activity	-Blending phonemes -Letters appear on top of screen when stimulus is played
22	Segmenting phonemes -4 fish in bucket - Letters appear on fish during feedback	-Introduces W -Letter search: name	-Blending phonemes -Letters appear on top of screen when stimulus is played
23	Segmenting phonemes -4 fish in bucket - Letters appear on fish during feedback	-Introduces W -Letter search: sound	-Blending phonemes -Letters appear on top of screen when stimulus is played
24	Segmenting phonemes -4 fish in bucket - Letters appear on fish during feedback	-Introduces W -Kangaroo activity	-Blending phonemes -Letters appear on top of screen when stimulus is played

APPENDIX D

PHONOLOGICAL AWARENESS DEVELOPMENTAL CHART BASED ON CHILDREN COMING FROM LITERACY BASED CULTURES

This chart was developed and proposed by Kid Sense Child Development. See Kid Sense Child Development (2017) in References.

Age	Developmental milestones	Possible implications if milestones not achieved
0-2 years	• No specific milestones	• None
2-3 years	• Rhyme awareness emerges at 24–30 months	• None
3-4 years	• Ability to produce rhyme emerges at 30-36 months	• The child may struggle with recognising similarities in letter patterns in words (e.g. cat, hat, mat, bat)
4-5 years	• Clapping/counting syllables in words (e.g. computer- com-pu- ter). [Note: 50% of children achieve this by age 4] • Recognises/produces words with the same beginning sound (e.g. cat – cup) • Segments/blends words by onset/rime (e.g. s+un= sun) OR given sounds, can blend them into a word • Counts sounds in words (e.g. dog-d-o-g = 3 sounds). [Note: 50% of children achieve this by age 5]	• The child may struggle with spelling longer words accurately as they will be unable to chunk them into smaller more manageable parts • The child may have difficulty articulating longer words and recognising similar word patterns • The child may have difficulty with spelling words accurately
5-6 years	• Able to recognise words that rhyme and determine the odd word out (e.g. cat – hat – big) • Identifies first sound in a word (e.g. What’s the sound at the start of ‘dog’? d) • Identifies last sound in a word (e.g.	• The child may have trouble spelling words correctly if they are unable to hear the individual sounds in different positions within words • The child may struggle with recognising that joining sounds together creates whole words and

	What's the sound at the end of 'dog'? g) • Lists words that start with the same sound (e.g. pet, pin) • Tells which of three words is different (e.g. sit, sit, sat) • Blends 3 – 4 sounds to make a word (e.g. h – a – n – d = hand) • Segments sounds in words that have 3 – 4 sounds (e.g. hand= h – a – n – d:4 sounds)	with reading words smoothly
6-7 years	• Delete syllables from words (e.g. Say 'cupcake'. Take away 'cup' and what is left? cake) • Substitute syllables in words • Delete sounds from words (e.g. Say feet. Take away the 'f' sound from 'feet'? eat) • Substitute sounds in words (e.g. Say hat. Change the 'h' to a 'c' – cat)	• If a child struggles with manipulating sounds in words, they may not be able to recognise similar letter/sound patterns within words • The child may struggle with creating a visual representation of a word and to hold onto that image in their mind as they manipulate (change) sounds to create new words
7-8 years	• Uses phonological awareness skills when spelling	• The child may have difficulty with spelling words correctly • The child may struggle with reading words accurately and fluently