Pamela J. February

Teaching and Learning to Read in Afrikaans

Teacher Competence and Computer-assisted Support

UNIVERSITY OF JYVÄSKYLÄ

FACULTY OF EDUCATION AND
PSYCHOLOGY

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ABSTRACT

This thesis is in the form of a monograph consisting of three distinct, but related studies. The three studies examined Grade 1 teachers' knowledge and perceptions of reading instruction in classrooms in Namibia; and the use of GraphoGame in Afrikaans as a digital learning tool and as an intervention tool for struggling readers. Three data sets were collected: teachers (N = 132), children (N = 202) and struggling readers (N = 19). The results offered three main findings. First, the results revealed that teachers lacked basic knowledge regarding language and reading instruction. Second, the effect of using the GraphoGame Afrikaans digital reading tool in the classroom showed that the gain scores of the learners who played GraphoGame Afrikaans were higher than those of learners who formed the two control groups (i.e. the GraphoMath group who played a digital mathematics tool and the no-treatment control group) in reading skills. Additionally, the results revealed that the two groups that played a digital game (GraphoGame Afrikaans or GraphoMath Afrikaans) during the intervention phase showed higher gains than the control group that did not play. The results also revealed that playing GraphoGame Afrikaans for an extended period vastly improved the reading skills of struggling readers. The evaluation of the struggling readers' motivation revealed mixed results. Although the learners themselves had a strong self-concept and a high regard for their classroom tasks, their classroom teachers observed that they tended to avoid tasks in which they struggled. When one considers the learners' high self-concept and motivation, which show that struggling learners have strengths, there is much hope for Namibian children' reading acquisition.

Keywords: reading skills, reading instruction, GraphoGame, Afrikaans, computer-assisted reading intervention, motivation

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TIIVISTELMÄ (FINNISH ABSTRACT)

Väitöskirja koostuu kolmesta toisiaan täydentävästä osatutkimuksesta. Tutkimuksessa selvitettiin ensimmäisen luokan opettajien tietämystä ja näkemyksiä lukemaan opettamisesta Namibiassa, tutkittiin afrikaans kielistä GraphoGame tietokonepeliä lukemaan oppimisen tukena luokassa ja interventiovälineenä lapsilla, joilla oli lukemisvaikeuksia. Tutkimusaineisto koostui opettajien kyselyaineistosta (N = 132), ensimmäisen luokan oppilaiden aineistosta (N = 202) ja lukivaikeuslasten aineistosta (N = 19). Ensinnä havaittiin, että opettajien perustiedot afrikaans kielen rakenteesta ja lukemaan opettamisesta olivat puutteelliset. Toiseksi havaittiin, että lukemiseen liittyvät taidot edistyivät nopeammin lapsilla, jotka pelasivat luokassa afrikaansin kielistä GraphoGame tietokonepeliä kuin muihin ryhmiin kuuluneilla lapsilla (GraphoMath matematiikan tietokonepeliä pelannut ryhmä ja kontrolliryhmä, joka ei pelannut kumpaakaan tietokonepeliä). Lisäksi havaittiin, että GraphoGame tai GraphoMath tietokonepeliä pelanneiden lasten lukemiseen liittyvät taidot edistyivät nopeammin kuin kontrolliryhmän lasten taidot. Interventiotutkimus osoitti, että lapsilla, joilla oli lukivaikeutta, GraphoGame afrikaans tietokonepelin pelaamisen jatkaminen toisella luokalla edisti lukemiseen liittyvien taitojen kehitystä. Lukivaikeuslasten motivaatiota koskevat havainnot olivat ristiriitaisia. Vaikka lasten itsearvioitu minäkuva oli erittäin myönteinen ja he pitivät paljon koulutehtävistä, opettajan havaintojen mukaan he välttelivät tehtäviä, jotka olivat heille vaikeita. Lasten lukutaidon edistämiseksi Namibiassa on rohkaisevaa, että lapsilla, joilla on lukivaikeutta, on vahvuutena myönteinen minäkuva ja kiinnostus oppimiseen.

Avainsanat: lukutaito, lukemaan opettaminen, GraphoGame, afrikaans, tietokoneavusteinen lukutaidon interventio, motivaatio

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would have struggled to complete my thesis. The time meant that I could spend short periods in Finland under the close guidance of my supervisors. It was during these periods that I made progress by leaps and bounds.

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1   INTRODUCTION TO THE THESIS

Namibia is a sparsely populated country (2.1 million people in an 825 km² area) situated in South West Africa that became independent from South Africa in 1990; its government believes that education is essential for the development of the country (Namibia Statistics Agency, 2013). Education is vital to guaranteeing sustainable economic growth and creating a platform so all its citizens have the potential to participate in its growth (UNESCO, 2016). The Namibian government's commitment to education has been phenomenal, especially regarding financial input when compared to most African countries. The EFA Global Monitoring Report shows that Namibia invested 24% of its 2010 budget to education (UNESCO, 2015). This allocation is between 6 and 7% of Namibia's GDP, making Namibia one of the countries with the highest percentage of GDP allocated to education in the world (Katjavivi, 2016). Unfortunately, despite its considerable investment, when the return is measured by how learners fare in schools, especially in reading and mathematics, the results have not been encouraging.

Evidence shows that Namibian learners are not reading at the desired level. The Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ) Reports (Hungi et al., 2010) show poor English reading levels in Grade 6, while the Early Grade Reading Assessment (EGRA; Gains & Parkes, 2012) scores demonstrate poor mother tongue reading performance and English as a second language in lower primary grades (i.e. grades 1-3). These results are echoed by the Namibian National Standardized Achievements Test (NSAT) scores for grades 5 and 7 in English (Hanse-Himarwa, 2015; Nhongo, 2014).

To paraphrase Moats (1999), the tragedy is that most reading failures can be prevented. She claims that when classroom practices encompass well-researched components and practices, these can improve and even reduce the rate of reading difficulties. Consequently, the present thesis will examine these components and practices and suggest possible solutions to mitigate poor reading outcomes in Namibia. Accordingly, this thesis first examines teachers' knowledge and perceptions of reading instruction as a factor that impacts effec-

tive reading acquisition. Second, as a possible solution to the critical reading situation, the study investigates the use of GraphoGame (GG; Richardson & Lyytinen, 2014) in Afrikaans as a digital learning tool, and finally, the thesis examines the use of GraphoGame as an intervention tool for struggling readers in junior primary grades.

1.1   Education system in Namibia

Namibia's latest education system (table 1) was implemented in staggered phases in 2015, starting with the junior primary phase. It includes 13 years of schooling separated into four school phases. (Ministry of Education, Arts and Culture, 2015b; Sasman, 2012). A typical school year in Namibia (January to December) ranges between 195 and 200 days and is divided into three semesters (UNESCO, 2013).

TABLE 1   Namibian education structure

Phase	Grades
Junior Primary (4 years)	Pre-Primary and Grades 1-3 (ages 5-8, which is within the scope of Early Childhood Development)
Senior Primary (4 years	Grades 4-7 (ages 9-12)
Junior Secondary (2 years)	Grades 8-9 (ages 13-14/15)
Senior Secondary (3 years)	Grades 10-12 (ages 15-17/18). Learners can exit at the end of Grades 11 or 12 and enter tertiary institutions
	Grade 13 Advanced Level (A-Levels). Grade 13 is not compulsory.

According to the Education Management Information System's (EMIS) education statistics in 2012, the Namibian official theoretical age for grade 1 is seven years, and 75% of seven-year-old learners are to be found in grade 1 (Ministry of Education: Directorate of Planning and Development, 2013). Children with special needs (e.g., hearing, visual, and intellectual impairment) are enrolled in schools at age 3 years to facilitate early intervention, usually at special schools.

Mother tongue instruction is encouraged from pre-primary to grade 4, with a transition to English in grades 5 and 6, thereby enabling learners to acquire the necessary English language skills to cope with English as the medium of instruction in secondary school. A daily reading period of 40 minutes for all the phases is scheduled in the new curriculum, during which learners and teachers read for enjoyment, meaning the books read silently in class should be fun reading material rather than textbooks. This is an obvious acknowledgment of the literacy crisis in the country as well as a sound pedagogical foundation for learners who may not be exposed to reading for enjoyment at home.

1.2   Afrikaans as a Namibian language

The distribution of languages spoken per household at the time of the 2011 Population and Housing Census indicated that the five most spoken languages in Namibian cover 88% of the households; in descending order, they are Oshiwambo languages 48.9% (including Oshikwanyama, Oshindonga, Oshikwambi, Oshingandjera, and Oshikwaluudhi), Khoekhoegowab (ten dialects) 11.3%, Afrikaans 10.4%, Otjiherero languages 8.6%, and Kavango languages 8.5%. The other languages, including English (3.4%), comprise 12% (Namibia Statistics Agency, 2013). For a detailed breakdown of the distribution of households by language spoken, see Appendix 2.

This thesis focuses on learning to read in Afrikaans. The rationale for selecting Afrikaans is three-fold. In the Khomas region, where this study was undertaken, Afrikaans is either the medium of instruction or the second language that is offered at 38 of the 54 primary schools in the region at the time of the study (i.e. 70.4%). Thus, most of the schools in this region offer Afrikaans as a subject. The next largest local language used in schools in the Khomas region is Oshiwambo which is offered at 10 of the 54 schools. The second reason for selecting Afrikaans is that it is the mother tongue of the researcher who more familiar to Afrikaans as compared to the other indigenous languages in Namibia. The third reason for selecting Afrikaans was that the knowledge that the researcher has as mother tongue speaker made it possible to develop the Afrikaans version of GraphoGame with the experts.

To best understand Afrikaans, there is a need to briefly examine the history of the language. Due to colonialization, The Netherlands (i.e. the Dutch East India Company) introduced the Dutch language to South Africa in the 1650s. Over time, the Dutch language evolved into what is currently known as Afrikaans. Van Rensburg (2013) states that similarities between Dutch and Afrikaans are what early linguists have focused on and have focused little attention on the influence of non-European languages on Afrikaans. He cites Den Besten (1987:24) who states "… were it not for the agentivity of indigenous Khoekhoen and imported African and Asian slave labor … there would be no 'Afrikaans.'" Van Rensburg focuses specifically on the sociohistorical, linguistic, and geographical information that indicates Khoi's influence on Afrikaans occurred in specific areas during different periods and between identifiable groups who spoke several varieties of Afrikaans. Le Cordeur (2011) examines the origin and development of Afrikaans in South Africa, amongst others: Cape Afrikaans and the related dialect of Muslim Afrikaans, Namakwaland and Griqua Afrikaans as examples of Orange River Afrikaans, and Karoo Afrikaans and Tsotsitaal as examples of Eastern Border Afrikaans. All these influences, mostly from black South Africans, influenced the Dutch language and led to the development of Afrikaans as a language.

Despite the multilingual influences on Afrikaans, Afrikaans is historically seen as the language of the so-called white oppressor in the Apartheid era in

South Africa and Namibia. Unethically enforcing Afrikaans' use in schools is a testament to this in most so-called black schools in which Afrikaans was not used. However, there is an alternate history of Afrikaans that is not as well known, especially by people outside of South Africa and Namibia. According to Groenewald (2010), before the official introduction of Apartheid, Afrikaans was spoken as a home language by inhabitants although they were oppressed by the Afrikaner and historically marginalized by poverty, location, and race. Le Cordeur (2011) argues that all varieties of Afrikaans have value for the speakers of the language, and it displays their unique identity.

Even before the South African annexation of what was then South West Africa (now Namibia), Afrikaans was well established through the influx of the Oorlams (a subtribe of the Nama people), westernized Khoikhoi groups, Basters (a Namibian ethnic group descended from European settlers and indigenous African women from the Dutch Cape Colony), and European settlers from South Africa. Through the enforcement of Apartheid, the language was further entrenched in the country (Groenewald, 2010). Before independence, South West Africa had two official languages: Afrikaans and English. English was not the dominant language. Afrikaans was considered the lingua franca. According to Tötemeyer (2010, p. 11), "even the Finnish Lutheran mission in the north (the former Ovamboland) decided on Afrikaans as the medium of instruction in 1925…," but upon independence, English became the official language in Namibia.

English was chosen as the official language of independent Namibia because it is an international language and was considered a unifying language. Furthermore, the British had not occupied or colonized South West Africa like Germany and South Africa had. As a result, German and Afrikaans were not options for the main official language. The other languages used in Namibia with standardized orthographies were regarded as national languages (Tötemeyer, 2010). Choosing one of the national languages was also not considered for the official language because it would have been considered divisive for an already Apartheid-divided population. Considering that English is the home language of only a small portion of the Namibian population (3.4%), implementing English in schools remains a problem (Namibia Statistics Agency, 2013).

1.3 The impact of the language policy in Namibia on reading acquisition

According to Benson (2005), many developing countries use a colonial language as the dominant or official language, but Namibia is characterized by multilingualism, and the government's language policy tries to provide for this multilingual society. The Namibian language policy is an outcome of a policy document titled Toward Education for All: A Development Brief for Education, Cul-

ture, and Training (1993); it states that all languages are equal regardless of the number of people who speak the language or the language's level of development. The policy also states that from a pedagogical perspective, it is ideal that children study in their own language, especially during the early years of schooling (Ministry of Basic Education and Culture, 1993).

According to the revised Language Policy for Schools in Namibia (Ministry of Education, Arts, and Culture, 2015a), learners are offered education in 16 languages from pre-primary to grade 3 with English as a subject in grades 1 to 3 (including Namibian Sign Language but excluding French). They switch to English as the medium of instruction in grade 4 with the home language as a subject. Grade 4 is also seen as a transition year from the mother tongue to English (Ministry of Education, Arts, and Culture, 2015a). Reading performance results from the SACMEQ (Hungi et al., 2010) show that this is not ideal since almost three-quarters of Namibian grade 6 learners have not attained the minimum level of English reading mastery after being in school for six years (not including pre-primary) and three years after switching over to English as the language of instruction. SACMEQ defines eight reading levels from pre-reading (level 1) to critical reading (level 8). Most Namibian learners have only reached level 3 (basic reading). Ideally, learners should reach at least level 4 (reading for meaning).

While Namibia's language policy caters to mother tongue instruction and, therefore, initial reading acquisition is expected to be in the learners' mother tongue, the language policy is not implemented as it should be, especially in multilingual urban areas (Ministry of Education, Arts, and Culture, 2015a). Specifically, many children are not taught to read in their home language. For example, according to the annual Namibian Education Management Information System (EMIS), in grade 1, only 42% of Khoekhoegowab speaking learners had Khoekhoegowab as their medium of instruction, while 56% of Otjiherero speaking learners had their home language as medium of instruction, and 62% of Afrikaans speaking learners were taught through the medium of Afrikaans in 2012. These are three of the larger language groups according to the Namibia Population and Housing Census (Namibia Statistics Agency, 2013). Alarmingly, less than two percent of learners who are taught initial reading in English had English as their home language (Ministry of Education: Directorate of Planning and Development, 2012). Namibian junior primary school teachers typically teach subjects such as mathematics, environmental learning, arts, physical development, and religious and moral education in either their home language or English.

Enforcing the language policy implies that children who speak a certain language must attend the schools that offer the language. One reason for the non-enforcement of the language policy could be related to politics. The history of Namibia related to colonialism and apartheid under South African rule forcibly divided the people of the South West Africa into groups according to the Group Areas Act No.41 of 1950. This division was made based on skin color as well as ethnicity, which resulted in groups of people with the same language

being forced to live together. After gaining independence in 1990, it would prove to be difficult to force children to attend a school based on their home language as it was too much of a reminder of a rule that still existed 25 years earlier. This sentiment echoes that of Brock-Utne (1997) when she states that choosing a language is an extremely sensitive political issue.

Although Namibian parents may be correct in their belief that educated people need to know English, they are mistaken that the best way to learn English is making it the medium of instruction and that removing mother-tongue instruction provides more time for learning English (Brock-Utne, 1997). Thus, the most that the current Ministry of Education, Arts and Culture can hope for is to convince parents that it is in their children's best educational interest to be taught in their home language despite the country's political history. In fact, the current revised language policy notes that "the aim of the language policy is not to encourage ethnic fragmentation, but to support a sound pedagogical principle to facilitate better learning…" (Ministry of Education, Arts, and Culture, 2015a, p. 4).

The Project for the Study of Alternative Education in South Africa's (PRAESA) research (Trudell, Dowd, Piper, & Bloch, 2012) concluded that the best solution for Africa is multilingualism, and because of the intelligence of its children, they can overcome the language-based obstacles if optimal policies and the effective implementation thereof take place. The research established that children learn best when they learn concepts and skills in their mother tongue in the early school years. These concepts and skills can later be transferred when learning another language. Part of the intervention to address the challenges that PRAESA identified was creating print-rich classrooms, especially in the learners' mother tongue. Another strategy was training teachers to use the classroom languages effectively by knowing how to teach reading and spelling in the mother tongue, how to teach English successfully, and how to promote bilingualism and biliteracy among the learners.

Creating an awareness of the mother tongue's importance, especially in initial literacy, will take a while in Namibia. Other African countries, for example, Zambia, Kenya, and Tanzania have similar multilingual situations and issues. Research in these countries reveals the difficulties of implementing their language policies that emphasize the importance of learning to read in the students' mother tongue, especially since the local languages in these countries mainly have transparent orthographies and therefore easier for children to read (Alcock & Ngorosho, 2003; Jere-Folotiya et al., 2014; Puhakka, 2015). Alexander (2006) notes that although the language policy and how it is implemented are significant, it is not a sufficient explanation of poor performance. He states that there are many contributing factors besides the language policy. Some of these factors include the process through which children acquire reading, how teachers teach reading, the training of teachers to teach reading, and the environmental factors that enhance or prohibit reading acquisition. The following section examines what the acquisition of reading skills entails.

1.4 Learning to read

This section investigates the various literacy skills that contribute to successful learning to read. The role that language plays in learning to read is discussed. As part of this thesis involves an experimental design using a reading digital tool in Afrikaans, specific focus is on learning to read in Afrikaans. The optimal teaching and learning methods for learning to read in Afrikaans is examined. For successful reading acquisition to occur, learners need to be motivated to read. The role of that motivation plays in learning to read is discussed. As learning to read is not a natural developmental process, learners need support for this to happen successfully. The theory of scaffolded learning as related to learning to read is explored.

1.4.1 The precursors to reading ability

According to the model of emergent literacy skills development (Whitehurst & Lonigan, 1998), the ability to read is dependent on the acquisition of several component abilities such as language skills and print knowledge as well as rules for decoding the printed words such as phonological awareness and letter knowledge. A formal and structured context such as classroom instruction purposefully aims to enhance the learners' knowledge and skills in these domains (Dubeck & Gove, 2015). However, informal or unstructured contexts such as the home environment can act as a motivator for learning to read.

Early literacy skills predict later literacy success. *Print knowledge* consists of the awareness of the orthographic system and the language as it is written. It includes understanding what the purpose of a book is and how to use a book correctly. *Phonological awareness* has been shown through several studies as a strong predictor of reading achievement whether the language has a transparent or opaque orthography. By assessing the phonological awareness of children from kindergarten to grade 4, Vloedgraven and Verhoeven (2009) demonstrate that the cognitive task requirements for five different phonological awareness items differ. Children found rhyming, phoneme identification, and phoneme blending easier than phoneme segmentation and phoneme deletion. Additionally, *letter knowledge* (e.g., letter recognition, letter names, and corresponding letter sounds) has proven to be a strong predictor of early reading skills (Dubeck & Gove, 2015).

Rapid Automatised Naming (RAN), together with phonological awareness and phonological memory, are regarded as important phonological processes involved in reading, and thus, are regarded as effective predictors of reading proficiency. Two types of RAN are identified. *Serial RAN* can be compared to reading text line by line, while *discrete RAN* can be compared to sight words being flashed (whole word recognition). According to Norton and Wolf (2012), RAN provides insight into the complex set of cognitive processes that needs to operate together for fluent reading to occur. Fluency is mainly based on familiarity with print, rapid word identification and orthographic skill. If familiar

words and letter patterns are recognized straight away, this leaves the working memory free to analyze unfamiliar words without affecting fluency of the script too much. If not letter patterns and/or words are not recognized immediately, the orthographic and phonological information is dropped from the working memory, and must be reread (Albuquerque, 2012); Bowers & Newby-Clark, 2002). Although RAN in itself cannot isolate reading challenges nor distinctly predict reading proficiency, a learner with fast RAN is able to recognize letters and letter combinations by linking these to the letter sounds quickly to produce fluent reading (Norton & Wolf, 2012; Taub & Szente, 2012). A struggling reader with a RAN deficit (RD), however, will read letters, letter combinations, and words in a slow serial (one by one) process and not recognize familiar letter combinations that support decoding (Albuquerque, 2012; Bowers & Newby-Clark, 2002).

Orthographic knowledge relates to understanding how the order of certain letters will form words. Learners with this knowledge learn which words are familiar with the language and how to decode unfamiliar words either from the context of the text or in isolation. Orthographic knowledge increases developmentally, which Ehri and McCormick (1998) demonstrate in their five-phase model (elaborated upon in Section 3.1.4).

A successful reader must be able to read words before understanding individual sentences and combining their meanings to provide an interpretation of the whole text when reading. Both of these components, word reading and reading comprehension, are integral to the Simple View of Reading model (SVR; Gough & Tunmer, 1986). According to this model, reading ability (R) is a product of two critical components: decoding (D) and comprehension skills (C); R=DxC (Gough & Tunmer, 1986; Juel, Griffith, & Gough, 1986; Juel, 1988).

According to the SVR model, if decoding, comprehension, or both these skills are poorly developed, the child will obviously have difficulties in reading If the child fails to decode, the child may be dyslexic; R=DxC and D=0. If the child can decode, but has problems with comprehension, the child may be hyperlexic; R=DxC and C=0. If it is found that the child has problems with both decoding and comprehension, Gough and Tunmer (1986) view this as a reading disability, seemingly a more common occurrence. However, Juel (1994) claims this is only true if the language that the person reads is familiar. She provides the example that even if one is a fluent reader in English, when confronted with text in unfamiliar Finnish, even if one knows how all the letters are pronounced in Finnish, it will not necessarily lead to comprehending the text.

It should be noted that the reading process described in this section places a stronger emphasis on reading in terms of word recognition than comprehension. Lerkkanen (2003) claims past studies tended to research word reading and comprehension separately and that recently there is a trend to emphasize functional reading skills that include both to make sense of what is read. This study, however, focuses on word reading only for the following reasons. This study focuses on initial reading that takes place when reading is first taught in grade 1 as well as on learners in grade 2 who may still be struggling to read words. Sec-

ondly, GraphoGame Afrikaans as a reading tool focuses only on word reading and not on reading comprehension. This study, however, wishes to recognize the importance of what Lerkkanen emphasizes about the combination of word reading and comprehension to attain a functional reading ability.

1.4.2   The role of language in learning to read

Languages can be classified according to their grapheme-phoneme consistency along a continuum. The greater the grapheme-phoneme consistency in a language, the more that language is regarded as having a transparent or regular orthography. Conversely, as the grapheme-phoneme consistency in a language decreases, the more the language is regarded as having an opaque or irregular orthography. For example, because English is recognized as having an opaque or irregular orthography, children learning to read English have more difficulty compared to children who learn to read in languages with transparent or regular orthographies like Italian, German, Hebrew, and most Scandinavian and African languages (Furnes & Samuelsson, 2011; Katzir, Schiff, & Kim, 2012; Lyytinen, Erskine, Kujala, Ojanen, & Richardson, 2009; Ojanen et al., 2015). In a study of 13 European orthographies, including English, learners in transparent orthographies learned to read accurately and fluently at a foundation level by the end of their first school year (Seymour, Aro, & Erskine, 2003). The same could not be said of the learners in the study who were learning to read in languages with more opaque orthographies, especially English. The researchers attributed the difference in the rate at which learners acquired reading to the difference in the transparency of the orthographies as well as the complexity of the syllable structure of these languages.

In Namibia, most of the indigenous languages including Afrikaans have transparent orthographies and it should not be too difficult for children to learn to read if taught correctly. The issue is that, as highlighted in the section on the Namibian language policy, not all children who have a home language with a transparent orthography have the option to use their home language at school when learning to read. In addition, using a language that a child is familiar with assists in early reading acquisition because the letter-sound correspondence is familiar to the child (Benson, 2005). Typically, the best scenario is when the child acquires code-related skills in the same language in which the oral language skills were acquired, meaning the mother tongue (Cabell, Justice, Konold, & McGinty, 2011).

1.4.3   Reading instruction in Afrikaans

The development of reading skills in a language with a transparent orthography such as Afrikaans occurs in a predictable pattern, and according to Liberman, Shankweiler, and Liberman (1989), about three-quarters of learners can learn to read on their own irrespective of the method. They can also acquire the alphabetic principle without much explicit teaching. These lucky learners learn for themselves the commonalities between similarly spoken and words, if they

experience enough printed materials. In contrast, there are a number of learners that need focused instruction, while other learners need concentrated intervention for acquisition to occur (Dubeck & Gove, 2015). This resonates with academic research (August & Shanahan, 2006) which has found that each learner acquires reading at his or her own pace. Teachers should take this into account as they scaffold tasks on reading skills for the learners in their classroom.

The Namibian education system emphasizes the use of phonics as the primary method of learning to read. Phonics as a teaching and learning method is especially appropriate for reading in languages with more transparent orthographies (Puhakka, 2015; Saine, et al, 2010; Soodla et al., 2015). Namibian local languages are generally considered to have transparent orthographies and thus are ideal for the phonics method. Therefore, in grade 1, the emphasis is on the knowledge of letter-sound connections, and the letters' names are not initially taught to learners.

According to Malda, Nel, and Van de Vijver (2014), the orthography of Dutch, from which Afrikaans originates, is considered to be intermediate. Afrikaans, however, is seen as more transparent than Dutch because it has a more systematic phonological and orthographic structure. Reading instruction in Afrikaans in Namibia follows a letter-learning order that is ideal for the language's orthography (see Appendix 3). For example, four consonants are introduced first: s, m, v, and r. Two consonants are introduced per week through stories. Typically, the letter 'y' (/əi/) is introduced in grade 1 as the first 'vowel' in week three. The fourth week is used as a revision of these five sounds (s, m, v, r, and y).

The reason 'y' is introduced as the first vowel is the grapheme-phoneme correspondence for the letter 'y' (/əi/) remains the same. The other vowels are introduced later in the following order: e (/ɛ/), a (/ɐ/), i (/ə/), o (/o/), and u (/ʊ/ or /œ/). The grapheme-phoneme correspondence of these vowels, however, does not remain constant and changes under the following circumstances; as a result, these differences are introduced even later.

Words containing double vowels: ee (/iə̯/ or /eə/), oo (/uə̯/), and uu (/y/), e.g., 'weet' (know), 'loop' (walk), 'muur' (wall).

Words, typically short, that end in a vowel (usually 'a' or 'o') have the long sound of the double vowel: 'ma' (mother) - /m/ /ɑː/; 'pa' (father) - /p/ /ɑː/; 'bo' (on top): /b/ /uə̯/; dra (carry) - /d/ /ɾ/ /ɑː/.

Typically, plural words that are formed from words containing double vowels continue to sound as if they have the double vowel but only have one vowel in the spelling: e.g., 'mure' (plural of 'muur') - /m/ /y/ /ɾ/ /ə/; 'sade' (plural of 'saad') - /s/ /ɑː/ /d/ /ə/.

Alternative grapheme-phoneme use of vowels includes e (/ə/) and i (/i/).

The grapheme-phoneme correspondence for consonants is usually constant. The letters, 'd,' 'g,' and 'w' are exceptions. Usually, 'd' is /d/, but when it is at the end of the word, the pronunciation of the 'd' is /t/. If we use the example of the word 'saad' (seed), it is pronounced as /s/ /ɑː/ /t/ while its plural 'sade' retains the /d/ sound (/s/ /ɑː/ /d/ /ə/). For 'g,' the pronunciation

is usually /x/, but in a few cases, words are pronounced as /g/: e.g., 'ghoen' (/g/ /ʊ̯/ /n/). The letter 'w' is regularly pronounced /v/ as in 'wat' (/v/ /ɐ/ /t/), but /w/ is used rarely after a consonant as in kwart (/k/ /w/ /ɐ/ /ɾ/ /t/. These are cases where the same grapheme has two phonemes. However, the letters 'f' and 'v' have the same phoneme /f/. Learners are also taught the following diphthongs in grade 1: oe (/u/), i.e. (/i/), ou (/ɵu/), ui (/œj/, and eu (/eø/).

Because the orthography of Afrikaans is classified as having intermediate consistency, a mixture of phonics and rime is less likely to confuse learners. Also, it is important that learners have an adequate opportunity to establish letter knowledge. All learners typically do not grasp the knowledge at the same time. Unfortunately, due to large classes, teachers may not always be able to check whether each of the 40 learners in the class has established this letter knowledge without confusion.

1.4.4 Reading and motivation

Motivation directs students' behaviors and effort in learning situations (Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006), which subsequently have a positive effect on achievement. According to Wigfield and Eccles (2000), learners need to be motivated because it drives learning effort and behaviors that can impact their academic performance. This can be driven by the expectancy-value theory of achievement motivation that argues a child's choices, persistence, and performance are influenced by their *beliefs* on how well they expect to do on a task and the *value* that this task holds for them. The ability aspect is defined as the child's perception of his or her current competence in a specific task. Ability beliefs also play a dominant role in different motivation theories (e.g., attribution theory, self-concept theory, self-worth model, and self-determination theory). The value aspect of the expectancy-value theory of achievement motivation incorporates three components: attainment value (importance), utility value (usefulness), and intrinsic value (interest). Wigfield and Eccles (2000) determined that children's ability beliefs in grades 1 and 2 are related to their academic performance, but achievement values are not related.

Concerning reading related motivation, Stanovich (1986) is credited with coining the phrase 'the Matthew effect' in reference to findings demonstrating that the more children read, the better they become at reading. The converse has also been shown to be true, in that, when children do not read regularly their reading stagnates or even deteriorates (Eklund, Torppa, & Lyytinen, 2013; Georgiou, Manolitsis, Nurmi, & Parrila, 2010; Hamilton, Nolen, & Abbott, 2013; Leppänen et al., 2004; Rosenthal & Ehri, 2011; Wigfield & Cambria, 2010; Zhang, Nurmi, Kiuru, Lerkkanen, & Aunola, 2011).

Task-focused behavior, as a construct of motivation, predicts high reading performance, whereas task-avoidance predicts slower reading progress (Aunola et al., 2002; Georgiou et al., 2010, 2011). According to Zhang, Nurmi, Kiuru, Lerkkanen, and Aunola (2011), academic performance is dependent on learners' on-task behavior. This behavior has been described as learner engagement, per-

sistence on tasks, and effort demonstrated on tasks that are challenging. Thus, they demonstrate task-focused behavior. Task-avoidance behavior has been described as avoiding difficult tasks, resisting challenging situations, and not putting effort into tasks that could possibly lead to failure. Research has shown that when teachers provide individual attention and support, there is less task-avoidant behavior (Pakarinen et al., 2011). Therefore, increasing motivation leads to increased reading, as the following studies reveal.

Wigfield and Guthrie (1997) examined the role that different aspects of reading motivation (e.g., self-efficacy, intrinsic-extrinsic motivation and goals, and social aspects) have on the amount and breadth of children's reading. The results show that intrinsic motivation more strongly predicted the amount and breadth of children's reading than extrinsic motivation. Guthrie, Wigfield, and VonSecker (2000) demonstrated that when instruction integrated strong elements of motivation (e.g., learning goals, real-world interaction [e.g., hands-on science activities], competence support [e.g., strategy instruction], autonomy support [e.g., self-directed learning]) and collaboration called concept-oriented reading instruction, the result was higher reading motivation. The learners who formed part of the experimental group were more curious about reading and used more strategies than the control groups. Teachers need to be aware of obstacles to children's learning and motivation both in the school and home environment that could impact their reading progress (Lerkkanen, 2003). In the present thesis, Study 3 examined struggling readers' ability beliefs related to academic-related tasks (i.e. reading, spelling, and mathematics) after playing GraphoGame as well as the value they assigned to these tasks.

1.4.5 The role of support in reading development

This thesis is based on the presumption that with adequate support and facilitation, Namibian learners can gain the needed level of reading skills to ensure the attainment of an education that will eventually help them earn a good living. According to Vygotsky's (1978) sociocultural theory, the interactions within social environment provide much-needed support and facilitation for learning. In this environment, the learner should be an active participant in his/her own learning process (see also Chou & Chen, 2014; Miller, 2011; Reid, 1998; Stone, 1998; Valsiner, 1987; Wink & Putney, 2002).

This interdependent relationship between a child and his or her cultural environment that promotes the child's development led to the Vygotskyan concept of the zone of proximal development. According to the concept, there are at least two developmental levels. The first level was termed *actual developmental level*. It represents the mental development level at which a child is already able to operate. Specifically, at this level, a child can carry out a set of mental tasks independently, and this level depicts retrospective mental development. When it is demonstrated that a child can reach a higher level of mental development with assistance from a more knowledgeable person, this higher level becomes the child's *potential developmental level.* This level depicts prospective mental de-

velopment. The distance between these two levels is termed the *zone of proximal development* (ZPD) (Vygotsky, 1978). Once the child has internalized the higher level, it becomes the new *actual developmental level*, and a new zone of proximal development is created. Wink and Putney (2002) conceptualized this process as follows: the *actual development level* is seen as past learning, the *zone of proximal development* is seen as present learning, and the *potential developmental level* is seen as future learning.

Although the term scaffolding was not used by Vygotsky, the concept fits in naturally with the concept of ZPD (Fani & Ghaemi, 2011; Stone, 1998; Valsiner, 1987). The use of the word scaffolding as a metaphor to describe how more knowledgeable others assist children in problem-solving tasks was adopted by Wood and Middleton (1975) and Wood, Bruner, and Ross (1976). Stone (1998), however, attributes the use of scaffolding in a teacher-learner situation in a classroom environment to Cazden (1979), who specifically referred to the use of question-answer sequences in classroom discourse as an example of scaffolding. As literacy teachers and working in the field of special education, Vacca and Levitt (2008) claim that when teachers use scaffolding as an instructional tool, they model good learning strategies, ensure that learners comprehend the desired learning outcomes at all levels, and foster interaction between the teacher and the learner and among the learners themselves. Thus, scaffolded learning interactions in classroom aim at efficiency and momentum and most importantly, success.

This is the ideal classroom milieu where learning and teaching are optimal. In many African countries where grade 1 learners come from diverse educational settings (e.g., different or no kindergarten experience and different socio-economic status (SES) levels including parent education levels) and large classes, this ideal classroom milieu where the teacher can scaffold the reading process for individual learners does not usually happen at the optimal level. A computer-assisted adaptive intervention could play a role in mimicking the scaffolding a learner may need. It could also play a role in providing the support that a special education teacher can provide. Typically, a special education teacher scaffolds the learning process by providing the work in chunks or components that they are able to successfully cope with. In the same way, a dynamic computer-assisted adaptive intervention has the potential to do the same.

Van de Pol, Volman, and Beishuizen (2010) determined that amid numerous definitions of scaffolding, three common characteristics emerged. The first characteristic that they highlight is *contingency*, which they describe as the calibrated responsiveness of teachers in their support of learners based on their level of need. This level should be determined through a diagnostic tool that was referred to as dynamic assessment, formative assessment, online assessment, or monitoring learners' understanding. The aim of these assessments is to garner knowledge of the learner so that optimum support is provided. In other words, through assessment, the teacher determines the learner's zone of proximal development. Van de Pol et al (2010) posits that scaffolding is 'dynamic intervention' and thus, it stands to reason that the knowledge of the learner

gained by the teacher before and during the scaffolding process is dynamic as well.

The second characteristic identified is *fading*, which they describe as the teachers' gradual withdrawing of support to the learners. The rate of fading is dependent on the rate at which the learner gains competence. Correlated to fading is the third characteristic, *transfer of responsibility*. This is taken to infer that as teachers increase their contingent fading (or as they decrease their support), the transfer of responsibility to learners for their own learning is increased.

These characteristics are, in essence, the effective learning-teaching process that should occur in a classroom. In the grade 1 Afrikaans classroom contingent fading support should be present throughout the process learning to read. First the teacher should assess the learners' reading competence using appropriate diagnostic tools, as part of the *contingency* process. Should the diagnosis reveal that a learner, for example, is not be able to recognize letter sounds when attempting to sound out words, the teacher should first address the deficiency of letter knowledge before moving on to word blending. As *fading* and *transfer of responsibility* work in tandem, as the teacher addresses the deficiency, at the same time the teacher positively recognizes the letter sounds that the learners has mastered. The cyclic nature of the characteristics of scaffolding acknowledged by van de Pol et al. (2010) suggests that as the learner increases the competence in letter knowledge, the teacher can move on to blending of words using the recognized letter sound.

Similarly, GraphoGame aims to emulate these characteristics of scaffolding. As part of the *contingency* process, GraphoGame has an inbuilt diagnostic tool that assesses the learner's knowledge regarding letters and words. Based on this assessment, for example, the learner is exposed to learning situations which present the learner with a combination of mostly known and few unknown letters to motivate towards success. The game tracks the learner's progress in a dynamic manner. In a manner of *fading* and *transfer of responsibility* the game recognizes when the learner learns previously unknown letters and in a cyclic manner, presents the learner with new unknown letters. Simultaneously, the learner is shown how letters are blended to form basic words. This process enforces both letter knowledge and word recognition constantly, thus supporting *fading* and *transfer of responsibility*.

Of the 66 studies on scaffolding studied by van de Pol et al. (2010), 8 studies based on the effectiveness of scaffolding were analyzed. They determined that these studies revealed that scaffolding was effective. Similarly, Vadasy, Sanders, and Peyton (2006) describe two research studies for grades two and three that use scaffolded oral reading practice by paraeducators (e.g. teacher assistants, parent tutors, student teachers) with success particularly dividing words into parts that the learners can recognise. They found that this method was especially useful to learners who were poor readers. Although their studies involved English reading, the techniques may prove useful for learners who are struggling to read in languages with transparent orthographies such as Afrikaans. They had previously studied the successful role of paraeducators who

were responsible for supplemental instruction for struggling learners, particularly on a one to one basis. In the absence of paraeducators in Namibia and most other African countries and because of our large class sizes, could computer games such as GraphoGame be a substitute paraeducator and could GraphoGame by virtue of its functioning be used as a scaffolding tool for supplementary reading instruction?

1.5 Computer-assisted interventions

1.5.1 Computer-assisted reading interventions

Computer-assisted reading instruction is being explored as an individual-orientated, intensive, and viable method of teaching reading skills (Torgesen, 2002). Previous computer-assisted intervention (CAI) studies have recognized that a computer-assisted reading intervention can be effective in teaching at-risk children (e.g., Barker & Torgesen, 1995; Magnan & Ecalle, 2006; Nicolson & Fawcett, 2000; Nicolson, Fawcett, Moss, Nicolson, & Reason, 1999; Regtvoort & van der Leij, 2007; Regtvoort, Zijlstra, & Van Der Leij, 2013; Torgesen, Wagner, Rashotte, Herron, & Lindamood, 2010). For teachers, this type of intervention could provide access for more learners, freeing teachers to focus on learners who need their attention more urgently. For the at-risk learner, this type of intervention could mean a more individualized intervention as well as more time spent on the intervention. Similarly, computer applications have been acknowledged as useful instruments in teaching literacy skills to children with reading disabilities in kindergarten and primary school (e.g., Elbro, Rasmussen, & Spelling, 1996; Hurford & Sanders, 1990; van Daal & Reitsma, 2000; Wise, Ring, & Olson, 1999; Wise, Ring, & Olson, 2000) as well as secondary school (e.g., Lynch, Fawcett, & Nicolson, 2000; Potocki, Magnan, & Ecalle, 2015). Other studies in the form of meta-analyses (Hall, Hughes, & Filbert, 2000; Hattie, 2008; Maddux & Lamont, 2013) and reviews (Blok, Oostdam, Otter, & Overmaat, 2002; Stetter & Hughes, 2010) support these findings.

In their comparative review, Hsin, Li, and Tsai (2014) analyzed 87 empirical studies using content analysis technologically-enhanced learning. A third of the studies involved children aged 0-8 years from low socioeconomic status or immigrant backgrounds, with special needs, or both. According to Hsin, Li, and Tsai, this implies that the researchers are cognizant of the opportunities that technology affords in scaffolding learning for these learners. The results of the comparative review revealed that technologically-enhanced learning had a positive impact on learners' performance across social, emotional, physical, and cognitive developmental domains despite concerns that technologies may hamper them. These results consider the impact of children's age, experience, time spent using the technologies, and gender. An added advantage of using technology, according to Jeffs, Evmenova, Warren, and Rider (2006), is it usual-

ly offers learning opportunities in multiple modalities (i.e. visual, auditory, and kinesthetic). This implies there is likely a modality or a combination of modalities that will enhance the learning for each learner in a way that traditional teaching may not be able to emulate.

While investigating the merit of integrating technology in education, there are also concerns about the cognitive load that is involved in interaction during literacy activities using ICT screens. The cognitive load includes, for example, being in possession of the sensorimotor skills necessary to interact with the computer, interpreting the computer's interface, navigating onscreen texts, and locating and retrieving relevant information. However, the alternative hypothesis is that it is precisely this explicit and overt interaction required to manipulate ICT screens when reading that enhances the development of literacy (Plowman & Stephen, 2003).

Not all computer-assisted instruction (CAI) have had good reviews. In a study to assess the effects of selected reading and mathematics technology products, Dynarski et al. (2007) found that test scores were not significantly higher between the experimental and the control groups. They also found that for reading technology products, the overall test scores were correlated in grade 1 for teacher: learner ratios and in grade 4 the correlations were related to the amount of time that the products were used. For mathematics technology products, the effects were not correlated to teacher: learner ratios and the amount of time that the product was used. Kreskey and Truscott (2016) carried out a study using a CAI tool, Headsprout Early Reading, on kindergarten children who were at risk for reading failure. It was found that there were no significant differences between the kindergartners who participated in the CAI and those who had not.

Some studies have mixed results. In an investigation on the benefits of a computer program (Lexia Reading) that were designed to supplement regular reading instruction, Macaruso, Hook, and McCabe (2006) found that although grade 1 learners made significant reading gains over the school year, their post-tests compared to the control group, although higher, were not significant. When analyses were focused on learners who were low-performing, the post-tests show that there was a significant difference compared to the control group who were not typically low-performing.

1.5.2 GraphoGame as an intervention tool

The results of the Jyväskylä Longitudinal Study of Dyslexia (JLD; Lyytinen et al., 2006) necessitated the attempt to prevent or at best minimise the effects of dyslexia on reading by showing that early identification of children at familial risk resulted in early intervention (Puolakanaho, 2007). This study as well as a number of other research studies (Lerkkanen, 2003; Lyytinen et al., 2006) on predictors of reading success demonstrated that the spontaneous acquisition of letter names before school age and their corresponding sounds during school age correlated strongly with successful reading in the Finnish language, where the orthography was highly consistent. Children who attained this knowledge quick-

ly acquired the decoding skill needed for reading in a few months (Lerkkanen, Rasku-Puttonen, Aunola, & Nurmi, 2004). Hence, according to Lyytinen, Ronimus, Alanko, Poikkeus, & Taanila, (2007), if a computer game were developed that provides opportunities for children at risk for dyslexia to be exposed to letter names and especially letter-sound associations, the game could minimize or even prevent the effects that dyslexia is known to have on reading.

The game that was originally devised at the University of Jyväskylä in Finland was called 'Ekapeli' (*First Game*) (Lyytinen et al., 2009; Lyytinen, et al., 2007). It was later renamed 'GraphoGame' for the English and other international language versions (Ojanen et al., 2015). GraphoGame is a mobile learning game that teaches the basics of reading in different languages. It focuses especially on the phonics approach. The game requires the player to match falling balls that display a written stimulus with an auditory stimulus that they hear through headphones. The game begins by requiring players to match letters to sounds and increases in difficulty in subsequent levels, which holds children's interest. Players aged 5-8 years only need an introduction by the teacher or parent before being able to play the game independently.

According to Lyytinen et al. (2007), after playing the game, children aged 6–7 years who were initially non-readers acquired basic reading skills after playing the game in 10–20 minutes sessions 3-4 times a week for a total of between one and four hours, depending on the needs of the child. Many children who are at risk may need more playing time for reading acquisition. Because of the way the game is set up, children are constantly exposed to the same letters and words, resulting in them being able to more quickly and accurately recognize these letters and words. Thus, the game can also be used as a predictive dynamic test of reading acquisition (Lyytinen et al., 2007; Ronimus, Kujala, Tolvanen, & Lyytinen, 2014; Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2010). Lyytinen et al. (2007) noted that reading practice will eventually automatize the skills and lead to reading fluency and a better comprehension of the content of texts.

Not all research involving GG has revealed positive results. A Polish study showed that in an experiment with 6-7-year-olds, there was no difference between those children playing GG and those playing GraphoMath (Kamykowska, Haman, Latvala, Richardson, & Lyytinen, 2014). Another Polish study showed that when GG is played unsupervised (for an extended time at home) it did not improve reading for poor readers (Szczerbiński et al., 2012).

Studies have also shown that GG in combination with other interventions or training provide better results than if GG was used alone (Ktisti, 2015; Sucena, Filipa, & Viana, 2016)

GraphoGame (GG) has since expanded globally to children with reading difficulties, and hence, the GraphoWorld Network (grapholearning.info/graphoworld) was created. Several research studies have been conducted around the world to ascertain the benefits of using GG. Each country involved in the GraphoGame project must develop its own content in its own language when developing GG. Table 2 displays countries that have developed

GG in a local language and conducted research studies using GG. The overall results of these specific studies show that GG has shown positive results in improving the reading skills of early grade learners (aged 6-9 years). As a research tool, GG has a strong research base as the children's data are uploaded to a server, and via analysis of this data, one can determine with which letters and word patterns the child has difficulties. This information can be a valuable guide for teachers to identify a child's specific reading difficulties. The University of Namibia participated in the GraphoLearn project coordinated by the Niilo Mäki Institute. The aim of the project was to equip teacher educators from four African countries (Kenya, Namibia, Tanzania and Zambia) with evidence-based knowledge and skills of learning to read and reading difficulties that they could in turn use in their teacher training. Each country in the project had developed at least one GraphoGame version based on a local language. Intervention studies using GraphoGame were carried out in each of these countries. This project was the main rationale for this PhD study involving GG.

TABLE 2 Research including GraphoGame

Language	Country	Study	Age (yrs/ Grade)	Number of participants in study	Playing time (PT) and/or Exposure time (ET) as provided
Finnish	Finland	Saine et al (2010)	7-8 yrs	n = 166: CARRI=25 and RRI=25; Control=116	4x45 mins per week/28 weeks
German	Switzer-land	Brem et al. (2010)	6-6.9 yrs	ERP group=32:GG=15, Control (Number-knowledge)=17 fMRI group=16:GG=8; Control (Number-knowledge)=8	PT=+/-3.6h
English (GG Phoneme, GG Rime)	U.K.	Kyle, Kujala, Richardson, Lyytinen, & Goswami (2013)	6-7 yrs	n = 31: *GG Phoneme=10; *GG Rime=11; *Control=10	PT = 10-15 mins/5 sessions per week/12 weeks (+/-60 sessions) No ET provided
Polish	Poland	Kamykowska, Haman, Latvala, Richardson, & Lyytinen (2014)	6-7 yrs	n = 62 *Intervention Crossover (lowest pre-test scores)=24 (GG=12; GM=12 and vice-versa) *Reference/Control (next results higher than intervention group)=24 *Deleted from study (highest results, ceiling results)=14	PT=15 mins per day Early GG group (M= 57.4 min); Late GG group (M=48.9 min)
Swedish	Sweden	von Mentzer et al. (2014)	5-7 yrs	n = 48: *CI=17; * HA=15; NH=16	PT: 10 mins/day/4 weeks; M=3h20min
Norwegian	Norway	Kyle, Lundetræ, Schwippert, Solheim, & Uppstad (2014)	6-7 yrs	n = 1024 (17 schools): *Intervention-Grade 1=9 schools (lowest 20%; n = 92) *Intervention-Grade 2=4 schools (lowest 20%; n = 34) *Control=4 schools	1/hr intervention/ 4 days per week / 25 weeks (4 intervention elements: Letter knowledge (GG or OnTrack); guided reading; spelling; and shared reading)
Cinyanja	Zambia	Jere-Folotiya et al. (2014)	5-9yrs	Pre-T, 573 (Post-T 314) learners:*No GG; *Learners GG *Learners/Teachers GG; *Teachers GG	M=94 min (between 50-190 mins)
Kiswahili Kikuyu	Kenya	Puhakka (2015)	Gr 1	196 participants: *111 Kiswahili (n = 18 GG) *85 Kikuyu (n = 11 GG)	15 mins/4 times per day/5 days Min = 4hrs playing time
Greek	Cyprus	Ktisti (2015)	6-7yrs	n = 56 with RD: 4 experimental groups- GG, PREP, GGto-PREP, PREPtoGG plus Control (n = 17)	PT/ET not specified
Portuguese	Portugal	Sucena, Filipa, & Viana (2016)	Gr. 1	n = 57 participants: *Grp 1 (mixed intervention-daily GG + weekly promotion of reading skills)=24; *Grp 2 (GG)=20;*Grp 3 (Control)=13	No available info on playing time
Spanish	Chile	Rosas, Escobar, Ramírez, Meneses, & Guajardo (2017)	Gr.1	n = 48: *Low SES=56 (GG=28; Control=28) *High SES=31 (GG=16; Control=15)	30 mins per day x 5days (+/-3 months)
Spanish	USA	Luft Baker et al. (2017)	Gr.1	n = 78(5 classes): GG=3 classes; Control=2 classes	10 min/day/16 weeks

Note. GM = GraphoMath; RD = reading difficulties; PREP = PASS Reading Enhancement Program

The studies displayed in the table are not exhaustive. The table displays only one GG study per country, but some countries have conducted multiple studies

1.5.3 GraphoMath

GraphoMath is a computer-based numeracy game that was translated into Afrikaans from the English-version of the original Finnish version. The game teaches and assesses learners' competency in counting and simple mathematics operations. The game focuses on number concepts from zero (0) to ten (10). This is also the focus area regarding mathematics operations for grade 1 in Namibian mathematics. In Studies 2 and 3 GraphoMath was used as a control measure.

1.6 The aims of the thesis

As reflected in the discussion above, Namibia has demonstrated positive steps in improving education. These include, *inter alia*, good enrolment rates and fairly low dropout rates in schools, a language policy that encourages all learners to learn to read in their mother tongue from pre-primary to grade 3, and a system of reading that focuses on phonics, especially for the languages with more transparent orthographies. The number of qualified teachers in Namibia has increased. Despite these good practices, scores on national and international assessments related to reading show that Namibia's learners are not faring as well as expected. This raised interest in identifying factors in the Namibian classroom that may be preventing effective reading achievement. Besides describing this situation, there was also a need to seek for possible solutions to alleviate the reading problem.

The overall aim of this thesis was to determine the situation related to learning and teaching reading in the Namibian grade 1 classroom, as well as investigate the use of GraphoGame as a digital tool that could contribute to improving the support provided to learners' reading acquisition. The thesis also aimed at investigating how GraphoGame could be used as an intervention tool for struggling readers, as well as determining their motivation level to provide further insight to these learners. The thesis focused on grade 1 because it is the grade in which reading instruction and learning to read are first targeted in Namibian schools.

In order to address the overall aim of the thesis, three studies were undertaken, each with its own aim(s) and research question(s).

Study 1:
Research Question: What are teachers' knowledge and perceptions regarding reading instruction in grade 1 in Namibia and how do they support their learners' reading acquisition?

To understand the situation in terms of initial reading in grade 1 the aim of Study 1 was to investigate the perceptions of grade 1 teachers in Namibia regarding their knowledge and classroom practices in teaching reading and how they support their learners' reading acquisition. This study was the first

survey that focused on the knowledge and skills in reading instruction of grade 1 teachers in Namibia.

Study 2:

There are two research questions (and aims) for Study 2.

Research Question 1: Is GraphoGame an effective reading acquisition tool in Namibian classrooms?

The aim of Study 2 was to investigate the effectiveness of GraphoGame Afrikaans in facilitating grade 1 learners' reading acquisition in a regular class-room. The significance of this study is to explore the use of GG as a possible teaching and learning tool for Namibian learners who are taught in Afrikaans as mother tongue instruction for junior primary grades. Should GG prove to be of benefit for Afrikaans learners, it could have similar or better value for other Namibian learners whose mother tongue has a more transparent orthography than Afrikaans.

As part of the validation of this study, GraphoGame Afrikaans was compared to two control groups in the study. One of the control groups had class as usual with no intervention. The other control group was another computer-assisted game. GraphoMath as one of the control groups in this study is a computer-assisted game that targets grade 1 mathematics (See 1.5.3). This research question aimed at testing the hypothesis that the mean gain scores of the assessment tests for GraphoGame were equal to the mean gain scores of the two control groups (GraphoMath and Control), i.e. H_0: $\mu GG = \mu GM = \mu C$.

Research Question 2: Does the effectiveness for reading of a computer-assisted game transfer to other computer-assisted games, not related to reading?

The second part of Study 2 aimed at testing whether playing GraphoGame Afrikaans and GraphoMath (as computer-assisted games) improved aspects of reading better than not playing a computer-assisted learning game. This research question investigated how the two computer-assisted games compared to the control group that had class as usual with no intervention.

Study 3:

There are two research questions (and aims) for Study 3.

Research Question 1: Is GraphoGame Afrikaans an effective intervention tool for struggling readers?

The aim of Study 3 was to identify to what extent the GraphoGame Afrikaans intervention improved the reading skills of struggling readers. The use of GG to assist struggling readers could prove to be significant for Namibian grade 1 classes where the typical class size is 40 learners and struggling readers may not get the attention, assistance, and practice that they need.

Research Question 2: What is the motivation level of struggling readers?

This study aimed to cast some light on certain factors that coexist with reading difficulties that teachers should be aware of, such as motivating factors, for example, self-concept, task-value, task-avoidance, and the classroom behavior of learners who are struggling with reading.

Figure 1 illustrates the three studies that form the thesis. Study 1 was a survey of teachers to ascertain their knowledge and perceptions regarding reading instruction in grade 1. Studies 2 and 3 were experimental designs that start with 202 grade 1 learners in Study 2 to examine the efficacy of GraphoGame as a reading tool in an Afrikaans classroom. Study 3 selected struggling readers identified in Study 2 and investigated the use of GraphoGame as an intervention tool. Both studies administered pre- and post-assessment tests to measure the efficacy of GraphoGame. The motivation of struggling readers was also assessed in Study 3. More detailed descriptions of each study will be presented in Chapters 2-4.
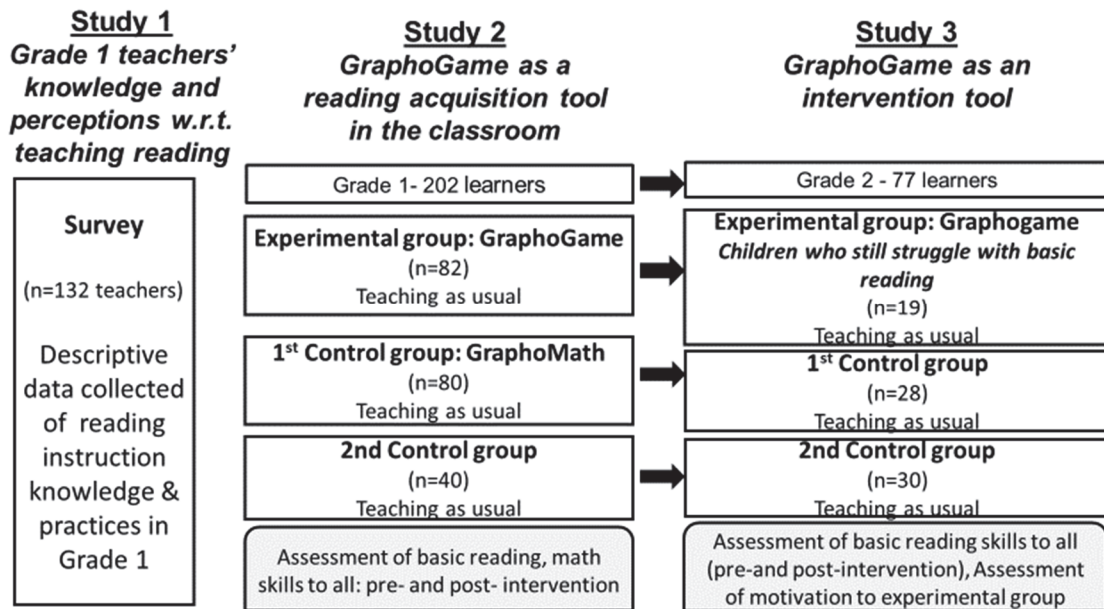
FIGURE 1   The design of the thesis

2 STUDY 1: GRADE 1 TEACHERS' KNOWLEDGE AND PERCEPTIONS REGARDING READING INSTRUCTION

2.1 Introduction to Study 1

Study 1 investigated Namibian teachers' knowledge, perceptions, and classroom practices related to teaching reading and how they support their learners' reading acquisition. A number of interrelated factors such as the educational policy, the school, teacher, and home play a role in teaching and children's learning to read (Alivernini, Lucidi, Manganelli, & Di Leo, 2011). While all these factors are recognized as important in reading acquisition, this study focused on teacher-related factors. Since teachers play a direct role in the instruction of reading, their impact on learners' reading acquisition cannot be overemphasized.

The following literature review is based on the main questions asked in the survey to discover what the literature and research state about these pertinent aspects of teachers' knowledge and perceptions regarding teaching reading in the early grades. These aspects include teacher training as it relates to reading instruction, languages used in teaching reading, teaching methods, classroom practices, and class size.

2.1.1 Teacher training

A teacher's capacity to ensure the success of early-grade reading is key to the child's learning to read (Trudell, Dowd, Piper, & Bloch, 2012). For this to happen, teachers need to be well-trained, mentored, and supported on an ongoing basis, especially when new reading programs are introduced. Moats (1999) describes the competencies in which teachers should be trained. She states that effective teacher training in reading instruction should include the knowledge of basic psychological processes encompassed in reading, how children develop reading skills, the difference between good and poor readers, how the language

is structured so that the most effective practices to teach reading in that language are used, and the use of research-proven principles of effective reading instruction. Using this knowledge, teachers should exhibit effective teaching skills that include the ability to prepare and present lessons that cater to a range of learners with different abilities, select the most appropriate research-proven teaching methods and materials, and employ assessment strategies that will inform tailored teaching.

A small survey was undertaken in the United Kingdom by the Office for Standards in Education, Children's Services and Skills (Ofsted, 2012) to evaluate how well new teachers are trained to teach language and reading, including phonics, in primary schools. The results showed that there was considerable variation in teachers' depth of knowledge and skill level. The survey determined that a considerable number of teachers did not receive a consistently high quality of training and induction to ensure that they obtained sufficient knowledge and skills required to be effective teachers of reading instruction. The survey also found that a weakness of many training and induction programs is that they do not consider the different beginning levels of the trainees or new teachers. The survey determined that despite inadequate training, if the induction program for new teachers ensures that their gaps in knowledge and skills are recognized and addressed, these teachers can be as effective as their better-trained colleagues. One of the barriers identified in the study is although almost all teachers indicated they understood how to teach phonics effectively, nearly half did not have enough understanding of the development of learning from one age group to another.

According to the UNESCO report of the assessment of teacher training and development needs in Namibia, the overall percentage of qualified primary teachers grew from 41% in 2001 to 78% (77% female) in 2012; at the secondary level, it grew from 73% in 2001 to 93% (93% female) in 2012 (UNESCO, 2013). Although the number of qualified teachers in Namibia has increased, there is a need to examine the quality of teacher training, especially regarding reading instruction in the lower primary grades.

The Early Grade Reading Assessment (EGRA) results and lessons learned indicate that teacher education programs across many Sub-Saharan African countries do not offer specific training for teaching reading in the mother tongue, and this would affect how junior primary teachers teach reading across the languages. Researchers from the Project for the Study of Alternative Education in South Africa (PRAESA), affiliated with the University of Cape Town, found that in Southern Africa (including Namibia), teachers were not properly trained how to teach reading and writing in the mother tongue and English as an additional language. Because most Namibian junior primary teachers were trained at the previous colleges of education, there is a need to examine the training that they have received in reading instruction as part of their three-year basic education teachers' diploma (BETD). There is also a need to examine what has been offered at the University of Namibia since 2011 and what the bachelor

of education (B.Ed.) cohorts in the junior primary phase have received in their four-year training (Trudell et al., 2012).

There appear to be several similarities between the BETD and B.Ed. modules related to understanding the concept of literacy/reading, applying different reading approaches and theories, using appropriate resources, and creating a literacy-friendly classroom. The BETD module had a component that examined traditional modes of literacy development and how it could be linked to current techniques. It also had a component that identified methods, materials, and conditions for promoting literacy. The B.Ed. module has components that explain the emergent literacy approach as well as a reading readiness approach. It examines concepts related to reading such as of phonemic and phonological awareness, phonics, and vocabulary in more depth and examines the theories of writing development for first and second languages. It also emphasizes the development of a positive attitude towards reading. The B.Ed. module examines differentiated reading activities according to the needs of learners as well as investigates strategies for diagnosing reading problems. It seems that while both the BETD and B.Ed. modules for training reading instruction cover reading acquisition adequately, the B.Ed. module is more current regarding the individual reader.

In 2011, a Continuing Professional Development (CPD) Unit was established at the University of Namibia (UNAM), guided and supported by a National CPD Consortium Advisory Committee consisting of the Directorates of the National Institute for Educational Development (NIED), the Programme and Quality Assurance (PQA) (from Ministry of Education), and the Faculty of Education. Among other objectives, the CPD Unit aims to focus on subject-matter and pedagogic-content knowledge as well as educator needs rather than centrally determined programs. Programs such as these will hopefully improve teachers' competency in teaching reading.

2.1.2 Reading instruction

Teaching methods used for reading acquisition should be considered a critical factor if there is to be a change (Moats, 1999). Thus, Bloch (1999) states that teachers need to acquire the necessary teaching skills that will bring about more literate learners. According to McGuinness (2004), the knowledge of how to teach children to read, write, and spell is highly developed; however, this highly developed knowledge has not been made available to educators, legislators, parents, and researchers. In fact, several teachers show a lack of knowledge of appropriate teaching methods (Moats & Foorman, 2003). Thus, it seems this knowledge does not always filter down to teachers in the classroom who are teaching children how to read.

Moats (1999) and McGuinness (2004) contend that writing systems are inventions and not part of our biological inheritance like spoken language. As such, children need to be trained to read the writing system. Reading instruction should ensure that the nature and logic of the writing system are transparent to the learner. They also believe that a writing system was never based on

whole words because languages have too many words for us to remember all of them. Thus, a reading method that is either totally or partially dependent on whole word memorization is bound to cause most children who use the system to fail. Incidental reading where children are compelled to recognize words instead of being able to decode them falls in this category. McGuinness (2005), Lyytinen, et al. (2009), Shanahan (2005) and others, including the United States National Reading Panel (National Reading Panel, 2000), maintain that teachers who teach the phonemic basis of the alphabet produce the most successful readers, especially in languages with transparent orthographies. This means that if teachers focus on teaching the phonemic basis of the alphabet, they can produce superior readers. In Namibia, the phonics-based approach to reading instruction is one of the teaching methods that is emphasized (Ministry of Education, 2005).

In addition to teachers using the teaching methods that is appropriate for languages with transparent orthographies, the findings of the longitudinal study by Lerkkanen, Rasku-Puttonen, Nurmi, and Aunola (2004) indicate that initial word reading skills predict two components of reading performance, namely word reading and reading comprehension. This implies that the instructional methods that teachers use should consider the different antecedents that will lead to the acquisition of the two components. To ensure the successful acquisition of word reading and reading comprehension, Lerkkanen, Rasku-Puttonen, Nurmi, and Aunola (2004) believe that both components should be taught simultaneously. Even in initial reading acquisition, reading comprehension (especially listening comprehension) should not be neglected while focusing on word reading only. The question is how well teachers are able to use this method of instruction.

In their studies examining the methods that teachers in the Otjozondjupa and Kavango regions in Namibia use to teach reading, Mutenda (2008) and Kekhani-Mhoney (2015) found that most did not use the methods that they were taught in their basic education teachers diploma (BETD) program in college. Rather, they used random methods, for example, drilling (making learners reread a text until they can do it well), that were unsubstantiated by the research literature. Furthermore, Kekhani-Mhoney's (2015) study, 21 percent could not recall any of the teaching methods for reading instruction that they had been exposed to in college.

In conclusion, Ojanen et al. (2015) believe that studying the process of literacy in each language will assist in developing the most optimal method to teaching literacy in that particular language. It is this optimal instructional method that teachers need to know well in order to scaffold the reading acquisition process for learners.

2.1.3 Teaching experience

Many studies have shown that teacher quality affects how well learners perform. Teaching experience is regarded as an important factor which contributes to teacher quality (Rice, 2010; Rockoff, 2004). In an analysis of panel data from

New Jersey school districts, Rockoff (2004) determined that teacher experience had statically significantly positive effects on reading test scores. Rice (2010) qualifies teaching experience by claiming that, in general, teachers who have more than 20 years of teaching experience perform better than teachers who have no experience, but that they are not necessarily better than teachers with at least five years of experience. She states that teachers show their greatest productivity advances during their first years of teaching and that it seems this burst of productivity levels off after this period. So, while it appears teaching experience is a strong teacher quality, increased years of teaching does not necessarily equate to increased gains for learners.

Nevertheless, teaching experience is rated as important, and thus, it is a factor that we need to examine closely to measure its impact on various components of teaching and learning. In a study designed to examine how teaching experience affects attitudes towards learning to read in the early years, Mackenzie, Hemmings, and Kay (2011) found that teachers who had more experience in teaching learners in early grades, as compared to general teaching, tended strongly towards a Vygotskian approach to the teaching and learning of literacy, especially writing. However, Viljaranta et al. (2016) found that work experience is also associated with the choice of teaching practices: more experienced teachers are more teacher-directed than younger, less experienced teachers whose recent training has stressed more sensitive and child-centered practices in reading instruction.

2.1.4   Class size

Scaffolding as an instructional tool is based on providing the optimal support to an individual learner. The more learners there are, the more difficult it is to provide individual scaffolding. Like most African countries, Namibian classes are larger than the average developed country. The countries belonging to the Organisation for Economic Co-operation and Development (OECD) had an average of 21.4 learners per classroom in primary school (Rampell, 2009), while of the countries that exceed 40:1, sub-Saharan Africa and Asia have the highest learner to teacher ratio (Benbow, Mizrachi, Oliver, & Said-Moshiro, 2007). How does class size impact on learning and teaching? Benbow, et al (2007) state that the research analysis has differing results. There is an argument for the positive impact that smaller classes have on learner achievement, while at the same time there is evidence where small classes have no significant impact. The research results, however, agree that smaller classes benefit learners who are disadvantaged and younger learners. In fact, they claim that for younger learners the benefits gained from smaller classes extend into higher grades.

Mueller (2013) found that the more experienced teachers only outperformed the rest when the class size was small. According to Mueller, this effect was, however, more likely due to greater quality of teaching than due to fewer class disruptions. A study carried out by Harfitt (2012) examined teachers' perceptions and their teaching approaches on both large (39-41 learners) and small (21-25) classes. He found that teachers' lesson plans and teaching approaches

were the same for both groups. The differences were in how teachers perceived the two class groups. They cited classroom management issues for large classes (noise, disruptions) and had a more positive outlook to learners in small classes. They admitted to knowing learners in small classes better in terms of the learners' learning strategies and their personalities. In terms of classroom discourse analysis, they addressed far more questions to individual learners in a smaller class and these questions tended to be more open-ended than for a large class. The teachers had more personalised interactions in smaller classes, as well as more group work.

In her study examining the reading methods that Bachelor of Education Teachers Diploma (BETD) teachers in the Kavango region in Namibia used, Kekhani-Mhoney (2015) found that the majority of teachers (81%) in the study claimed that the success of reading lessons was dependent upon class size rather than the teaching methods used. They were of the opinion that the larger the class size the more difficult it is to teach reading in these classes. One of the teachers claimed that large classes made it difficult for her to support learners who were at-risk for reading difficulties. Kekhani-Mhoney echoes the findings of Harfitt (2012) that found that learners in large classes do not receive much individual attention from teachers. At the time of her study, there were classes in the Kavango region that had 65 learners. The class size of Grade 1 learners in Windhoek where the study took place had an average 40 learners per class. The question is how the class size impacts the support that teachers provide to the grade 1 classes.

2.1.5 Teachers' knowledge

As a result of the findings from a survey carried out by Ofsted (2012), characteristics of the best newly qualified teachers were determined. These teachers have a very good understanding of language development in children and its link to reading acquisition. Because of their strong knowledge of language development and reading acquisition, these teachers can support learners across ability and age groups. They demonstrate good knowledge of phonics and how it supports reading and spelling. This level of knowledge is what is expected of all teachers who are guiding children through the process of reading acquisition. However, reality may not always reflect this scenario.

Bos, Mather, Dickson, Podhajski, and Chard (2001) examined the perceptions and knowledge of both pre- and in-service teachers regarding early reading instruction. The findings reflect that teachers had limited knowledge of phonological awareness, phonics, and language structure. They also perceived themselves to be lacking in skills related to teaching reading. Moats and Foorman (2003) carried out a survey as part of a longitudinal study to determine the reading-related content knowledge (i.e. the sounds, words, sentences, and principles of instruction) of kindergarten to fourth-grade teachers in low-performing, high-poverty urban schools similar to the Windhoek schools that formed part of this study. Their findings showed that there is an overall modest predictive relationship between teachers' knowledge, classroom reading

achievement levels, and teachers' observed teaching competence, and the associations between them increased significantly by the third and fourth grades.

In a study to determine the extent of early educators' knowledge of early literacy development in the United States, Crim, Hawkins, Thornton, Rosof, and Copley (2008) determined that these teachers had difficulty identifying specific print-to-speech concepts of the English language structure, meaning the basic skills related to beginning reading instruction. They listed these skills to include counting syllables in words and identifying the number of morphemes and phonemes in words. Regarding separating words into syllables, the success of teachers who formed part of the study ranged between 68% and 95%. In perfect contrast, the teachers had an inaccuracy rate ranging between 68% and 95% in identifying the number of morphemes in a word. There was a wider range of inaccuracy (40-85%) in identifying the number of phonemes in words. Crim et al. (2008) conclude that although most teachers could correctly separate words into syllables, some struggled to carry out the task. This implies that, as these teachers cannot correctly identify syllables, they will be unable to assist their learners in learning how to identify them correctly. The worst performance from teachers came from the area of morpheme identification, and if teachers do not understand the structure of words, they will be unable to create a solid foundation for learners in phonological awareness.

Due to the findings indicating that some early childhood educators do not make the link between phonological awareness (e.g., syllabification, morpheme identification, and phoneme identification) and early literacy acquisition, the researchers recommend that teacher training programs ensure early childhood educators have a strong basic knowledge of early literacy skills. Failure to train teacher educators in the important area of phonological awareness poses a risk to their learners' reading achievement.

In a study involving four English speaking countries' pre-service teachers' knowledge of language constructs, it was determined that there was a lack of knowledge of constructs that was needed to teach reading skills (Washburn, Binks-Cantrell, Joshi, Martin-Chang, & Arrow, 2016). An Australian study (Stark, Snow, Eadie, & Goldfeld, 2016) found that teachers' perception of their knowledge of required language constructs related to teaching reading had no correlation to actual knowledge demonstrated in these areas. These teachers rated their knowledge of phonemic awareness, phonics, vocabulary, comprehension, and spelling as either moderate or very good. Although these studies may have generalizability limitations, lessons can be learned and applied to Namibian teacher training. As these findings are for the English language; it is expected that the results would be better for a language with a more transparent orthography.

Aro and Björn (2015) similarly investigated Finnish pre- and in-service teachers' knowledge of language concepts significant for literacy acquisition. Although Finnish morphology is complex, its orthography is based on the very transparent phonemic structure and yet they found these teachers' morphology knowledge was substantially lower than their knowledge of phonics and pho-

nology. Aro and Björn suggest that this may be because morphology was not emphasized in their teacher training. A possible reason for this is that, pre-service teachers have less knowledge of language constructs than in-service teachers. While the pre-service teachers' perceptions of their expertise were weakly related to their knowledge and skills, the in-service teachers' perceptions of their expertise were totally unrelated to their knowledge and skills. Likewise, a Swedish study (Alatalo, 2015) revealed that on average, grade 1–3 teachers had poor awareness of language elements. Less experienced teachers whose teacher training included little or no literacy training had weaker knowledge than more experienced teachers with good literacy education. Thus, it would appear that even when the orthography of a language is more transparent, teachers' knowledge of language constructs may not be ideal.

All these studies recommend that pre-service teacher education should ensure that teachers have the core knowledge of language constructs that are required in teaching reading, especially in the early grades, irrespective of the transparency of the orthography of the classroom language used. Continuous professional development programs should address the misconceptions that teachers appear to have about their knowledge of language constructs and their actual lack of critical knowledge.

2.2   The aim of Study 1

The aim of Study 1 was to investigate the perceptions of grade 1 teachers in Namibia regarding their knowledge and classroom practices in teaching reading and how they support their learners' reading acquisition.

Research question: *What are teachers' knowledge and perceptions regarding reading instruction in grade 1 in Namibia and how do they support their learners' reading acquisition?*

2.3   Methods to Study 1

Participants
Grade 1 teachers (N = 132) in Windhoek, the Namibian capital (Khomas Region), completed a survey to determine their perceptions and knowledge of reading instruction. According to the Educational Management Information Statistics (Ministry of Education: Directorate of Planning and Development, 2013) that was consulted, there were 39 government primary schools in the Khomas Region. Only schools in the urban area of Windhoek were targeted: 39 schools. Therefore, the seven schools from the rural area of Windhoek were not included. However, as data was collected from school to school, it was discovered that new schools (that had previously been project schools) had been established. Through this process, 34 schools were surveyed. By oversight, two

urban schools were not surveyed. Therefore, the final number of urban schools at the time of the study was 36, bringing the total to 43 schools when 7 rural schools were added.

Measures and Procedures

A questionnaire based on the research questions was developed for this study based, *inter alia*, on previous ideas from the OECD Teaching and Learning International Survey (TALIS) Teacher Questionnaire (International Project Consortium, 2008) and the Teacher Knowledge of Literacy Content: Evaluation of Delaware Reading First (Ackerman, Grusenmeyer, Nian, & Qiao, 2008). The survey consisted of the details of the teacher characteristics (e.g., personal details, teacher training, and their classroom size and situation), their specific training in reading instruction, reading methods and materials they used, their beliefs about early reading and spelling instruction, and their knowledge of the structure of the Namibian languages offered at these schools, including English (see Appendix 4).

The survey questionnaire was developed into an electronic format using an application called SurveyGizmo and then downloaded onto ten tablets. After gaining permission from the Ministry of Education, snowball sampling was used to collect the data by going to a school and identifying the grade 1 teachers. The mean number of grade 1 classes per school was four, and their teachers were surveyed. After explaining the purpose of the research study to teachers and obtaining their permission to participate in the data collection, they were shown how to complete the electronic questionnaire. As this was the first time they had completed a questionnaire in this manner, they found the experience 'enjoyable' and different from the usual paper and pen questionnaires. After data collection at a school was completed, the next school in the area was targeted. This process of moving from school to school and area to area in the city of Windhoek lasted until the target of completed questionnaires was accomplished (1 month).

Data analysis

The survey data ranged from nominal to scale, with several variables presented as ordinal data, which is typical when gathering views through surveys. Data analysis included mainly descriptive statistics consisting of frequencies and cross-tabulations.

2.4   Results of Study 1

The results of this study describe the demographics of the grade 1 teachers who formed part of the study, teachers' recognition of good reading instruction, teachers' reading instruction practices in classrooms, and teachers' knowledge of key reading components. The section concludes with a summary of important results.

2.4.1   Demographics

Most of the grade 1 teachers (84%) were 30-60 years of age, with the largest age group being 30-49 (59%). The five Afrikaans teachers whose learners participated in the GG study were above age 50, with only one teacher in the age group aged 20-29. In terms of professional qualifications, most of the teachers had a teaching diploma (86%), which was the case of four of the Afrikaans teachers. One teacher had a teaching certificate which is an outdated teacher qualification requiring two years of training.

The teachers' mean overall teaching experience was 15.8 years (*SE* = .98, *SD*= 11.25, min = 0, max = 44), while the mean teaching experience in grade 1 was 9.5 years (*SE* = .85, *SD* = 9.69, min = 0, max = 44).

The mean class size was 40.1 students (*SE* = .35, *SD* = 3.56, min = 15, max = 46). The smallest class was a special education class (i.e. a separate class at selected Namibian schools for learners who had learning difficulties; sometimes it was a multi-grade class). The mean class size for the five Afrikaans teachers whose learners participated in the GG study was 41 students. 3.9% of the teachers had more than 44 learners in their class and they claim to have small groups for reading. Conversely, 14.4% of teachers claim large classes as the reason for not having small groups as part of their reading instruction methods.

Most of the teachers (91%) had at least a teaching diploma that is the current acceptable standard in Namibia; alarmingly, almost a third of the teachers (32%) claim they did not have training in reading instruction. Most teachers (82%) rated the quality of training in reading instruction as average, above average, or excellent, while 5.9% rated it as extremely poor or below average (see Appendix 5).

2.4.2   Teachers' recognition of good reading instruction

Teachers' beliefs regarding early reading and spelling instruction were measured via statements using a 5-point Likert scale. The results show that most (97%) of the teachers agree with these statements about reading and language instruction. In fact, the largest response was from those that strongly agree (66%).

2.4.3   Teachers' reading instruction practices in classrooms

To gauge their use of reading practices, teachers were asked about the number of teaching methods they use, the specific instruction content they use, how they create a literate classroom, how they encourage and support poor readers, and whether and how reading instruction in small groups occurs. Their responses are presented below.

(1) Number of teaching methods used. Teachers reported that they mostly use a range of methods when teaching reading (83%), while (15%) report using only one method. Regarding how teachers develop their learners' under-

standing of 'phonological units,' most teachers (82%) tend to do so from smaller units of speech (i.e. phonemes, morphemes) to larger units of speech (i.e. syllables, words) rather than the opposite approach (9%). In both these survey questions, 6% reported that they do not understand these concepts.

(2) Specific instruction content regarding language and reading skills. Figure 2 describes the specific instruction content concerning language and reading skills that teachers report they use in their classrooms. Teachers could select one or more from a list of seven. The figure shows each of the specific instruction content either selected or not totaling the 132 teachers in the survey, e.g. phonological awareness was selected by 11 teachers and not selected 13 teachers adding up to the 132 teachers in the study, while word features was selected by 44 teachers and not selected by 88 teachers again adding up to the 132 teachers, etc.
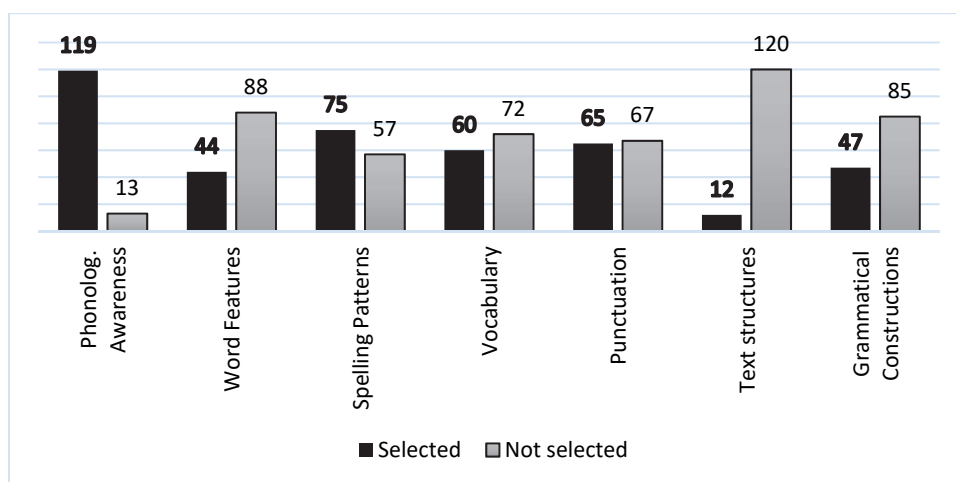
Note: teachers could select more than one alternative

FIGURE 2   Specific instruction content concerning language and reading skills

As Figure 2 demonstrates most teachers, i.e. 119 of the 132 teachers (90%) included phonological awareness as part of their reading instruction content, more so than the other reading and language skills. After aggregating their selections, 42 combinations emerged. Two aggregated combinations noticeably had the most responses. Phonological awareness as a response on its own was selected by 30 teachers. A combination of six language and reading skills including phonological awareness, word features and their structures, spelling patterns, vocabulary and word study, grammatical constructions, and punctuation was selected by 11 teachers. The other 40 combinations were selected by a range of 1 to 6 teachers. One teacher used none of these practices, while one teacher claimed to not understand these concepts.

(3) Creating a literate classroom. Teachers were asked about the practices they use to create a literate classroom environment. They could select a combi-

nation of the following practices: encouraging children to write for a range of audiences, incorporating literacy materials in dramatic play areas, and using labels and notices (see Appendix 5). The use of labels and notices to draw children's attention to literacy was the practice that most teachers selected (80%) as well as in combination with other practices. The teachers who indicated that they use other practices mentioned, *inter alia*, that they collect story books with pictures that attract learners' attention, use word strips to build sentences, and use posters, rhymes, pictures, stories, songs, and games.

(4) Encouraging poor readers. To encourage struggling readers to read, teachers indicated they use the following strategies reported in Figure 3 in their selection of texts for poor readers, either on their own or in combination.
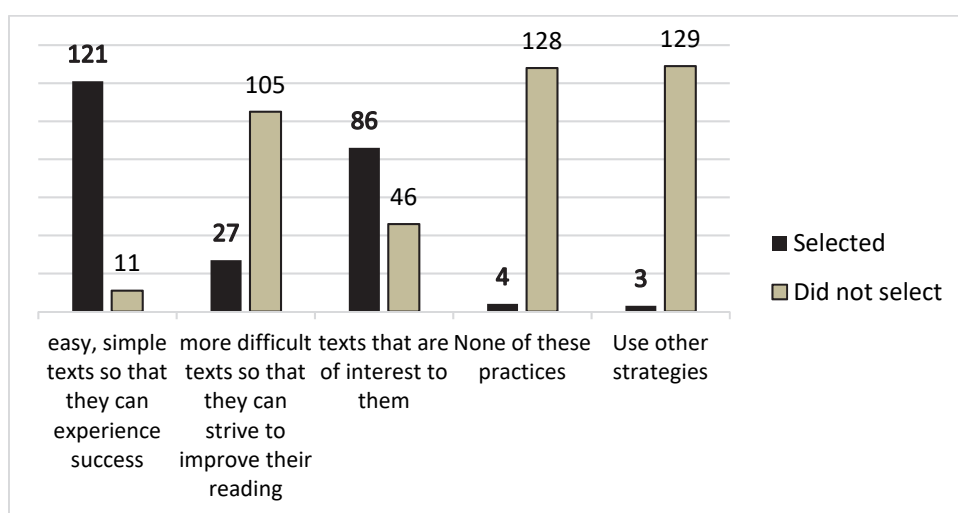
Note. Teachers could select more than one alternative

FIGURE 3   Encouraging poor readers to read

Using simple, easy texts so that poor readers can experience success was the strategy most teachers selected either on its own or in combination with other strategies used to encourage poor readers to read (92%). Other strategies that teachers mentioned using include providing learners with theme-related texts or reading material, using pictures for them to make up their own stories, including more reading activities that the parents help them with when at home, and a having reading corner where students select a story of interest and read independently.

(5) Reading instruction in small groups. Teachers responded to the different strategies and practices they used to facilitate small-group instruction as described in Figure 4.

Reading instruction in small groups

divide the class into small groups with similar reading abilities — Selected 92, Did not select 40

texts and instruction are matched to the small group — Selected 41, Did not select 91

evaluate learners regularly and regroup as needed — Selected 94, Did not select 38

plan tasks for rest of class while busy with a small group — Selected 68, Did not select 64

large class size prevent small group instruction — Selected 19, Did not select 113

Note. Teachers could select more than one alternative

FIGURE 4   Reading instruction in small groups

Most teachers indicated that they used a combination of these strategies. Of the 19 teachers who responded that their large classes prevented them from having small group instruction, 37% indicated that they also evaluate learners regularly and regroup learners as their progress changes.

2.4.4   Teachers' knowledge of key reading components

This section describes teachers' knowledge regarding certain language and reading components and examines the possible connection between the training that teachers state they received in reading instruction and their knowledge of phonics as a reading instruction method.

(1) Teachers' knowledge of language and reading components. Figure 5 displays the knowledge that the teachers possess related to language and reading components. The black bars indicate the number of teachers that answered correctly, while the grey bars indicate the number of teachers who had incorrect answers (totaling the 132 grade 1 teachers for each knowledge statement in Figure 5). The bottom group of black and grey bars show the overall percentage for correct and incorrect answers, respectively. The results revealed that teachers lacked knowledge about some language and aspects of reading with an inaccuracy rate between 50% and 97%. The results demonstrate that the knowledge question asking teachers to identify the word that has incorrect syllable division is the only question that most teachers (69%) answered correctly. Most teachers

answered the other questions incorrectly, ranging from 51% to 98% incorrect (Figure 5).
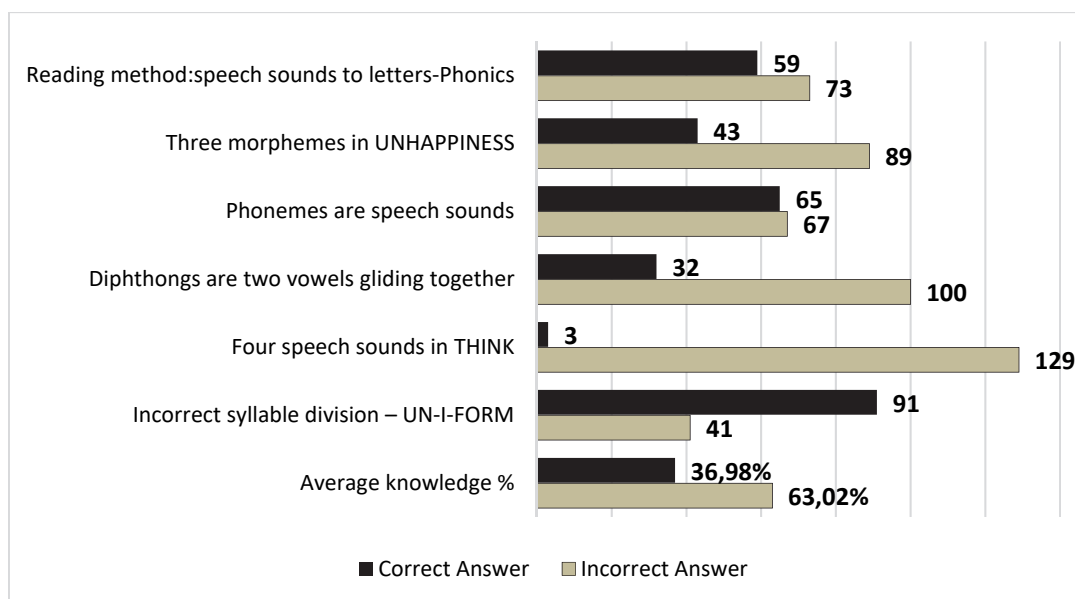
FIGURE 5   Knowledge about key aspects of reading

(2) The connection between training received in reading instruction and teachers' knowledge of phonics as a reading method. According to the Namibian curriculum for the junior primary phase, phonics is a preferred method of teaching reading in Namibia, as most of the local languages have transparent or regular orthographies. More than half of the teachers (55%) were unable to correctly identify that phonics is a reading method. Of these, the majority (almost 60%) claimed to have received training in reading instruction.

2.4.5   Summary of the results

While most teachers (81%) claim that they have received average to excellent training in teaching reading and demonstrate that they overwhelmingly agree (99%) with good reading practices and beliefs, the results reveal that their actual knowledge of various aspects of reading does not relate to their stated teacher training and reading beliefs. It appears that the overall average for the knowledge section showed that less than 37% of teachers had detailed knowledge of specific aspects of reading such as being able to identify syllables, morphemes, and speech sounds in words as well as demonstrating knowledge of phonics, phonemes, and diphthongs.

2.5   Discussion of Study 1

In terms of teaching experience, the teachers in the study had a mean overall teaching experience of 15.8 years, while the mean teaching experience in grade 1 was 9.5 years. According to Rice (2010), this quantity of teaching experience is good as it is at least five years of experience. Furthermore, Mackenzie, Hemmings, and Kay (2011) found that teachers who had more experience in teaching learners in early grades, as compared to general teaching, tended strongly towards a Vygotskian approach to the teaching and learning of literacy. This should bode well for Namibian teachers in the study in terms of their potential to scaffold learning opportunities in reading instruction.

The mean class size for the study was 40.1 and while a small percentage of teachers (3.9%) with more than more than 44 learners in their class claim to have small groups for reading, more than 10% of teachers claim large classes as the reason for not having small groups as part of their reading instruction methods. Research has shown that, in general, smaller classes have a positive impact on learner achievement, especially for learners who have learning difficulties and younger learners (Benbow et al, 2007; Mueller, 2013; Kekhani-Mhoney, 2015). This was partly due to the positive perception that teachers had towards smaller classes (Harfitt, 2012). This outlook manifested itself in scaffolding activities such as addressing far more questions to individual learners as part of classroom discourse and these questions tended to be more open-ended than for a large class. The teachers had more personalized interactions in smaller classes, as well as more group work, which resulted in knowing learners better in terms of their learning strategies and their personalities.

Although most Namibian teachers in the study have adequate teacher training as required by the Namibian Ministry of Education, almost a third claim (32%) they did not receive training in reading instruction. This is a worrisome finding, as the importance of having teachers trained in reading instruction is emphasized by experts in the field of reading acquisition. These experts claim that reading acquisition, unlike language acquisition, is not a biological process (McGuinness, 2005) but a human invention (McGuinness, 2004) that is very complicated, and as such, teachers need to understand this process and implement their teaching practices accordingly (Lee, Gable, & Klassen, 2012). That is why training in reading instruction is so important. This knowledge that teachers should have is especially important in understanding how reading is acquired in different languages, whether their orthographies are transparent or opaque (Furnes & Samuelsson, 2011; Katzir et al., 2012; Lyytinen et al., 2009; Ojanen, 2007; Ojanen et al., 2015). An overwhelming majority of grade 1 teachers (97%) state that they can recognize good reading practices related to early reading and spelling instruction. Experts such as Ofsted (2012) claim that teachers' knowledge and recognition of good reading practices are key to their learners' successful reading acquisition.

Most grade 1 teachers also use multiple methods to successfully teach aspects of reading. Teachers also indicated that they use different practices to create a literate environment. These practices include, as the most widely used, the use of labels and notices to draw children's attention to the use of literacy. To encourage poor readers to read, teachers indicated they use a variety of practices, the most widely used being selecting simple, easy texts so poor readers can experience success. These practices resonate with what experts and researchers have shown as examples of scaffolding. Van de Pol et al (2010) characterize this stage of scaffolding, where teachers support their learners based on their level of need, as *contingency.* The other two characteristics that they discuss, namely, *fading* and *transfer of responsibility* whereby teachers withdraw their support gradually are not evidenced in the study. This is because the study did not directly elicit responses to these characteristics.

With an inaccuracy rate between 50% and 97%, the results revealed that teachers lacked knowledge about some language aspects of reading instruction. These findings mirror those of Crim et al. (2008), whose teachers performed poorly in identifying the number of morphemes and phonemes in a word (i.e. an inaccuracy rate between 40% and 95%), while in contrast, they had accuracy rates ranging between 68% and 95% in the ability to separate words into syllables. The study carried out by Bos, Mather, Dickson, Podhajski, and Chard (2001) also showed that both pre- and in-service teachers showed limited knowledge in phonological awareness, phonics, and language structure. How does this limited knowledge impact teachers' ability to teach reading? Previous studies have shown a predictive relationship between teachers' knowledge of language development and their classroom practices, especially in the very early grades (Aro & Björn, 2015; Moats & Foorman, 2003).

According to various studies (Alatalo, 2015; Aro & Björn, 2015; Bos et al., 2001; Crim et al., 2008; Moats & Foorman, 2003; Stark et al., 2016), there appears to be a tendency with regard to the limited knowledge of phonological awareness, phonics, and language structure that many teachers appear to have. It also appears that this limited knowledge on in-depth language structures may not have such adverse effects on the teachers' ability to teach reading effectively.

However, for example, while Finnish teachers have a Masters' degree, Namibian grade 1 teachers only need a basic teacher's diploma. This is not only a difference of five years of teachers' training versus three years but also speaks to a higher level of training, specifically, a master's degree rather than a diploma. Therefore, even if some Finnish teachers may lack some knowledge of exact language structures (Aro & Björn, 2015), their higher level of teacher training compensates in the successful methods they use to teach reading.

In addition to adequate teacher training, there are several other aspects that affect the teaching of reading in Namibia. Chief among them is the multilingual situation in Namibia, where learners are not necessarily taught to read in their mother tongue. Instead of being taught in the mother tongue with a largely transparent orthographies, many learners are taught to read in English, which has an opaque orthography as well as not being the mother tongue of

most of the teachers and students. Teacher training should ensure that teachers are trained adequately in how to teach reading in languages with both transparent and opaque orthographies since both are taught to learners during the junior primary phase.

As the above discussion indicates, successfully resolving several crucial issues could lead to improvements in how children learn to read in Namibia. These include mother-tongue instruction, higher teacher qualifications for junior primary teachers, better training in reading instruction, and of course, better reading resourced classrooms, among others. Many of these issues mentioned can only be addressed via long-term strategies. A number of them are currently being addressed, e.g. higher teacher qualifications for junior primary teachers. Other issues may have short to mid-term solutions. One of these is to support teachers and more directly learners in addressing initial literacy acquisition, which is a step towards improving the critical reading situation in the country. This thesis examines the use of a digital reading tool as an intervention tool for teachers to use when assisting struggling readers who can get lost in large classroom situations.

2.6   Limitations of Study 1

Limitations of the study include the fact that Study 1 was focused on grade 1 teachers in Windhoek only. Perceptions of teachers in other parts of the country may differ from those expressed by teachers in the capital city. There a was a problem of the structure of the questionnaire as there were some questions that had limited possibilities to select inappropriate methods. Accordingly, the results to these questions are somewhat skewed. This reduced the instrument reliability. A more in-depth study could have included interviews with teachers to better understand their perceptions of their knowledge and skills of reading instruction in grade 1. Since using an electronic questionnaire was a first-time experience for most teachers, this led to a few challenges with submitting the completed questionnaire. Should the researcher not have been available, there would have been problems in submitting the questionnaire.

3 STUDY 2: GRAPHOGAME AS A READING ACQUISITION TOOL IN NAMIBIAN CLASSROOMS

3.1 Introduction to Study 2

Study 2 investigates the effectiveness of a digital reading tool that could be used as one of the solutions to the poor reading results that are revealed in both national and international assessments. In order to investigate the potential of GraphoGame, it is important that an understanding is reached about how learning to read and spell occurs, especially those reading skills that are related to the pre-and post-assessment that forms part of the GG intervention in Study 2. GraphoGame is discussed as an adaptive tool for reading instruction and the development of GraphoGame Afrikaans is examined.

3.2 Elements contributing to learning to read and spell

Although reading and spelling processes are complex and dependent on several pre-literacy skills and language development processes, numerous studies have shown that a strong predictor of reading and spelling skills are letter knowledge and phonological awareness (Katzir et al., 2012; Lerkkanen et al., 2004a; Lerkkanen et al., 2004b; Torppa et al., 2010). Typically, phonological awareness and letter knowledge along with rapid automatized naming (RAN) are areas where children that have early reading difficulties have problems (Cardoso-Martins, Mesquita, & Ehri, 2011; Kirby, Georgiou, Martinussen, & Parrila, 2010; Lerner & Lonigan, 2016). Lyytinen and colleagues (2007) emphasize the importance of children mastering letter-sound connections during early reading acquisition in regular orthographies. Phonological awareness and letter knowledge are seen to be precursors to word reading, reading comprehension and spelling. Thus, if these elements were addressed, it could also contribute to reducing reading difficulties. For the purpose of this study, the elements of

phonological awareness, letter knowledge, word reading, and spelling are used to measure initial reading acquisition in the Namibian Afrikaans grade 1 classroom. These elements are further discussed below.

3.2.1 Phonological awareness

Phonological awareness is a set of skills that support initial reading. In short, it can be described as a child's sensitivity to a language at a phonological level and the ability to discriminate and manipulate sounds in a spoken language (Dubeck & Gove, 2015; Furnes & Samuelsson, 2011). In an experimental study conducted by Cardoso-Martins, Mesquita, and Ehri (2011), the results showed that preschool children in the experimental group who were specifically trained in phonological awareness found it easier to learn letter sounds than the children in the control group who had no training. Other studies have also shown that phonological awareness is a good predictor of reading success (Furnes & Samuelsson, 2011; Georgiou et al., 2011; Kim, 2011; Lyytinen et al., 2009; Manolitsis, Georgiou, Stephenson, & Parrila, 2009; Saine et al., 2010; Torppa et al., 2010). Moreover, studies have shown that phonological awareness is also strongly related to spelling, especially in regular orthographies (Furnes & Samuelsson, 2011; Kim, 2011; Lerkkanen et al., 2004a).

More specifically, phonemic awareness is the ability to detect letter sounds, and this is a vital skill in the initial reading process (Cardoso-Martins et al., 2011; de Jong & Van Der Leij, 2002; Cockroft, Broom, Greenop, & Fridjohn, 2001; Farrall, 2012; Lerkkanen, et al., 2004a, Nation & Cocksey, 2009). For example, Ehri et al. (2001) determined, through their meta-analysis of 52 studies, that phonemic awareness instruction benefitted both word reading and comprehension. In fact, it was ascertained that the relationship between phonemic awareness and reading is reciprocal, even after children become literate. This means that as children's phonemic awareness increased, so did their reading ability and vice versa (Lerkkanen et al., 2004a).

3.2.2 Letter knowledge

Drouin, Horner, and Sondergeld (2012, p. 544) state that alphabet knowledge includes "the ability to recognize, name, and provide the sound for the uppercase and lowercase letters of the alphabet." Their study confirmed that alphabet knowledge is a "unitary construct" since most of the alphabet tasks presented to a sample of preschoolers overlapped. The results of these tasks showed that the children experienced a difficulty level that saw letter recognition as the easiest task, followed by letter naming and letter sounds. The researchers recommend that teachers assess and teach letter knowledge using combined letter tasks rather than separating them. The children in their research found uppercase letters easier than lowercase letters. At the beginning of the school year, Finnish grade 1 teachers teach both upper- and lowercase letters together with letter-sound connections (Lerkkanen, 2007), while in comparison, Namibian grade 1 teachers focus mainly on letter sounds and prefer lowercase letters,

with uppercase letters only used at the beginning of a sentence and for proper nouns.

The study conducted by Manolitsis et al. (2009) of Greek and English speaking children showed that direct teaching of letter sounds and names at home lead to better letter knowledge. According to Piasta and Wagner (2010), the ease with which children learn letter names and sounds are dependent on several properties related to the letters themselves. These properties include whether the letter is a consonant or a vowel, its position in the alphabet, whether the child is developmentally ready to pronounce and thus learn the letter, if there are one or more phonemes connected to a letter, the confusion that might be associated with the letter's shape or pronunciation, and the frequency of the letter in print. One of the theories that Tønnessen and Uppstad (2015) posit is that letter knowledge acquisition could be viewed from a behaviorist and cognitivist point, where the learner makes the association between a phoneme and a grapheme. Repeated associations of the letters reinforce the letter knowledge and eventually leads to automatization. Phonics as a reading method that is based on these associations dovetails well into this theory.

3.2.3 Word reading

In the Simple View of Reading model, Gough and Tunmer (1986) explain the process of reading as R = D x C, where R is reading, D is decoding, and C is comprehension. The main aim of learning to read is comprehending what printed materials mean. To reach the goal of fluent reading, it is important that children learn to read the individual words that form sentences. For correct and fluent word reading, a child has to decode each word as seamlessly as possible. Gough and Tunmer (1986) define word decoding as being closer to word reading than just "sounding out." They believe that a skilled decoder is a reader who can silently, swiftly, and accurately read a list of words. The previous findings support the SVR model in the context of a transparent orthography such as Finnish, but they also show the direct effect of reading fluency on reading comprehension (Torppa et al., 2016).

How children become skilled decoders is explained through five developmental phases as laid out by Ehri and McCormick (1998). Each of the five phases characterizes learners' understanding and use of the alphabetic system when learning to read. During the first phase, the *pre-alphabetic phase*, children begin to participate in a literate environment, acquire oral language skills, and identify printed signs from their environment, gradually learning the shapes and names of letters. However, this visual code learning does not equate to reading ability because the alphabetic knowledge is not used to read words. A reader focuses on letters while the prereader in the *pre-alphabetic phase* ignores the letters and instead 'reads' the environment by remembering or guessing words from the context. A transition into the *partial-alphabetic phase* is thus signaled when children start attending to some letter-sound relationships, usually the initial or the final letters and sounds, to aid word recognition. In the *full-alphabetic phase,* the child can use complete connections between letters and

sounds they see in words. For the first time, they can also decode unfamiliar words and read stories. In the beginning of this phase, decoding is slow, but fluency increases with practice. In the *consolidated-alphabetic phase*, children begin to operate with multi-letter units in words like affixes, onsets, or syllables and store the orthography and spelling patterns of words in memory. Their sight vocabulary grows, especially in languages with more opaque orthographies, and the words are recognized automatically as a whole without letter-sound processing being necessary. In the *automatic phase*, words are read proficiently with high automaticity and speed.

Through a longitudinal study, Nordström, Jacobson, and Söderberg (2016) determined that early word decoding in grade 2 predicted academic performance in grade 9. The two reasons they provide for this phenomenon is that, firstly, word decoding development follows an expected trajectory according to developmental models of growth in reading. Word decoding at any specific time is dependent on previous word decoding development. Secondly, children in grade 2 who are ready to automatize their word decoding skills must have the skills to gain knowledge from the teaching-learning situation in school that will provide the foundation for later academic achievement. They state that children's word decoding skills early in their school career is an indicator of who is likely to succeed and who is not.

According to Ehri and Wilce (1983), 'unitization' is the final stage of word recognition, when a child stores the spelling of the word in memory, together with the meaning and pronunciation of the word. In less-skilled readers, unitized speed develops at a slower rate. Ehri's theory of printed-word learning states that because struggling readers lack sufficient letter-sound knowledge, they fail to commit to memory the full pronunciation, spelling, and meaning of the words. Consequently, when they encounter the words again, they struggle to retrieve their pronunciation and spelling. To rectify this problem, these children need to gain more knowledge of how the orthography of the language maps the speech sounds.

Although the tendency has been to assess reading mainly as text comprehension since this is the main aim of learning to read, the importance of assessing word reading should not be forgotten. When poor readers read a text and encounter an unfamiliar word that they cannot pronounce, they tend to guess by using the context in which the word is found. While this is a good coping mechanism, this default manner ensures that poor readers pay less attention to the letters in the spelling as well as the spelling patterns of these unfamiliar words. Hence, it takes longer for the unfamiliar word to be 'unitized' (Ehri & Wilce, 1983). In languages with more transparent orthographies, readers tend to go back to the alphabetic level and sound out unfamiliar words.

Stanovich (1981) found that even when skilled and unskilled readers in grade 1 were assessed on chosen words that were specifically familiar to them in a naming word test, unskilled readers' scores still lagged their skilled peers. This lag was in the number of words that were read in the allotted time, the dif-

ficulty of the words read, and the number of errors made. He suggests that word knowledge as well as decoding speed is an essential facet of reading.

3.2.4 Spelling

The link between reading and spelling has been endorsed by many research studies (Ehri, 1987; Retelsdorf & Köller, 2014). Moreover, in languages with transparent orthographies such as in Finnish (Lerkkanen et al., 2004a), children can learn the spelling rules and patterns of words simultaneously with reading. It is also claimed that when children are taught to read and write in a literacy-rich environment, they can for the most part learn how to spell without being taught, especially in languages more with transparent orthographies. The success of this 'natural' spelling acquisition through reading is dependent on the amount of exposure to print. The more exposure a child has, the better the quality of the spelling acquisition (Retelsdorf & Köller, 2014). Share (2008) hypothesized that the correlation between reading and spelling is so strong that children can self-teach spelling and reading in a reciprocal manner.

Masterson and Apel (2010) state that spelling is a set of skills that includes knowing the phonemes, orthography, and morphology of words, as confirmed by other studies (Labat, Ecalle, Baldy, & Magnan, 2014; Lyytinen et al, 2007; Torppa, Lyytinen, Erskine, Eklund, & Lyytinen, 2010). They describe their spelling analysis procedure that examines the linguistic knowledge individuals typically use when they spell a word. They may use their phonemic awareness to evoke the speech sounds that form part of the word. After identifying the sounds, they recall the orthographic knowledge for translating the speech sounds into spelling. This can happen directly when the individual knows the graphemes that represent the phonemes, or if the individual does not have this knowledge, they must rely on their knowledge of phoneme-grapheme patterns as well as the meaning and context of the word to represent their spelling of the word. Individuals may use their morphological awareness when spelling words derived from base words. This is true for many languages, including Afrikaans. Despite this triarchic knowledge that comes into play when individuals spell, assessments of learners' spelling do not typically examine this but merely indicate whether a learner has spelled the word correctly. For example, Masterson and Apel (2010) view this as lacking, and in an example where the word 'trick' is spelled incorrectly ('trik' and 'tek') by two learners, they examine the linguistic knowledge that these learners have or lack as demonstrated by their spelling. Taking this knowledge into consideration during research and instruction is more meaningful than recording both spellings as merely incorrect. Teachers could use these spelling forms as diagnostic measures to indicate the learners' level of phonological awareness.

3.3   GraphoGame in the Namibian classrooms

3.3.1   GraphoGame as an adaptive tool for reading instruction

Educational computer games differ in how they adapt in order to support the varying needs of individual children. While reward cycles and adaptive progression is typical in computer games, they should ensure that the game is tailored towards the population cohort for whom it is geared for in order minimise deficits observed in this population. Other aspects that add to the success of computer games are aspects such as the ability to immerse the player in the game, fun, real world features, story, and music (Mishra & Gazzaley, 2014).

The original training game, Ekapeli (the Finnish version that led to GraphoGame), was devised sought to take the following characteristics. It had to be computer-based, in order to be available on the internet and thus accessible everywhere. The participants had to be non-readers at the beginning. Initially, the focus was on at-risk children. Letter-sounds were at the core of the training programme. Full-time adult supervision is not necessary during training. The training game includes aspects that gain and keep the attention and interest of the child so that s/he continues with the game until the targeted skills are acquired (Lyytinen et al., 2007).

Currently, GG can be played on computers, tablets and mobile phones. Using headphones, each child can focus on their playing time without disturbing others or being disturbed by outside noises. Children are logged in as players with their name, age and gender and they get to choose from 20 characters ranging from animals, robots and fairy-type characters. When they click on their character, their name appears. When they click on their name the game commences from where they last stopped. The game keeps track of the time that the child responds for each 'Session', as well as the overall 'Exposure time' (time from the stimulus onset to the child's reaction) that the child has had in the game. The child plays the game by listening to letter sounds and words and responds by clicking on the correct letter or word. If the answer is correct, the letter or word is highlighted in green. If the child's response is incorrect, the correct answer is shown alone, and the letter sound or word is repeated so that the child makes the connection. Through a series of rewards, potentially the learner stays motivated to the task for at least 20 minutes (Kyle, Kujala, Richardson, Lyytinen, & Goswami, 2013; Lyytinen et al., 2007).

The game monitors each child's progress and thus, ensures that the game is played at the literacy level of that particular child. Once the child has mastered the letters and word patterns of this level, the game switches to the next level. However, the letters and word patterns that the child is struggling in is presented in a variety of forms, for example, letters and words are on fish that are caught if the child chooses the correct fish or the fish swims away if the child chooses the incorrect fish. Thus, although letters and words are repeated

in order for the child to learn them, they are done in different ways to keep the child's attention.

Unlike a teacher whose time is limited in the amount of attention they can provide to individual learners, as a computer-assisted device, this is not an issue for GG. When a learner plays GG, there is not a limit to the number of exposures that the adaptive game will present to a struggling learner. A teacher, especially in large classes, is not always able to do this. Thus, as a supportive reading tool, GG can be used in large classes to tailor individual support. This frees up some time for teachers to attend to children who desperately need their individual attention. This kind of repetition that struggling children need is not always possible in African classrooms where teachers have large classes and cannot always provide the attention that the child needs. In the Namibian schools where a grade 1 teacher may have in excess of 40 learners in the classroom, GG can be a way of learning and practicing reading skills. This makes GG an invaluable scaffolding tool for teachers and learners alike.

3.3.2 GraphoGame Afrikaans

Afrikaans has a fairly regular orthography, and this was taken into account when developing GraphoGame Afrikaans. It was developed using the syllabus for teaching Afrikaans literacy in grades 1 and 2 (see Appendix 3). To minimize confusion in instances where letters or the combination of letters are not typically transparent, these combinations of letters were presented to children in a rime format. An example of this is the 'oo' (/uə/) sound. Children are introduced to the sound and presented with words that contain this sound, for example, 'loop' (walk), 'room' (cream), and 'boot' (boat).

The sounds for GraphoGame Afrikaans were recorded in a radio studio in Windhoek, Namibia, and the graphics and technology were created at the University of Jyväskylä, Finland. The piloting of GraphoGame Afrikaans was undertaken during the GraphoLearn project by five teacher educators from the University of Namibia, involving ten grade 3 struggling learners. During this project, GraphoGame Afrikaans was used as an intervention tool to improve reading skills. Pre- and post-test assessments were conducted, and learners played GG for an average exposure time of 180 minutes.

3.3.3 The aim of the Study 2

The aim of Study 2 was to investigate the effectiveness of GraphoGame Afrikaans in supporting grade 1 learners' reading acquisition in a regular classroom. According to previous studies (e.g., Ktisti, 2015; Kyle, Kujala, Richardson, Lyytinen, & Goswami, 2013; Ojanen et al., 2015; Saine et al, 2010) on the benefits of GG, it is expected that the use of GraphoGame Afrikaans could improve grade 1 learners' reading and spelling skills. The hypothesis attempted to prove that GG improves children's reading skills better than compared to the two control groups in the study. The first control group had class as usual, while the

second control group played a computer-assisted mathematics game, Grapho-Math.

Research Question 1: Is GraphoGame an effective reading acquisition tool in Namibian classrooms?

This study examined the hypothesis that the mean gain scores of the assessment tests for GraphoGame were equal to the mean gain scores of the two control groups (GraphoMath and Control), i.e. H_0: $\mu GG = \mu GM = \mu C$.

Research Question 2: Does the effectiveness for reading of a computer-assisted game transfer to other computer-assisted games, not related to reading?

Studies show that computer-assisted learning can improve the performance of learners socially and developmentally (Hsin et al., 2014; Jeffs et al., 2006) and more specifically, reading performance (e.g., Regtvoort et al., 2013; Torgesen, 2002). As such, the second part of this study attempted to prove that playing a computer-assisted game improves improve aspects of reading better than not playing a computer-assisted learning game. The computer-assisted games (GraphoGame and GraphoMath) were compared to the control group that had class as usual without intervention.

3.4 Methods to Study 2

Participants

All four schools in Khomasdal, a suburb of Windhoek, that offer Afrikaans as the medium of instruction in grade 1 participated in the study. These schools are in one of the largest Afrikaans speaking communities in Windhoek. Because children are in the same suburb, they may have a similar socioeconomic status, although this was not controlled. All learners were from previously disadvantaged communities.

A total of five grade 1 classes in four schools formed the population as well as the sample (N = 202). Four classes formed the experimental group (n = 162) and the fifth class formed the control group (n = 40). In each of the four classes of the experimental group, the learners were randomly divided into GraphoGame Afrikaans (n = 82) and GraphoMath (n = 80) groups. Henceforth, the groups will be termed GraphoGame (GG), GraphoMath (GM) and Control (C). All the learners undertook pre-tests (n = 202) and post-tests (n = 197) in phonological awareness, letter knowledge, word reading, spelling, counting, and mathematical operations.

Five learners moved to other parts of the country and dropped out of the study early (Little's MCAR test: Chi-Square = 16.5, DF = 11, Sig. = .241). As the result is not significant, it can be concluded that the missing data was likely to be completely at random. As a result, cases can be excluded listwise when running analyses without biasing the estimates (Enders, 2011).

Measures

Pre- and post-tests in reading and numeracy skills were used to assess the learners' skill level in Afrikaans reading before and after playing GG. These included the assessment of phonological awareness, letter knowledge, word reading, spelling, counting, and simple mathematical operations.

Letter-Sound connection. The 23 letters of the Afrikaans alphabet (minus C, Q, and X in the English alphabet) were randomly presented on flashcards to individual learners, and they had to respond by providing the correct letter sounds (Ketonen, Salmi, & Krimark, 2015). Each learner's response to each letter was recorded with a tick or a cross to indicate correct or incorrect responses, respectively. The total score was calculated out of 23. Cronbach's alphas were .93 and .91, respectively.

Phonological Awareness. Learners were individually assessed on their ability to identify (1) the number of syllables in two words of varying length; (2) the initial letter sound in three words; (3) the final letter sound in three words; and (4) two items each of syllable deletion, phoneme identification, phoneme addition, and phoneme deletion (Ketonen, et al., 2015). Each learner's response was reported and recorded to indicate correct or incorrect responses. The total score was calculated out of 16. Cronbach's alphas were .84 and .79, respectively.

Word Reading. Twenty listed words were presented to learners individually (Ketonen, et al., 2015). The child's task was to read as many words correctly as possible within one minute. The words ranged from easy (i.e. two letters/one syllable words) to more difficult (i.e. ten letters/four syllable words). Each learner's response was reported and recorded to indicate correct or incorrect responses. The total score was calculated out of 20. Cronbach's alphas were .89 and .86, respectively.

Spelling skills. Twenty words were dictated in a class as a group test (Ketonen, et al., 2015). Children were required to write the words down using the correct spelling. The words ranged from easy (i.e. two letters/one syllable words) to more difficult (i.e. ten letters/four syllable words). The total score was calculated out of 20. Cronbach's alphas were .83 and .82, respectively.

Mathematics skills. Learners were individually assessed on their ability to count, add, subtract, and solve mathematical problems (Bridges in Mathematics, 2012; Ministry of Education, 2005). The counting tasks involved counting from 1 to 30, counting forward, counting backward, and counting in twos, both forward and backward. The addition and subtraction tasks (three tasks each) involved simple operations up to 10. Two problem-solving word tasks involved a combination of addition and subtraction. Each learner's response was reported and recorded to indicate correct or incorrect responses. The total score was calculated out of 17. Cronbach's alphas were .86 and .83, respectively.

The coefficients for Cronbach's alpha show that all the assessments (both pre- and post-intervention tests) were suitably reliable as their items demonstrate a relatively high internal consistency with lowest at .79 and the highest at .93. Thus, instrumental reliability was consistent for all the assessment tests.

Procedures

This phase of the research took place between September and November 2013. Learners were pre-and post-tested class-by-class. Each learner was tested individually on letter-sound connections, phonological awareness, word decoding, and mathematics. The spelling assessment was conducted as a group assessment with each class where the words were dictated, and learners wrote their individual answers on a piece of paper.

Following the pre-assessment tests, the four classes that had been randomly divided into GraphoGame Afrikaans or GraphoMath Afrikaans played for a period of two months (October–November 2013).

The study utilized 41 tablets (with their headphones) containing the content of either GraphoGame Afrikaans or GraphoMath Afrikaans. Each tablet was assigned to four learners (i.e. one for each class). A profile was created for each learner containing details of his or her first name and surname, his or her date and place of birth, and the school's name. Learners chose a character or avatar to accompany their name. Two classes played per day. This meant that learners played every second day. They played +/-40 minutes in two sessions of 20 minutes each. The playing continued until an exposure time of about 5 hours (+/-300 minutes) was reached for each player. Exposure time begins when a learner hears the letter sound, syllable, or word and ends when he or she selects the corresponding written letter sound, syllable, or word, whether correct or incorrect. The time when learners are not focused on the game and doing something else is not calculated as being part of the exposure time. Allocating and collecting tablets as well monitoring the playing sessions were carried out solely by the PhD student. The class designated as the control group did not play any game and except for the playing time for the GraphoGame Afrikaans and GraphoMath Groups, teaching took place as usual in all the classes. During this period, the GraphoGame Afrikaans and GraphoMath Afrikaans data were routinely uploaded to the server in Finland.

3.5 Results of Study 2

This study examined the hypothesis that the mean gain scores of the assessment tests for GraphoGame were equal to the mean gain scores of the two control groups (GraphoMath and Control), i.e. H$_0$: μGG = μGM = μC.

3.5.1 Comparison of GraphoGame Afrikaans and control groups regarding reading and spelling skills

The means and standard deviations for the three groups (GraphoGame Afrikaans, GraphoMath and Control) in letter-sound connections, phonological awareness, word reading, spelling, and mathematics, both pre-test and post-test scores are presented in Table 3.

TABLE 3   Means and standard deviations of assessment scores across sample groups: Study 2

Measure		Groups		
		GraphoGame (n = 81)	GraphoMath (n = 77)	Control (n = 39)
Letter Sounds (Pre-Test) (max 23)	M	15.4	16.09	18.69
	SE	0.75	0.71	0.74
	SD	6.62	6.23	4.61
	Range	0-23	0-23	7-23
Letter Sounds (Post-Test) (max. 23)	M	19	18.57	19.72
	SE	0.55	0.61	0.56
	SD	4.94	5.31	3.51
	Range	4-23	3-23	7-23
Phonological Awareness (Pre-Test) (max. 16)	M	9.07	9.19	11.69
	SE	0.40	0.45	0.47
	SD	3.63	3.93	2.95
	Range	0-16	1-16	4-16
Phonological Awareness (Post-Test) (max. 16)	M	12	9.68	10.46
	SE	0.34	0.37	0.51
	SD	3.02	3.25	3.19
	Range	2-16	0-15	3-16
Reading (Pre-Test) (max. 16)	M	2.6	2.87	4.56
	SE	0.3	0.35	0.52
	SD	2.7	3.05	3.27
	Range	0-11	0-10	0-10
Reading (Post-Test) (max. 16)	M	4.73	3.92	5.92
	SE	0.31	0.35	0.50
	SD	2.78	3.06	3.15
	Range	0-12	0-10	0-10
Spelling (Pre-Test) (max. 20)	M	3.17	3.45	5.97
	SE	0.30	0.34	0.48
	SD	2.69	2.99	3.01
	Range	0-11	0-11	0-11
Spelling (Post-Test) (max. 20)	M	7.17	6.94	7.69
	SE	0.41	0.37	0.42
	SD	3.66	3.26	2.62
	Range	0-18	0-16	1-12

(continues)

TABLE 3 (continues)

Measure			Groups		
			GraphoGame (n = 81)	GraphoMath (n = 77)	Control (n = 39)
Mathematics (Pre-Test) (max. 17)	*M*	8.49		9.12	10.64
	SE	0.43		0.44	0.60
	SD	3.88		3.81	3.75
	Range	0-17		2-17	3-17
Mathematics (Post-Test) (max. 17)	M	11.48		12.08	12.44
	SE	0.39		0.36	0.58
	SD	3.5		3.19	3.65
	Range	3-17		1-17	2-17

For all three groups (GraphoGame, GraphoMath and Control) mean assessment scores increased after the intervention except for phonological awareness in the control group. The increase in mean scores shows that, in general, learners improved their skills in these areas between the time points 1 and 2 (September to November). However, the means of the three groups in the pre-test assessments were not equivalent. In fact, the Control group had higher means in all the pre-test assessments.

Due to the differences across the means in the pre-test assessments, there was a need to calculate the gain scores. To determine whether the increase in the means of the assessment tests were the same across the groups, the difference between the pre- and post-intervention scores of letter-sound connections, phonological awareness, word reading, spelling, and mathematics were calculated. The means and standard deviations for the gain scores between the pre- and post-test scores were computed (Table 4) and then multiple group comparisons of the gain scores were carried. As the main aim of this study is to examine the effectiveness of GraphoGame Afrikaans in Grade 1 as a supporting tool, the focus of this section of the study was the comparison of GraphoGame Afrikaans to the control groups (GraphoMath and Control). The results are discussed in Table 4.

TABLE 4   Means and standard deviations of gain scores across sample groups: Study 2

Gain Scores for assessments		Groups		
		GraphoGame (n = 81)	GraphoMath (n = 77)	Control (n = 39)
Letter Sound	Mean	3.60	2.48	1.03
	SD	3.26	2.93	2.42
	SE	0.36	0.33	0.39
Phonological Awareness	Mean	2.93	0.48	-1.23
	SD	2.53	2.60	1.77
	SE	0.28	0.30	0.28
Word Reading	Mean	2.12	1.05	1.36
	SD	1.61	1.56	1.41
	SE	0.18	0.18	0.23
Spelling	Mean	4.00	3.38	1.72
	SD	2.93	2.50	2.51
	SE	0.33	0.28	0.40
Mathematics	Mean	2.99	2.96	1.79
	SD	2.48	2.76	2.45
	SE	0.28	0.31	0.39

The ANOVA *F*-test was used to determine whether any of the treatments (GraphoGame, GraphoMath and Control) is superior, inferior or equal, as per the null hypothesis, i.e. H_0: $\mu GG = \mu GM = \mu C$. The results reveal that, in general, there was a significant effect in all three groups on the gain scores of all five assessments at the $p < .05$ level for the three conditions:

- Letter-Sound connections: $F(2, 194) = 10.061$; $p < .001$; $\eta_p^2 = .094$
- Phonological Awareness: $F(2, 194) = 43.266$; $p < .001$; $\eta_p^2 = .308$,
- Word reading: $F(2, 194) = 9.784$; $p < .001$; $\eta_p^2 = .092$,
- Spelling: $F(2, 194) = 9.560$; $p < .001$; $\eta_p^2 = .092$, and
- Mathematics: $F(2, 194) = 3.255$; $p = .041$; $\eta_p^2 = .032$.

Additionally, the partial eta square values show that the effect sizes, that is the variation of the dependent variable (the assessment tests) range from 3% in mathematics, 9% in letter-sound connections, word reading, and spelling to 31% in phonological awareness for the grouping. The conclusion is that the *F*-test proves that the null hypothesis can be rejected because of the variation, that is, H_0: $\mu GG \neq \mu GM \neq \mu C$.

The *F*-test, however, does not indicate which treatment (group) is superior to the other. Thus, a comparison of gain means was made between the three groups' scores on each of the assessment tests using a one-way ANOVA including post hoc multiple comparisons using Games-Howell, which is recommended by Field (2017) for unequal group variances and sample sizes to avoid a family-wise error (Type I error) (see Table 5).

TABLE 5   Multiple variable pairwise group comparisons of the mean gain scores: Study 2

Measures	Groups		Mean difference in gain scores	SE	Sig.	95%CI for mean difference in gain scores	Effect Size (Cohen's d)	95% CI for ES
Letter Sounds	GG	GM	1.12	.49	.061	-.04 - 2.29	.36	.046 – .68
	GG	C	2.58*	.53	.000	1.32 - 3.84	.85	.46 – 1.25
	GM	C	1.46*	.51	.015	.24 - 2.67	.52	.13 – .92
Phonological Awareness	GG	GM	2.45*	.41	.000	1.48 - 3.41	.96	.63 – 1.28
	GG	C	4.16*	.40	.000	3.21 - 5.11	1.797	1.35– .24
	GM	C	1.71*	.41	.000	.74 - 2.69	.73	.33 – 1.12
Reading	GG	GM	1.07*	.25	.000	.47 - 1.67	.67	.35 – 1.00
	GG	C	.76*	.29	.025	.08 - 1.45	.49	.11 – .88
	GM	C	-.31	.29	.535	-.99 - .38	-.21	-.59 – .18
Spelling	GG	GM	.62	.43	.322	-.40 - 1.64	.23	-.09 – .54
	GG	C	2.28*	.52	.000	1.05 - 3.52	.81	.42 – 1.21
	GM	C	1.66*	.49	.003	.49 - 2.84	.66	.27 – 1.1
Math	GG	GM	.03	.42	.998	-.96 - 1.02	.01	-.30 – .32
	GG	C	1.19*	.48	.040	.05 - 2.34	.49	.10 – .87
	GM	C	1.17	.50	.058	-.03 - 2.37	.44	.051 – .83

Notes. (1) GG = GraphoGame, GM = GraphoMath, C = Control, E.S. = Effect Size, C.I. = Confidence Interval.
(2) Determining specific effect size for the 3 groups, Cohen's ds was computed using an online calculator (Psychometrica; Lenhard & Lenhard, 2016).
(3) *The mean difference is significant at the 0.05 level.

Specifically, the results showed that the gain scores for the GraphoGame group (GG) were higher than the two control groups (GM and C) in all the assessment tests. Significant differences were attained between GraphoGame (GG) and Control (C) in all the assessment tests. Significant differences between Grapho-Game (GG) and GraphoMath (GM) occurred in phonological awareness and reading but not in spelling and mathematics. In letter-sound connections, the result could be considered marginally significant between GG and GM.

When comparing the effect sizes of GraphoGame to Control only, according to Cohen (1992), large effect sizes were found in letter-sound connections, phonological awareness and spelling ($0.8 \leq d< 0.8$). Small to moderate effect sizes were found in reading and mathematics ($d < 0.5$).

When interpreting the effect sizes, there was a large effect size in phonological awareness ($d \geq 0.8$) between GraphoGame and GraphoMath, with a medium effect size in reading ($0.5 \leq d < 0.8$), and small effect sizes in letter-sound connections and spelling ($0.2 \leq d < 0.5$). These results reflect marginal significance.

In sum, these results indicate that GraphoGame could be an effective tool for improving grade 1 learners' skills as related to reading such as phonological awareness and play a role in improving letter-sound connections, word reading, and spelling.

3.5.2 GraphoGame Afrikaans and GraphoMath, as computer-assisted games improve reading better than not playing

The second part of the results focuses on testing whether playing GraphoGame Afrikaans and GraphoMath (as computer-assisted games) improve aspects of reading better than not playing a computer-assisted learning game. As the previous section focused on GraphoGame as related to the other groups, the comparison between GraphoGame and Control has already been discussed. The results reveal that significance were attained between GraphoGame (GG) and Control (C) in all the assessment tests.

When comparing GraphoMath and Control, Table 5 also shows that GraphoMath had higher gain scores than Control in all the assessment tests, except for word reading. Significance was attained in letter-sound connections, phonological awareness and spelling, but not in mathematics. Table 5 also shows that between GraphoMath and the Control, there was a medium effect size in letter sounds, phonological awareness, and spelling ($0.5 \leq d < 0.8$) with a small effect size in mathematics ($d < 0.5$). These results indicate that playing GraphoMath had some effect compared to not playing any computer game.

All these results demonstrate that the two groups who played the computer games GG or GM during the intervention phase showed increased gains when compared the control group that did not play.

3.6 Discussion of Study 2

The aim of Study 2 was to investigate to what extent using GraphoGame Afrikaans in a regular grade 1 classroom supports reading skills. The results reveal first that the gain scores among the learners playing GraphoGame Afrikaans were higher than learners in the two control groups (i.e. the GraphoMath Afrikaans and no-treatment control groups). Additionally, except for the mathematics and spelling test scores between GG and GM, significance was attained for all the reading-related tests (i.e. letter sounds, phonological awareness, word reading, and spelling) between other group combinations, and there were small to large effect sizes in these test scores when comparing pre- to post-intervention groupwise mean gain scores. The results are in line with several previous studies which have indicated that learners who played GraphoGame improved their letter sound skills and phonological awareness from the pre- to the post-intervention tests (Richardson, 2011; Saine et al., 2010; Sucena et al., 2016)

The results also revealed that when comparing the two groups that had played a computer-assisted game (GraphoGame Afrikaans or GraphoMath Afrikaans) to the control group that did not play at all, the two groups that played showed higher gains than the control group, including several effect sizes in the test scores. Several comparative studies (Hsin et al., 2014; Jeffs et al., 2006; Plowman & Stephen, 2003) show that ICTs support learning directly and indirectly, and using multiple modalities (i.e. visual, auditory, and kinesthetic) appeals to the learning styles of each learner. According to Mishra and Gazzaley (2014), neuroplasticity is enhanced when playing computer games. These could be possible reasons why the learners who played computer-assisted games in this study showed higher gains in reading than the learners in the control group.

In sum, GraphoGame is associated with increased scores on post-intervention assessment tests in aspects contributing to reading and spelling. Research has shown how these aspects are linked to reading (Katzir et al., 2012; Lerkkanen et al., 2004a; Lerkkanen et al., 2004b; Torppa et al., 2010; Furnes & Samuelsson, 2010; Georgiou et al., 2011; Ehri, 1987; Ehri & McCormick, 1998), and hence, if GraphoGame has been proven to increase these aspects, it also directly improves reading. The results of Study 2 also demonstrate how in a relatively short time (5 hours of playing time), GraphoGame affects reading skills development, and it could be used effectively in a regular classroom in Namibian schools with very little need for teacher input except monitoring the playing process.

3.7 Limitations of Study 2

Studies 2 and 3 were conducted in Windhoek, which has a large population of Afrikaans learners, but it could have been conducted in southern or western Namibia where there are also Afrikaans-speaking communities. The study was conducted in Khomasdal, a suburb of Windhoek that has the highest number of Afrikaans and the medium of instruction for classes, but no schools in town formed part of the study. Since the schools in Khomasdal are considered to have a lower socioeconomic status than the schools in town, this may have had an impact on the results of only using GG in this community. As all the classes that have Afrikaans in Khomasdal were part of the study the results can reliably be generalized to this community. However, this may limit the generalization to other parts of the country and may have an effect on the external validity of the study.

With regard to the intervention times in Studies 2 and 3, GraphoGame was only played in the classroom under supervision. Learners played in 2 sessions per day of 20 minutes each. According to previous research (Kamykowska et al., 2014; Lovio, Halttunen, Lyytinen, Näätänen, & Kujala, 2012; Saine et al., 2010), ideally learners should play in short stints of 5-20 minutes to ensure their engagements. Playing for long periods could have impacted on learners' concentration. In addition, results may have been better if learners could also have

played for short periods of time at home in their own time. As there were only 41 tablets available for the 162 learners who were part of the experimental design, this option was not available for this study.

It has been shown that the testing environment could play a role when assessing learners and may have an influence on their behavior, especially if they are taken out of their class and are tested in an isolated room. As a person from outside the school community, the ecological validity could have been impacted when assessing learners, especially the pre-test assessments when they did not know the researcher well.

When the pre-test assessments were conducted, it was found that the control group that did not play any computer-assisted game had higher scores in all the assessments than the GraphoGame and the GraphoMath groups. A possible reason for this phenomenon could be that the school had previously been a semi-private school as they were funded by a welfare organization to accommodate orphans and vulnerable children; the school is situated opposite the orphanage. This meant that they may have been better resourced compared to other schools in the area. They also had an excellent school principal that was very involved in learners' academic progress, especially reading. The latter reason was unknown at the time of the study. Due to the unexpected inequality of the pre-test raw scores, the difference between the pre-and post-tests were focused upon to ascertain the gain scores achieved during the intervention. A limitation of using the gain scores could mean that there may have been learners who because of their initial higher scores in the pre-test assessment could not achieve large gain scores.

Another possible reason why learners who played GraphoGame, and to some extent those learners who played GraphoMath, performed better could be due to the Hawthorne effect. These learners were aware that they were selected for a 'special' reason and they were doing something unusual (playing a computer-assisted game during part of the usual lesson time) and this may be the reason why they worked harder and put in more effort, thus gaining better results.

The current study compares the progress of learners playing GG (a reading-based game) with those learners who played GM (a mathematics-based game) and those who did not play any game. Another option could have been to compare GG with another reading-based game. The results of such a research design could have been more comparable. The focus of such a design would be of two reading programs and not the current design that compares a computer-assisted reading program with a computer-assisted mathematics program.

The version of GG which was used in studies 2 and 3 did not teach the fluency needed for more advanced reading skills such as comprehension. Although, a more recent version of GG for Finnish learners includes reading fluency practice (Richardson & Latvala, 2012), it is not available for Afrikaans learners as yet.

4 STUDY 3: GRAPHOGAME AFRIKAANS AS AN INTERVENTION TOOL FOR STRUGGLING READERS

4.1 Introduction to Study 3

Study 3 examines the viability of using GG as an intervention tool for struggling readers. This study starts by inspecting the research that has been carried out to support this viability. In addition, this study examines the motivation level of struggling readers. As such we discuss the reading interest of struggling readers, the self-concept of these learners, and task-value and task-avoidance as it relates to motivation. Lastly, the classroom attitudes and behaviour of struggling readers are discussed as it relates to learning to read and motivation.

4.2 GraphoGame intervention for struggling readers

Previous studies show that GG can play an important role in assisting children who are at-risk for reading difficulties. The original purpose of GraphoGame was an intervention for children with dyslexia (Lyytinen, Erskine, Hämäläinen, Torppa, & Ronimus, 2015; Lyytinen et al., 2009; Richardson & Lyytinen, 2014). As described previously, GraphoGame's ability to adapt to the individual learner's reading level is a good example of the properties of the GraphoGame as a good adaptive intervention tool. This dynamic and adaptive nature of GG is characteristic of scaffolding, whereby the learner is presented with 80% opportunity of being correct as only 20% of the targeted skills are unknown (Lyytinen et al., 2007). This ensures that the learner's attention and interest is maintained while the targeted skill is learned (Hsin, Li, and Tsai, 2014).

For example, Richardson (2011) provides evidence of GG as an intervention with preschool and grade 1 learners who had reading difficulties, were at risk for dyslexia (i.e. at least one member of the family manifested dyslexia), or both. These interventions involved four languages (Finnish, German, Dutch, and English) with varying depths of orthography. The intervention was in the form of 5 hours of GG playing time. Pre- and post-intervention assessments using reading-related tests were conducted. These tests revealed that children's basic reading skills improved significantly after the intervention period compared to the control groups (i.e. those who played a math game and those who did not play at all).

A longitudinal study compared three groups of 7-year-old Finnish children who were at-risk for a reading disability (n = 166) (Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2011). The groups received regular reading remediation, computer-assisted reading remediation (GG), or mainstream classroom instruction in reading. The children were assessed in grades 1, 2, and 3 in letter knowledge, reading accuracy, fluency, and spelling skills. The results reveal that the GG group had significant gains in these reading-related skills compared to the other two groups. These effects continued after the intervention, resulting in these initially at-risk children reaching the mainstream children's average level by grade 3.

In a similar study in Brazil, the Portuguese version of GG was used in an intervention study involving 57 grade 1 learners who were identified as being at risk for experiencing difficulties in reading acquisition (Sucena et al., 2016). The children were divided into three groups: GG intervention only, GG intervention and sessions with an education technician that trained them in pre-reading and reading competence, and a control group with no intervention except usual classroom instruction. There were positive results in letter-sound knowledge, phonemic awareness, word reading, and non-word reading for the two intervention groups when compared to the control group. Better results were indicated for the combined intervention group (i.e. GG and specialized reading instruction).

The current study (Study 3) focuses on how GraphoGame Afrikaans was used to assist struggling readers in grades 1 and 2. To better understand these learners, they were assessed on motivating factors that may have an impact on struggling readers' interest and engagement in playing the game.

4.3   The motivation of struggling readers

According to Pintrich (2003), researchers who are interested in determining why some children flourish in the school context while others flounder should consider the role of motivation. Theory and research have conceptualized intrinsic motivation as encapsulated by several concepts such as interest, goals related to task-acceptance, task-avoidance, and mastery. How a learner perceives him- or herself regarding learning activities influences his or her motiva-

tion to be engaged in the activity; therefore, self-concept also plays an important part in motivation. This study focuses on the following aspects of motivation: classroom attitudes and behavior of struggling learners, the learner's interest, self-concept, task-value, and task-avoidance.

4.3.1 Classroom attitudes and behavior of struggling readers

According to Moreau (2014), in a study that examined teachers' perceptions about struggling readers, teachers agreed that there was a relationship between reading and motivation or low engagement. However, they could not alleviate the subsequent classroom behaviors. They identified behaviors in struggling readers as reluctant, frustrated, or non-responsive. Some also made judgment calls stating that these learners were lazy and passive-aggressive. These behaviors start out being coping mechanisms in response to the struggles with reading, and without the necessary intervention, they can escalate into behavior patterns. When the behavior is judged, especially in isolation of the reading situation, this can impact the student even more profoundly and exacerbate an already tenuous situation. This can lead to the learner avoiding reading, which is the source of the behavioral issues from the learner's perspective.

A well-known tool for screening social, emotional, and behavioral attitudes is the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). The SDQ has five scales: emotional symptoms, conduct problems, hyperactivity, peer problems, and prosocial. Each scale has 5 subscales or items with 25 items in total measuring both strengths and difficulties. The Emotional Symptoms Scale assesses the child's emotional state including happiness, worries, fears, and nervousness. The Conduct Problems Scale assesses the child's behavior including tempers, cheating, aggressive behavior towards others, and obedience. The Hyperactivity Scale examines the child's ability to be focused on tasks as well as restlessness and inattention. The Peer Problems Scale assesses the relationship the child has with his or her peers and the peers' relationship with the child. The Prosocial Scale is an assessment of social behavioral strengths. Because it is comprehensive, the SDQ has been widely used in 4201 publications from 95 countries according to the official website (http://www.sdqinfo.com/py/sdqinfo/f0.py) (Koskelainen, Sourander, & Kaljonen, 2000; Moriwaki & Kamio, 2014; Vostanis, 2006) as well as in African countries (Kashala, Lundervold, Sommerfelt, Tylleskär, & Elgen, 2006; Sharp et al., 2014; Skeen et al., 2014), including Namibia (Gentz, 2016). The SDQ has been translated into more than 80 languages. This study used the Afrikaans translation of the SDQ.

4.3.2 Reading interest of struggling readers

Eccles and Wigfield (2002) assert that intrinsic motivation is a combination of preference for challenging tasks, learning that is determined by interest, and striving for mastery and competence. They opine that of the three, interest is the core concept of intrinsic motivation. A differentiation between individual and

situational interest is defined. Individual interest is described as a somewhat stable evaluative association towards certain areas of preference whereas situational interest is linked to the interest of the current interest whatever it is and whenever it occurs. Research on individual interest has been related to deep-level learning (i.e. better and clearer recall and comprehension) when reading texts. Research on situational interest has been linked to the characteristics of academic tasks that hold learners' interest. For example, text features that arouse learners' situational interest include "personal relevance, novelty, activity level, and comprehensibility" (Eccles & Wigfield, 2002, p. 115).

4.3.3 Self-concept of learner

According to McArthur, Castles, Kohnen, and Banales (2016), it is well-known that poor reading impacts academic performance, but only recently has it come to light how this affects the emotional health of struggling readers, which includes self-concept. Self-concept usually refers to a child's perception of him- or herself in a specific domain (e.g., the physical, social, home, or academic environment). McArthur et al. (2016) state research has indicated that the academic self-concept of struggling readers is typically lower than the other domains. However, within the group of poor readers, their self-concept is not homogenous. The results showed that the types of reading ability might be reliably related to specific types of self-concepts for poor readers. For example, the study determined that poor readers with inattention problems had a low academic self-concept, while poor readers with poor spoken language had a low general self-concept in addition to a low academic self-concept.

Viljaranta et al. (2016) investigated patterns and trends related to word reading skills, interest, and the self-concept of ability from kindergarten to grade 2. Their results show that although most of the children who were at risk for reading difficulty typically had both low interest in reading and a poor self-concept, the results were not homogenous. The relationship between the three constructs varied from child to child. There were children with high reading achievement and a positive self-concept but a low interest in reading, while other children demonstrated poor word reading skills and a negative self-concept but a high interest in reading.

Therefore, in addition to achievement and how it relates to reading and interest in reading, how does the process of reading acquisition itself impact a child's self-concept? Arya (2003) investigated the influence of reading acquisition on grade 2 learners' self-concept. In this case study of nine learners including both proficient and less proficient readers, she examined how these learners perceived themselves regarding being readers, belonging to a reading ability group, and their literacy identity. She found that classroom reading activities for less proficient learners focused on reading aloud while decoding words and reading comprehension focused on literal meaning. In contrast, more proficient readers were given more opportunities to read silently and reading comprehension activities comprised of extracting higher order meaning from the text. Arya concluded that learners develop an understanding of themselves as readers

based on their reading experience in the classroom. This reading experience also influences how they defined reading.

4.4 The aims of Study 3

Based on previous studies (Kyle, Kujala, Richardson, Lyytinen, & Goswami, 2013; Lyytinen et al., 2007) on the benefits of GG for struggling readers, it is expected that playing GraphoGame Afrikaans for an extended period improves various aspects of reading among struggling readers. As such, the main aim of study 3 was to investigate the extended use of GG to assist in intervening for learners who continue to struggle despite having initial GG exposure in grade 1. *Research Question 1: Is GraphoGame Afrikaans an effective intervention tool for struggling readers?*

The aim was also to better understand the learner who is struggling to read and more effectively tailor interventions. Thus, the second aim of this study examined motivating factors such as self-concept, task-value, task-avoidance, and the classroom behavior of learners who are struggling with reading.

Research Question 2: What is the motivation level of struggling readers?

4.4.1 Task-value as it relates to motivation

According to the expectancy-value model for achievement motivation developed by Eccles et al. (1983), students' achievement and task choices are influenced by their expectation of success in the tasks and the subjective value attached to the tasks (Eccles & Wigfield, 2002). They state that in the beginning, young children's competence and task-value beliefs are relatively separate. Over time, though, children begin to attach value to tasks in which they are more competent. Two reasons for this change are that the more they do well in a task, the more they want to engage in the task (Thorndike's law of effect), and if they lower the value that they give to tasks that they don't do so well in, they can still maintain their self-esteem and efficacy.

In a longitudinal study conducted over 8 years that had a cross-sequential design with 3 cohorts (grades 1, 2, and 4), Archambault, Eccles, and Vida (2010) identified 7 groups of children that showed different trajectories of change over time in subject task-value and ability self-concept. Although all children in the study showed a decrease of subject task-value and ability self-concept during their school years, some children showed a sharper decrease. They recommend that early detection of a dramatic decline in motivation is important and that intervention for children at risk for reading difficulty should also focus on increasing motivation.

4.4.2 Task-avoidance as it relates to motivation and achievement

Research has proven that skillful reading is a result of emergent literacy skills such as phonological awareness, letter knowledge, and rapid automatized naming in addition to non-cognitive behaviors such as engagement effort and task-focused behavior. In contrast, task-avoidant behavior has been linked to poor reading skills. Task-avoidance is characterized by expecting failure and low levels of effort and perseverance in academic tasks. Patterns of task-avoidance include learned helplessness, self-handicapping, and ego-oriented coping (Aunola et al., 2002).

Learners tend to avoid tasks when they have experienced failure in these tasks. If the task involves reading, it can lead to having a negative attitude towards all reading activities. Hence, a vicious cycle can exist wherein an avoidance of reading-related tasks eventually leads to limited time spent on reading and can result in a 'regressive reading pathway' (Eklund, Torppa, & Lyytinen, 2013; Georgiou, Manolitsis, Nurmi, & Parrila, 2010; Hamilton et al., 2013; Lerkkanen, 2003; Onatsu-Arvilommi & Nurmi, 2000; Rosenthal & Ehri, 2011; Wigfield & Cambria, 2010; Zhang, Nurmi, Kiuru, Lerkkanen, & Aunola, 2011). Good pre-reading skills were linked to low task-avoidance. (Hirvonen, Torppa, Nurmi, Eklund, & Ahonen, 2016).

4.5 Methods to Study 3

Table 6 displays the timeline for Studies 2 and 3.

TABLE 6   Timeline to Study 2 and Study 3

	STUDY 2		STUDY 3	
Date	Time 1: Sept. 2013	Time 2: Nov. 2013	Time 3: May 2014	Time 4: July 2014
No. of learners	203	197	77	77
Group numbers	GG = 82 GM = 80 Control = 40	GG = 81 GM = 77 Control = 39	GG = 19 GM = 28 Control = 30	GG = 19 GM = 28 Control = 30
Assessment Type	Pre-assessment	Post-assessment	Pre-assessment	Post-assessment
Assessment Tests	*Letter Sounds *Phonological Awareness *Word reading *Spelling *Math counting *Math operations	*Letter Sounds *Phonological Awareness *Word reading *Spelling *Math counting *Math operations	*Letter Sounds *Phonological Awareness *Word reading *Spelling	*Letter Sounds *Phonological Awareness *Word reading *Spelling *Struggling Readers only:* *Self-concept *Task-value *Task-avoidance *SDQ

Note. GG = GraphoGame; GM = GraphoMath

Participants

A total of 77 learners divided into three groups formed the sample in this study. First, based on the research conducted in Study 2, the lowest scoring 20 learners (about 25% of 81 learners) who had played GraphoGame Afrikaans were selected for the intervention group. The learners selected had to demonstrate that despite playing GraphoGame Afrikaans, they had not made substantial improvements in letter knowledge, reading, and spelling. One learner transferred to another school, leaving 19 learners. Second, two control groups of 30 learners each were randomly selected from the original control (41 learners) and GraphoMath (79 learners) groups in Study 2. Two learners from the GraphoMath had moved out of the area; therefore, the GraphoMath group included a total of 28 learners.

Measures

Assessment of literacy skills. Pre- and post-assessment tests in reading and spelling were used to assess learners before and after playing GG as an intervention. These included the same tests of letter knowledge, phonological awareness, reading, and spelling used in Study 2. For the present study, the Cronbach's alphas for the pre- and post-test scores were as follows: letter-sounds = .92 and .84; phonological awareness = .89 and .67; reading = 89 and .87; and spelling = .88 and .85. As for Study 2 the coefficients for the Cronbach's alpha's were reliably high and showed consistency of the assessment tests.

The following assessments on motivation took place after the reading-related post-tests were conducted.

Assessment of motivation factors:

The Self-Concept of Ability. Children's self-concept of ability in literacy was measured during an interview using the Self-Concept of Ability Scale (Viljaranta et al., 2016). During this, the children were individually presented with a sheet of paper that showed 10 pearls in a line from the top to the bottom of the page with pictures suggesting activities of running, writing, doing mathematics and reading. The children were told that the pearls represented children the same age as them and that the one at the top of the page represented the child who was best at a certain subject, who was in the middle, and so on down to the poorest performer. If children perceived that they were the best, they would select Pearl no. 1 on top. If they thought they were the worst, they would select Pearl no. 10 on the bottom of the page. The instructions were explained carefully, and the rating scale was also practiced together until it was determined that each child understood the scale. Running races against classmates was used as an example. Children's self-concept of ability in mathematics, reading and writing were measured by using the following instruction: "You should think how good or poor you are at reading and letter tasks. How do you feel? Are you the most skillful, in your class, somewhere up here, or are you down here, the least skilled in literacy, or are you somewhere here in the middle? Where are you?" The participants responded by pointing to one of the pearls. Cronbach's alpha was .76.

Task-Value. Children's interest in reading was assessed in an interview using the Task Value Scale for Children (TVS-C; Nurmi & Aunola, 1999; see also Lerkkanen et al., 2012; Viljaranta et al., 2016). This scale is based on the ideas presented by Eccles et al. (1983) concerning interest value. The scale consists of three items that measure children's interest in (i.e. liking of) reading, writing, and math tasks (e.g., "How much do you like reading tasks?"). All the questions were read aloud to the children. The children were asked to indicate, by pointing to one of five illustrated faces ranging from a big frown to a big smile, which best described their interest in specific reading tasks (1 = I do not like it at all/I dislike doing those tasks; 5 = I like it very much/I really enjoy doing those tasks). Cronbach's alpha was .66.

Task-Avoidant behavior. Task-avoidant behavior was assessed by asking the teachers to evaluate the extent of the child's task-avoidant behavior using the

Behavior Strategy Rating Scale (BSR; Onatsu-Arvilommi & Nurmi, 2000) rated on a 5-point Likert scale (1 = not at all; 5 = to a great extent). The teachers were asked to assess their students' typical behavior in learning situations (especially difficult tasks) at school. Behavior items assessed include task management and endurance, doing something else instead of the task and giving up. Cronbach's alpha was .82.

Classroom behavior. Children's classroom behavior was assessed by teacher-ratings using an Afrikaans version of the Strengths and Difficulties Questionnaire accessed from the internet (SDQ; Goodman, 1997; Steyn, Winkler, & Steyn, 2014). The SDQ consists of 25 items rated on a 3-point Likert scale (1 = not true, 2 = somewhat true, and 3 = certainly true), producing scales for hyperactivity/inattention, conduct problems, emotional symptoms, peer problems, and prosociality. Teachers rated each learner's areas of strengths and difficulties related to classroom behavior. Cronbach's alpha was .58.

Procedures

The 19 struggling readers played GG for 10 hours over a period of 2.5 months with two sessions of 20 minutes played per day (Exposure time: M = 604.95 min, SD = 5.35). For the two control groups, teaching took place as usual.

All the learners in this study were assessed using pre- and post-intervention assessment tests in letter sounds, phonological awareness, reading, and spelling. At the end of the intervention session, the struggling readers were evaluated regarding their motivation using the Self-Concept, Task-Value, Task-Avoidance and Strengths and Difficulties Questionnaire (SDQ) assessments.

4.6 Results of Study 3

The results correspond to the efficacy of using GraphoGame Afrikaans as an intervention tool for struggling readers as well as determining the motivation level of struggling readers after playing GG.

4.6.1 Benefit of GraphoGame Afrikaans to struggling readers

Descriptive statistics of the three groups' pre- and post-intervention test scores according to the GraphoGame, GraphoMath, and control groups are displayed in Table 7. The results showed that each group's mean test scores increased.

TABLE 7   Means and standard deviations of assessment scores across sample groups: Study 3

Measures		GraphoGame (n = 19)	GraphoMath (n = 28)	Control (n = 30)
Letter Sounds (Pre-Test Time point 3) (Max. 23)	M	6.58	11.89	12.067
	SE	.89	.65	.65
	SD	3.86	3.45	3.53
	Range	1-14	3-16	3-16
Letter Sounds (Post-Test Time point 4) (Max. 23)	M	19.79	20.29	20.87
	SE	1.05	.65	.32
	SD	4.58	3.46	1.78
	Range	4-23	8-23	16-23
Phonological Awareness (Pre-Test Time point 3) (Max. 16)	M	6.58	11.89	12.07
	SE	.89	.65	.65
	SD	3.87	3.45	3.53
	Range	1-14	3 16	3 -16
Phonological Awareness (Post-Test Time point 4) (Max. 16)	M	12.79	12.11	12.3
	SE	.62	.46	.39
	SD	2.70	2.41	2.15
	Range	6-16	5-16	7-15
Word Reading (Pre-Test Time point 3) (Max. 20)	M	2.37	5.89	8.37
	SE	.63	.62	.70
	SD	2.73	3.27	3.84
	Range	0-7	0-14	0-16
Word Reading (Post-Test Time point 4) (Max. 20)	M	6.26	7.29	9.63
	SE	.61	.70	.64
	SD	2.64	3.71	3.53
	Range	1-9	0-18	1-17
Spelling (Pre-Test Time point 3) (Max. 20)	M	3.17	7.17	8.87
	SE	.62	.67	.67
	SD	2.64	3.29	3.67
	Range	0-9	0-13	2-16
Spelling (Post-Test Time point 4) (Max. 20)	M	5.17	7.58	10.23
	SE	.65	.72	.68
	SD	2.75	3.53	3.74
	Range	0-10	0-17	3-17

Thereafter, to determine the size of this increase, the gain scores were computed. Table 8 shows the means for the gain scores for each of the three groups. The mean gain scores showed that the learners who played GG had higher mean gain scores in all tests as compared to the two control groups (GraphoGame and Control). A possible reason could be that the control groups had less room to improve, i.e. there could have been learners in the control groups that may have been closer to the ceiling level and thus not much room for gain.

TABLE 8   Means and standard deviations for gain scores across sample groups: Study 3

Measures		GraphoGame (n = 19)	GraphoMath (n = 28)	Control (n = 30)
Letter Sounds	M	13.21	8.39	8.80
	SD	5.23	2.53	3.06
	SE	1.20	0.48	0.56
Phonological Awareness	M	6.21	0.21	0.23
	SD	3.01	1.97	3.00
	SE	0.69	0.37	0.55
Reading	M	3.89	1.39	1.27
	SD	1.91	1.57	1.66
	SE	0.44	0.30	0.30
Spelling	M	3.21	0.57	1.30
	SD	2.23	1.40	2.52
	SE	0.51	0.26	0.46

The following results comparing the means of the gain scores were recorded after running a one-way ANOVA including post-hoc multiple comparisons using Bonferroni to avoid a family-wise error (i.e. a Type I error). The results showed that the mean differences between gain scores of the GraphoGame group and both the GraphoMath and control groups indicate significance in all the assessment tests. To gauge the size of the difference of the gain scores, the effect size was computed using Cohen's d_s with a confidence coefficient of 95%.

When determining the size of the difference between GraphoGame and GraphoMath, GraphoGame showed a large effect size (d $\geqslant$ .80) in all the assessment tests. In comparison to the control group, GraphoGame also showed a large effect size in all the assessment tests (the lowest d = .792). Between the two control groups (GM and C), the effect sizes were not significant (see Table 9).

TABLE 9 Multiple variable pairwise group comparisons of the mean gain scores: Study 3

			Mean difference in gain scores	*SE*	*Sig.*	95%CI for mean difference in gain scores	Effect Size	95%CI for ES
Letter Sounds	GG	GM	4.82*	1.06	.000	2.23 - 7.41	1.25	.62 - 1.89
	GG	C	4.41*	1.04	.000	1.86 - 6.97	1.09	.48 - 1.71
	GM	C	-.41	.94	1.000	-2.7 - 1.88	-.15	-.66 - .37
Phonological Awareness	GG	GM	6.00*	.80	.000	4.05 - 7.94	2.46	1.69 - 3.23
	GG	C	6.00*	.78	.000	4.06 - 7.9	2.00	1.29 - 2.69
	GM	C	-.02	.70	1.000	-1.74 - 1.7	-.01	-.52 - .51
Word Reading	GG	GM	2.50*	.50	.000	1.27 - 3.74	1.46	.80 - 2.11
	GG	C	2.63*	.50	.000	1.41 - 3.84	1.49	.84 - 2.13
	GM	C	.13	.45	1.000	-.96 - 1.22	0.07	-.44 - .59
Spelling	GG	GM	2.64*	.62	.000	1.11 - 4.17	1.49	.83 - 2.14
	GG	C	1.91*	.62	.008	.4 - 3.42	.79	.20 - 1.39
	GM	C	-.73	.55	.572	-2.08 - .62	-0.36	-.87 - .16

Note.
(1) ES=Effect Size; CI=Confidence Interval
(2) * The mean difference is significant at the 0.05 level.

Now that we have established that the gains made by the struggling readers who played GG were significant as compared to the two control groups, the focus of the rest of Study 3 will be on the struggling readers. Figure 6 displays the progress of struggling readers from Grade 1 (May 2013) to Grade 2 (July 2014) with assessments taken at four time-point. The legend shows each of the total of each assessment tests in brackets, e.g. letter sounds (Total-23). Figure 6 demonstrates that the first intervention in 2013 involving a total of 5 hours of the GraphoGame intervention showed some increase in the post-intervention mean scores (Time point 2). Extending the playing time to a total of 10 hours in 2014 clearly showed a marked increase in the post-intervention scores (Time point 4). The period between Time-Point 2 and Time-Point 3 includes two school holidays and a school term between the holidays.

The graph lines that represent the time line for each of the assessment tests in Figure 6 show that except for word decoding, all the assessment tests took a 'dip' after Time-point 2. This demonstrates that there appears to be decline in the assessment scores during school holidays (December-January) and a school term (January-April) before reassessment at Time-Point 3. Letter sounds was the only assessment test that decreased (from 6.68 to 6.58) to below the original starting Time-Point 1. Word decoding increased by .69 of a word between Time-Point 2 and Time-Point 3, an increase of less than one word overall.
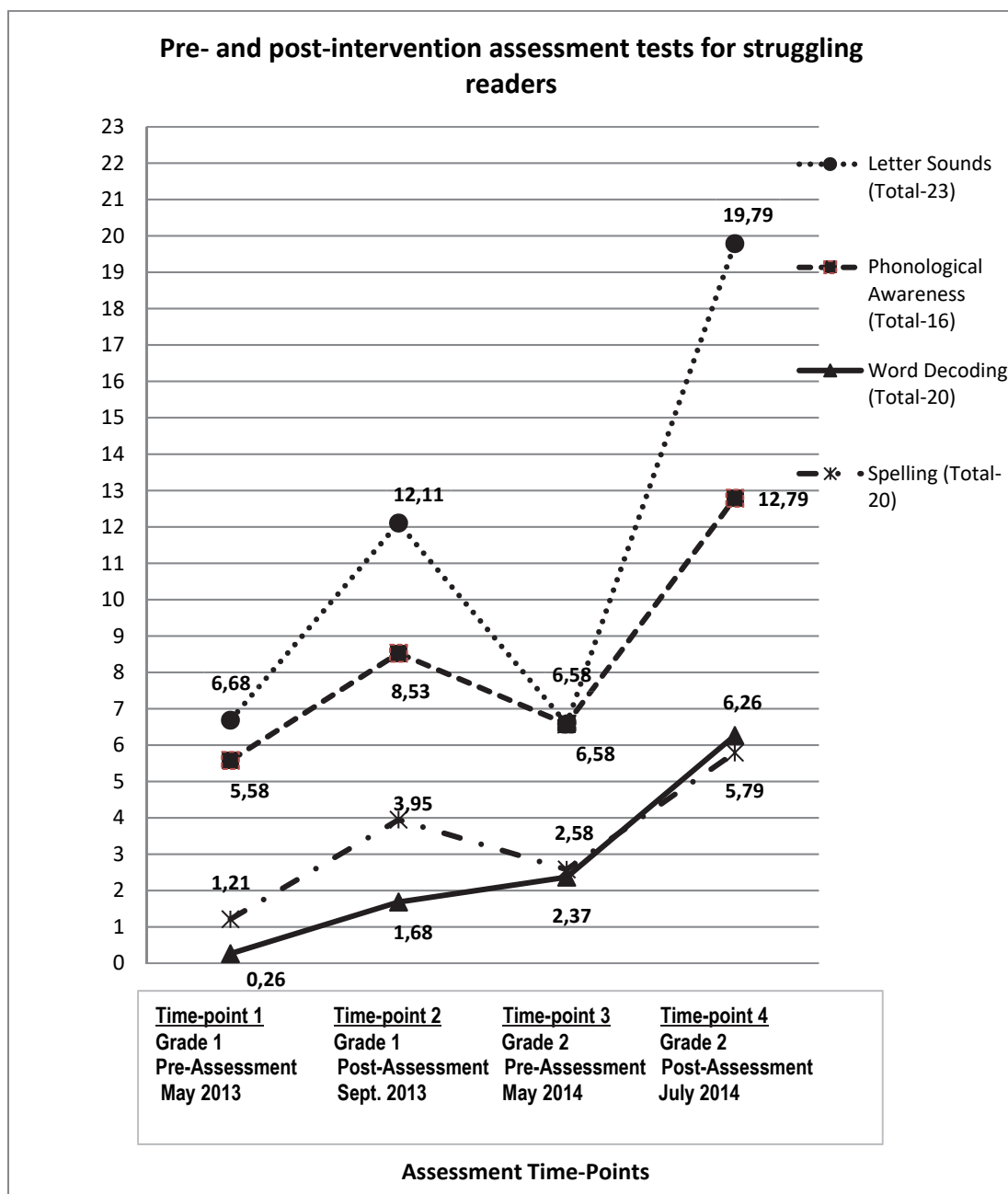
FIGURE 6   Assessment test scores of struggling readers assessed at four time points

Between Time-Point 3 and Time-Point 4 (the second intervention period for struggling readers), there were marked increases in the assessment scores for these learners who played GG. Even in comparison to the other control groups (GM and C), significance ($p < .001$) was attained, as well as a large effect size ($d \geqslant .792$) in all the assessment tests (See Table 9).

In sum, these results indicate that GG is an effective tool for struggling readers by contributing to improving their reading and spelling skills, and we can conclude that playing GG for an extended time is beneficial for struggling readers. Hence, we can accept that playing GG Afrikaans for an extended peri-

od improves the reading skills of struggling readers. Moreover, the gains made by the struggling readers (GG) exceeded that of the two control groups (GM and C) who did not receive the GG intervention.

4.6.2 The motivation of the struggling readers

At the end of the intervention, evaluations were conducted to gauge the level of motivation of struggling readers (GG intervention group). First, Figure 7 displays the strengths and difficulties of the struggling readers in the classroom. The higher the score out of 10, the more increased the strengths or difficulties were as indicated by their teachers.
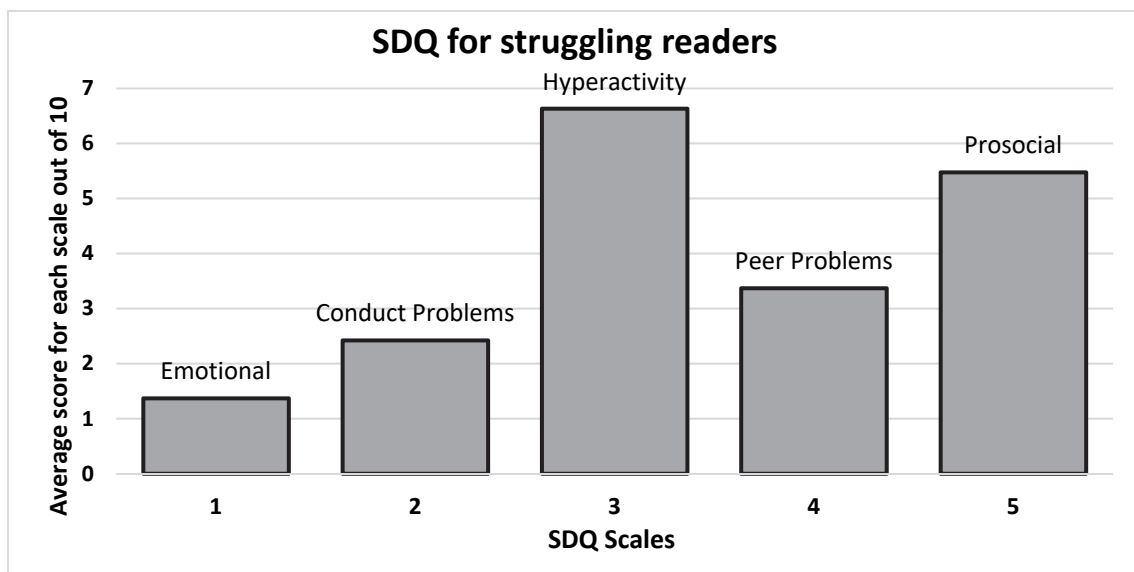
FIGURE 7   Strengths and Difficulties Questionnaire (SDQ) for struggling readers

Regarding the Emotional Scale, it seems the learners typically did not display the negative emotional symptoms that form part of this scale. Learners did not display many behavioral problems in the way they conducted themselves, according to the Conduct Problems Scale. It appears that struggling readers more commonly showed signs of hyperactivity and impulsivity, they were easily distracted, and struggled to complete assignments due to a reduced attention span. According to the teachers, most of the learners did not have many peer problems. On average, it seems these struggling readers were social towards others and quite helpful. The results showed that these struggling readers show more strengths than difficulties in the classroom (see Figure 7).

TABLE 10   The self-concept of ability and task-value that struggling readers have to-wards academic subjects

	Self-Concept (3-30)	Task-value (5-)
Mean	11.32	34.84
Mode	3	45
Std. Deviation	8.11	7.67
Skewness	1.25	.08
Std. Error of Skewness	0.52	.52
Kurtosis	0.99	-1.11
Std. Error of Kurtosis	1.01	1.01
Minimum	3	21
Maximum	30	45

With regard to Self-Concept, the minimum score that a learner could have was 3 (if that learner perceived that s/he was the best (1) in writing, mathematics and reading). The maximum score a learner could have was 30 (if that learner perceived that s/he was the worst (10) in all three academic subjects). The results showed that most learners have an above average self-concept (11.32) of their ability in academic subjects. A number of them thought that they were the best (the graph is positively skewed= 1.25) whether it was in mathematics, writing, or reading (see Table 10).

The Task Value Scale for Children required the learners to indicate, by pointing to one of five illustrated faces ranging from a big frown (1 = I do not like it at all) to a big smile (5 = I like it very much) for each of the academic subjects of reading, writing, and mathematics. They had to indicate how they liked the subjects, in addition to how they valued doing tasks in these subjects at school and at home (i.e. 3 indications per subject). The least total score that they could have was 9 (a score of 1 for each of the 3 indications multiplied by the 3 subjects). Conversely, the highest score that a learner could have a total score of 45 (a score of 5 for each of the 3 indications multiplied by the 3 subjects). As the measures of central tendency indicate for Task-Value, learners tended to value reading, writing, and mathematics towards the higher end of the scale (see Table 10). This meant that they liked reading, writing, and mathematics and liked doing tasks involving these subjects both at school and at home.

TABLE 11   Task-avoidance of struggling readers as indicated by their teachers

	Avoid difficult tasks	Easily gives up	If task not going well, does other things	*Not able to manage tasks*	*Does not endure tasks*
Mean	2.21	2.63	3.32	3.21	3.16
SE of Mean	0.37	0.37	0.37	0.33	0.34
Mode	1	1	5	2	5
Std. Deviation	1.62	1.61	1.60	1.44	1.46
Skewness	1.03	0.41	-0.40	-0.03	-0.07
SE of Skewness	0.52	0.52	0.52	0.52	0.52
Kurtosis	-0.58	-1.44	-1.52	-1.51	-1.35
SE of Kurtosis	1.01	1.01	1.01	1.01	1.01
Minimum	1	1	1	1	1
Maximum	5	5	5	5	5

Teachers evaluated each struggling learner's task-avoidant behavior using the Behavior Strategy Rating Scale (BSR; Onatsu-Arvilommi & Nurmi, 2000) which was rated on a 5-point Likert scale (1 = not at all; 5 = to a great extent). The last two columns were re-ordered in order for the Likert scale to apply in the same order as for the first three columns. This implies that a low number indicates that the learner is less inclined to avoid tasks (i.e. 1), while a high number (i.e. 5) indicates task-avoidance. It would appear from the means that according to the teachers, struggling readers did not display extreme task-avoidance behavior, but when difficulties arose, most of the learners tended to avoid completing their tasks (see Table 12).

     In sum, the motivation of struggling readers showed mixed findings. Evaluations from the learners' perspective demonstrate a strong self-concept of ability and a high regard (i.e. value) for the tasks with which they were presented. In turn, from the teachers' perspective, struggling readers tended to avoid completing tasks (i.e. task avoidance) when they were faced with difficulties. Teachers, however, indicated that struggling readers showed more strengths than difficulties.

4.7 Discussion of Study 3

The results concluded that playing GraphoGame Afrikaans for an extended period improves the reading and spelling skills of struggling readers. The results of this study are similar to those found in previous studies. Some children who may have dyslexia or other reading difficulties need more than four hours of GG playing time to impact reading acquisition (Lyytinen et al., 2015, 2009, 2007;

Ojanen et al., 2015; Richardson & Lyytinen, 2014; Saine et al., 2010). The ability of GG to accommodate the struggling reader is typical of scaffolded learning whereby targeted reading skills that are unknown and possibly difficult only form 20% of the skills that presented to the learner, while 80% of the skills are known to the learner. Thus, GG took into consideration the struggling readers individual levels, and over an extended playing time targeted their unknown skills. This is evident in their post-assessment test results. This is typical of scaffolded learning.

The fact that there is a 'dip' in assessment scores between Time-Line 2 and Time-Line 3 (two holidays and a school term in between) is not unexpected. Tønnessen and Uppstad (2015) uses the theory of connectionism to explain temporary lapses in skills performance, as well as the phenomenon of an increase and decrease in knowledge and skills. They claim that it is easier to increase performance than to develop skills. In this case, it would appear that the intensity of the intervention leads to an increase of performance as seen in the increase in the ensuing post-assessment scores but may not have had the same effect on the development of reading skills after a lapse of time (as seen by the 'dip' in the scores after Time-Point 2). Overall, though almost all the assessment scores (except for a decrease of .10 for Letter sounds) started on a higher level at Time-Point 3 than at Time-Point 1. This points to some increase in the development of the reading skills assessed. To what extent this increase is solely based on the GG intervention is inconclusive as there were many factors that could and should have contributed to the further development of reading skills. One of these factors includes classroom teaching that had been taking place as usual.

The evaluation of the motivation of struggling readers reveals mixed results, where the learners themselves have a strong self-concept and a high regard for their classroom tasks; however, their classroom teachers report that while they have more strengths than difficulties, they tend to avoid tasks in which they struggle. While it is expected that learners' high motivation levels necessarily results in high achievers, this was not the case in this study; the struggling readers in this study had a high self-concept, which is in contrast to Arya's study (2003). While a strong self-concept is laudable, it should also be realistic. A possible explanation for this result could be a consequence of playing GG and experiencing a high level of positive reinforcement. Eccles and Wigfield (2002) claim that learners who value a task will stay on task and usually do well on it. In contrast, the results reveal that the struggling readers in this sample had a high regard for their classroom tasks, including reading. These results resonate with those found by Viljaranta, Lerkkanen, and Poikkeus (2009) in their study on cross-lagged relationships between reading-task motivation and reading performance.

The concern is in teachers' observations that when these learners struggle with a task, they avoid it. This situation is detrimental because it impacts the further development of the learner in the subject task that they are avoiding as well as further motivation for the task, in this case reading (Eklund, Torppa, & Lyytinen, 2013; Georgiou, Manolitsis, Nurmi, & Parrila, 2010; Hamilton et al.,

2013; Hirvonen et al., 2016; Lerkkanen, 2003; Rosenthal & Ehri, 2011; Wigfield & Cambria, 2010; Zhang, Nurmi, Kiuru, Lerkkanen, & Aunola, 2011).

As several studies have indicated, teachers' expectations of struggling learners and how they are manifested in classroom activities is very important. If teachers can have a positive outlook and demonstrate that through positive reinforcement and with support and intervention, many of these hurdles associated with reading can be solved. Ensuring that reading topics and activities become and stay interesting to struggling readers is a good strategy to keep readers on task (Eccles & Wigfield, 2002; Lerkkanen, Kiuru, Pakarinen, Viljaranta, & Poikkeus, 2012). In conclusion, the positive increase in reading-related skills after the extended GG intervention is encouraging. When one considers the high self-concept and task-value that learners have regarding motivation along with teachers' ratings that show struggling learners have more strengths than difficulties, there is much hope for Namibian learners and reading acquisition.

These learners were always eager to play GraphoGame. Playing Grapho-Game appeared to have a positive effect on these learners' self-concept. The fact that several learners were of the opinion that they were among the best readers in the class indicated that they had a high self-concept with regard to reading. There appeared to be a relationship between learners playing GG and their self-concept as related to reading. This may be due to the characteristic of the game where learners had positive results 80% of the time due to the dynamic scaffolding nature of GG.

4.8   Limitations of Study 3

All the limitations regarding the experimental study using GraphoGame as discussed under the **Limitations of Study 2** (3.8) are applicable to Study 3. In addition, instead of a random selection of controls for Study 3, a more purposeful selection of paired learners in the control group with the experimental group would have been a better selection. The results of the pre-and post-assessment tests would have been more comparable.

To gain a better understanding of the motivation level of struggling learners, it would have been more enlightening to evaluate the motivation level before, during, and after the intervention rather than after it. It would have also been prudent to evaluate the learners who formed part of the control groups to compare their motivation levels to those of struggling learners.

5 GENERAL DISCUSSION OF THE THESIS

This research focused on investigating possible interventions to improve the reading situation in Namibia. The aim of the first study was to investigate reading situation based on the perceptions of grade 1 teachers in Namibia related to their knowledge and classroom practices in teaching reading. Given the reading situation, the aim of Study 2 was to determine to what extent the use of GraphoGame Afrikaans in a regular classroom supports and improves the reading acquisition of grade 1 learners. The aim of the Study 3 was to determine to what extent GraphoGame Afrikaans intervention supports and improves the reading skills of struggling readers when the intervention time was extended, as well as determine the motivating factors such as self-concept, task-value, task-avoidance, and the classroom behavior of learners who are struggling with reading.

This section discusses the potential that the results of this thesis has on improving teaching and learning in Namibia. The practical implications and recommendations based on this thesis are explored. The three studies that form this thesis have limitations to them, which are discussed together with possible solutions. A number of related issues have arisen as a result of these studies and suggestions are made for future research.

5.1 Potential for improving teaching and learning to read in Namibia

Economically, Namibia is ranked as a middle-income country; however, the disparity between the wealthiest and the remainder of the population is one of the widest in the world, as evidenced by an income Gini-coefficient of 0.6. This translates into the government not being able to provide adequately for all children's education, especially the poorest (Ninnes, 2011).

Furthermore, other issues confound the low socioeconomic climate in which most young learners live. The initial reading process is fraught with pos-

sible shortcomings. Many of the learners may come from homes where a love of books is not part of the culture. This is not surprising if one considers the financial position of their families. Buying books is considered a luxury. The language of instruction their parents choose, especially in the towns and capital city, may not be their home language. The perception of English as a prestigious language influences this choice. As a result, these young learners learn to read in a language with an opaque orthography, while their own mother tongue has a transparent orthography and infinitely easier to learn to read. The current situation is that most junior primary teachers only have a three-year diploma, the accepted minimum. Based on the survey responses, almost a third of the grade 1 teachers claim they did not have adequate training in reading instruction. These teachers teach in classes where the average class size is 40 learners with no assistance. When all these confounding issues are aggregated, it portrays a bleak picture for the average Namibian learner, especially if the learner is a struggling reader.

Developing teacher training program. There is a need to examine and reflect on the training programs that were offered to current early childhood teachers at the previous colleges and the current training program for classroom teachers at the University of Namibia. The results of Study 1 may provide useful information that could improve the training of teachers in reading instruction. Any new revisions should reflect a strong knowledge foundation in how learners acquire reading, starting with emergent literacy practices in pre-primary school. The essential connection between decoding and comprehension should be emphasized (Gough & Tunmer, 1986; Lerkkanen, 2003). The essential teaching and learning components/elements of reading should form part of that knowledge foundation in teacher training. While the current B.Ed. training contains most of these aspects, a stronger emphasis should be given on how teachers should scaffold these reading elements. Practical work should include scaffolding techniques appropriate in large classes. How students use scaffolding, as part of micro-teaching on campus and during school-based studies/teaching practice at schools, should be monitored to ensure that they have mastered the skills.

Appropriate instruction methods. Since phonics is the suggested reading method for Namibian local languages, it is disturbing that teachers still do not have enough knowledge of this area. It is recommended that every newly qualified teacher is provided with mentorship, especially in language and reading instruction. Schools should help newly qualified teachers identify what may be preventing some children from learning as expected. Kekhani-Mhoney (2015) recommended that appropriate teaching methods for reading instruction should be monitored through continued professional development workshops and seminars. In the Namibian set-up these training opportunities could be handled by mentor teachers at the schools; the regional education office, especially those advisory staff directly responsible for the lower primary phase; and the Continual Professional Development (CPD) unit attached to the University of Namibia. The results of the teacher survey in Study 1 show that on average

teachers had an overall teaching experience of nearly to 16 years and close to 10 years of teaching in grade 1. This implies that there are a number of long-serving teachers who could be mentors for the novice teachers.

Teacher knowledge of language aspects. With regard to teachers' knowledge, the results of Study 1 show that between 50 and 97% of teachers answered the items on language aspects of reading incorrectly. Although a case can be made in more developed countries that this may not affect the manner in which teachers teach reading acquisition (Aro & Björn, 2015), Namibian teachers differ from the Finnish teachers in a number of ways. The more obvious differences are, for example, in the level of teacher qualification (mostly Masters' degrees in Finland as compared to a three-year teaching diploma in Namibia), language spoken in the classroom (mostly monolingual in Finland as compared to multilingual in Namibia), class size and classroom resources. Thus, these factors (and others not mentioned), together with a lack of knowledge of languages aspects of reading may have an impact on the quality of initial reading instruction in Namibia.

Learner support. As part of the Ofsted (2012) recommendations, training institutions are encouraged to ensure that student teachers are given clear information about current age-related expectations of learners' progress and attainment in language and reading. The student teachers should also be given ample opportunity to observe and learn about these developments. The study also recommends that trainees receive more opportunities to assess, plan, and evaluate learners from an early stage so their planning accommodates the different learning needs of children more effectively. These recommendations once again reflect a strong need for support of individual learners if learning to read is going to be a successful process. As a 'dynamic intervention' process geared towards the individual learner and to ensure the zone of proximal development the teacher needs to know each learner and their progress well. Teachers need to be trained in the garnering of dynamic knowledge of each learner through reading assessments so that scaffolding is optimal (van de Pol et al, 2010).

Typically, Namibian classrooms have only one teacher (and no teacher assistants) to cater for learners (40.1 according to the results of Study 1). Because of the large class sizes, learners who struggle in Namibian classrooms are probably not receiving the appropriate individual scaffolding experience that they need. According to Tønnessen and Uppstad (2015), for the learners to develop their letter knowledge, they make associations between graphemes and the corresponding phonemes. As per contiguous learning (Behaviorism), repetition is required for successful learning. Due to large class sizes in Namibia, learners may not always get the opportunity for much-needed repetition and individual scaffolding opportunities to cement the initial literacy skills that leads to successful reading acquisition. The best that teachers can do is to get to know the class as a whole (their strengths and weaknesses) and guide their learning through instructional scaffolding.

GraphoGame as a potential initial reading solution. Based on the above scenario, effective scaffolding of the essential initial reading elements, such as

phonological awareness, letter knowledge, word reading, and to a limited extent, spelling may not be happening for the Namibian grade 1 learner. As a possible short-term solution GraphoGame can assist in scaffolding these elements. GraphoGame, as shown by the results of Studies 2 and 3 can greatly enhance the initial reading experience of the Namibian learner. GraphoGame will repeat learning opportunities in a variety of ways without the learner being aware of being drilled. The dynamic and adaptive nature of GG ensures that it follows the ability of the learner because 80% of the letters or words shown to learners are known to them. As a result, they experience success. Because GG is dynamic in catering for the individual level of the learner, it is a good scaffolding tool (Ojanen et al., 2015). As a teaching tool that could be used in classrooms where the emphasis should be learner-centered as prescribed by the Namibian education curriculum, GG could be invaluable in small group activities within large classes. Learners who would typically be unable to get enough of the teacher's attention could be provided with appropriate repetition in learning letter sounds and words during GG play as well as being occupied appropriately while the teacher provides attention to learners who need more individual attention.

The content for GG Afrikaans covers the syllabus for grades 1 and 2 and could be used by teachers of these grades as a remedial tool for learners in their classes who are struggling to read. As GG can be played without a teacher's constant assistance, these learners could play for short sessions both at school and at home over time until they have acquired the basic letter knowledge and words needed for more fluent reading. Each Namibian school is required to have a learning support group that is created to assist struggling learners. Since reading appears to be a problem for many Namibian learners, GG could even be used as a remedial tool by the learning support group in primary schools for struggling learners in grades higher than grades 1 and 2 if there is evidence that these learners do not have adequate letter knowledge and word reading skills.

GraphoGame is easily downloadable to an android device, and since many Namibians use mobile phones to communicate, even parents can download GG for their children. As a tool, teachers can check game logs to determine which areas learners are struggling with; therefore, it can also be a good diagnostic tool. GraphoGame could also be used as an assessment tool as the GG Afrikaans version regularly assesses learners' letter, word, and pseudo-word knowledge. The data for these assessments could be downloaded from the server and analyzed diagnostically for typical problem areas. These problem areas could be addressed during classroom teaching, providing further support to learners.

Motivation of struggling learners. Motivation has proven to play an integral role to successful initial reading, especially for struggling readers. The more learners are interested in tasks, such as reading, the more they will be motivated to stay on task (Eccles & Wigfield, 2002). The results of Study 3 are mixed in terms of levels of motivation. From the struggling readers perspective, they showed positive motivation in terms of their very strong self-concept and

their positive regard for (value of) classroom activities. While their teachers reported that these learners had more strengths (including good behavior) than difficulties, struggling readers tended to avoid classroom tasks in which they struggled. The results show overall high motivation levels, especially from the perspective of the learners themselves.

GG could positively impact the motivation level of learners, especially struggling learners, as tentatively suggested by the motivation levels of the struggling readers after the GG intervention in Study 3. By playing GG, even struggling readers will be provided with positive learning experiences because they will know 80% of the letters and words that are presented to them. This positive learning experience will likely keep them on task and as the saying goes "success breeds success".

5.2 Suggestions for future research

While there have been strides in Namibia to improve the level and quality of teacher education with the introduction of degrees in primary education, the rate at which reading levels improve have not been as rapid. A possible reason could be, as Mutenda (2004) contends, teachers tend to teach reading using the same methods that they have been taught in. In addition, schools tend to prescribe methods and routines that have been entrenched. Novice teachers tend to follow these trends despite exposure to newer and better researched methods during teacher training. The questions that need to be researched are why this is happening and how we ensure that novice teachers are more resilient in implementing good reading practices.

Research into the extensive use of GG in schools and its impact will be needed once the tool is installed in primary schools where Afrikaans is taught, whether as a first or second language of instruction. An investigation into how teachers use GG in their regular classroom teaching should be investigated as well as how the learning support groups use GG for struggling readers. A more rigorous research study (involving randomized sampling and equivalent control groups) on how GG can be used as an intervention tool for struggling learners is needed to determine the impact of GG. In order to minimize the Hawthorne effect, intervention crossover could be a better research design for learners involved in the study. This research design first selects one group as the experimental group. Later this group becomes the control group and the previous control group becomes the experimental group. Research into how the University of Namibia's Faculty of Education students use GG as part of their school-based studies and later when they become employed should be monitored and evaluated. It is envisaged that a community of partners will be formed to develop GG into the other 15 languages that are offered in Namibian schools. Initial discussions have already begun. More research surrounding this potential project is crucial as well as expanding GG into a tool that enhances reading fluency.

Future research into how GG compares to other computer-assisted reading programs is strongly suggested to further the search for reading programs that may better improve initial reading acquisition and the development of higher order reading skills.

YHTEENVETO (SUMMARY)

Väitöstutkimuksen lähtökohtana oli lasten lukutaidon erittäin heikko tilanne Namibiassa. Namibiassa, niin kuin monissa Afrikan maissa, tilanne kouluissa on hyvin haasteellinen johtuen esimerkiksi luokkien suurista oppilasmääristä ja oppilaiden hyvin vaihtelevista taustoista liittyen esimerkiksi vanhempien mahdollisuuksiin käydä koulua tai vanhempien lukutaidottomuuteen. Koska tutkimus kohdistui afrikaansia puhuviin koululaisiin, johdannossa kuvataan afrikaansin kieltä ja sen ortografiaa sekä kielen historiaa liittyen Etelä-Afrikan Apatheid politiikkaan sekä Namibian nykyistä koulujärjestelmää, monikielisyyttä ja koulujen kielipolitiikkaa.

Johdannossa tarkastellaan myös lasten lukemaan oppimista ja lukutaidon oppimisen kannalta keskeisiä kielellisiä taitoja sekä motivaation merkitystä lukutaidon oppimisessa. Teoreettisina käsitteinä tuodaan esille erityisesti lähikehityksen vyöhyke sekä scaffolding, joiden avulla pyritään ymmärtämään oppimisen tukemista opettajan ja erityisopettajan toiminnassa ja käytettäessä digitaalisia välineitä oppimisen tukena. Lisäksi johdannossa tarkastellaan laajemmin tutkimuksia, jotka liittyvät tietokoneavusteisen opetuksen merkitykseen lukemisen perustaitojen oppimisessa. Keskeinen huomio kohdistetaan Jyväskylän yliopistossa kehitetyttyä Ekapeliä (GraphoGame) koskeviin aiempiin tutkimuksiin, koska tässä väitöstutkimuksessa testattiin pelin afrikaans kielistä versiota.

Väitöskirja koostuu kolmesta toisiaan täydentävästä osatutkimuksesta. Koska opettajat ovat keskeisessä asemassa lukemaan oppimisessa, ensimmäisessä tutkimuksessa selvitettiin ensimmäisen luokan opettajien tietämystä ja näkemyksiä lukemaan opettamisesta Namibiassa. Toisessa osatutkimuksessa tutkittiin afrikaansin kielisen GraphoGame tietokonepelin yhteyttä lukemaan oppimiseen. Kolmas osatutkimus tarkasteli saman tietokonepelin mahdollisuuksia tukea niiden lasten lukemaan oppimista, joilla oli lukemisvaikeuksia.

Ensimmäisessä osatutkimuksessa selvitettiin namibialaisten opettajien tietämystä, näkemyksiä ja käytäntöjä lukemaan opettamisessa ja sitä, miten he tukevat oppilaidensa lukemaan oppimista. Kyselyyn vastasi 132 ensimmäisen luokaan opettajaan. Taustatekijöinä selvitettiin opettajien ikä (30-60-vuotta) ja opetuskokemus (keskiarvo 15.8 vuotta, ensimmäisen luokan opettajana 9.5 vuotta) sekä luokkakoko (keskimäärin 40 oppilasta). Opettajista 81% arvioi saamaansa koulutusta varsin myönteisesti (keskimääräisestä erittäin hyvään) ja he tunnistivat erittäin hyvin yleiset hyvät opetuskäytänteet. Kuitenkin heidän tietämyksensä lukemaan oppimisen ja opettamisen keskeisistä piirteistä ja erityisesti lukemisen kannalta keskeisistä kielen piirteistä ja rakenteista oli hyvin puutteellista (hyvät tiedot vain alle 37 prosentilla opettajista).

Toisessa osatutkimuksessa tutkittiin GraphoGame-tietokonepelin mahdollisuuksia tukea aiemmissa kansallisissa ja kansainvälisissä tutkimuksissa havaitun heikon lukutaidon parantamista Namibiassa. Tutkimusta varten kehitettiin afrikaans kielinen GraphoGame Afrikaans peliversio, joka harjoituttaa systemaattisesti lukemisen perusvalmiuksia ja adaptoituu vaikeusasteeltaan lapsen

suoritustasoon. Tutkimus toteutettiin neljässä afrikaans kielisessä koulussa Khomasdahlissa, joka on Namibian pääkaupungin Widhoekin esikaupunkialue ja yksi suurimmista afrikaansin kielisistä yhteisöistä. Kaikki lapset tulivat alueilta, joiden väestö on ollut perinteisesti heikko-osaista. Tutkimukseen osallistui viisi ensimmäistä luokkaa neljästä koulusta (N = 202). Neljä luokkaa (n = 162) muodostivat koeryhmän ja viides luokka toimi kontrolliryhmänä (n = 40). Jokaisessa koeryhmään kuuluneessa luokassa oppilaat arvottiin joko Grapho-Game Afrikaans ryhmään (n = 82) tai GraphoMath ryhmään (n = 80). Kaikki oppilaat osallistuivat esitestaukseen ja jälkitestaukeen, joissa arvioitiin fonologista tietoisuutta, kirjaintuntemusta, sanojen lukemista, oikeinkirjoitusta, laskemista ja matemaattisten laskutoimitusten suoritusta. Oppilaat pelasivat kyseisiä tietokonepelejä joka toinen päivä. Peliaika oli +/- 40 minuuttia 20 minuutin jaksoissa. Pelaamista jatkettiin kunnes tehollinen peliaika (exposure time) oli täynnä, yhteensä viisi tuntia per oppilas (+/- 300 minuuttia). Kontrolliryhmässä opetus toteutettiin normaalisti ilman kyseisten tietokonepelien tukea.

Tutkimus osoitti, että GraphoGame Afrikaansia pelanneiden lukemiseen liittyvät taidot paranivat kaikissa käytetyissä testeissä enemmän kuin kahdessa muussa ryhmässä (GraphoMath matematiikan tietokonepeliä pelannut ryhmä ja kontrolliryhmä, joka ei pelannut kumpaakaan tietokonepeliä). Verrattaessa efektikokoja havaittiin, että ne olivat suuret kirjainten ja äänteiden yhdistämisessä, fonologisessa tietoisuudessa ja oikeinkirjoituksessa. Pienistä kohtalaisiin efektikokoja havaittiin lukemisessa ja matematiikassa. GraphoGame ja GraphoMath ryhmä erosivat toisistaan fonologisessa tietoisuudessa ja lukemisessa, mutta ei oikeinkirjoituksessa ja matematiikassa. GraphoGame- ja GraphoMath-ryhmiä vertailtaessa efektikoot olivat suuria fonologisessa tietoisuudessa, kohtalaisia lukemisessa, ja pieniä kirjainten ja äänteiden yhdistämisessä ja oikeinkirjoituksessa. Tulokset osoittivat myös, että tietokonepelejä pelanneet ryhmät paransivat tuloksiaa enemmän alku- ja loppumittauksen välillä kuin kontrolliryhmä, jossa ei pelattu kyseisiä pelejä. Verrattaessa GraphoMath-ryhmää kotrolliryhmään havaittiin GraphoMath-ryhmän parantaneen tuloksiaan enemmän kuin kontrolliryhmä kirjainten ja äänteiden yhdistämisessä, fonologisessa tietoisuudessa ja oikeinkirjoituksessa, mutta ei lukemisessa ja matematiikassa. Sekä GraphoGame että GraphoMath pelin pelaamisella oli siten positiivisia vaikutuksia oppilaiden edistymiseen verrattuna tavallista opetusta saaneeseen kontrolliryhmään.

Tämä osatutkimus osoitti, että suhteellisen lyhyellä viiden tunnin tehollisella peliajalla luokassa oli myönteisiä vaikutuksia lukemiseen liittyviin taitoihin. Näin olleen se saattaisi olla hyvä tuki lukemaan opettamisessa. Vaadittaisiin kuitenkin vielä lisänäyttöä muualla Namibiassa ja GraphoGame-pelin tulosten vertaamista muihin digitaalisiin lukemaan oppimista tukeviin menetelmiin.

Kolmannessa osatutkimuksessa tarkasteltiin GraphoGame Afrikaans -pelin toimivuutta interventiovälineenä lapsilla, joilla oli lukemisvaikeuksia. Tutkimuksessa arvioitiin lukemiseen liittyvien taitojen (samat kuin toisessa osatutkimuksessa) lisäksi myös oppilaiden motivatiota, oppimiseen liittyviä

käsityksiä ja käyttäytymistä luokassa, kiinnostusta lukemiseen ja minäkuvaa sekä tehtävää välttävää käyttäytymistä. Toisen osatutkimuksen tulosten perusteella interventioryhmään valittiin GraphoGame Afrikaans -peliä pelanneista oppilaista ensimmäisen luokan aikana kirjaintentuntemuksessa, lukemisessa ja oikeinkirjoituksessa heikoimmin edistyneet 25 % (n = 19). Kaksi kontrolliryhmää (n = 58) valittiin satunnaisesti normaaliopetusta saaneesta luokasta (kontrolliryhmän oppilaat) ja GraphoMath-peliä pelanneista oppilaista. Tähän osatutkimukseen valitut osallistuivat alku- ja loppumittauksiin. Motivaation ja käyttäytymisen vahvuuksien ja heikkouksien (Strengths and Difficulties Questionnaire, opettajan arvio) arviointi toteutettiin jäkimittauksen yhteydessä. Interventiovälineenä oli vain GraphoGame Afrikaans -pelin pelaaminen. Koeryhmään kuuluneet oppilaat, joilla oli lukemisen vaikeuksia pelasivat kahden ja puolen kuukauden aikana yhteensä 10 tuntia 20 minuutin pelijaksoissa päivittäin. Tehollinen peliaika oli noin 600 minuuttia.

Tutkimus osoitti, että GraphoGame Afrikaans -pelin käytön jatkamisella toisella luokalla oli selvästi myönteistä vaikutusta lasten lukemiseen liittyvien taitojen kehittymiseen. GraphoGame-ryhmään kuuluneet edistyivät taidoissa selvästi kontrolliryhmiä paremmin kaikissa lukemiseen liittyvissä testeissä. Efektikoot interventioryhmän ja kontrolliryhmien välillä olivat suuret. Lukivaikeuslasten motivaatiota koskevat havainnot olivat ristiriitaisia. Vaikka lasten itsearvioitu minäkuva oli erittäin myönteinen ja he pitivät paljon koulutehtävistä, opettajan havaintojen mukaan he välttelivät tehtäviä, jotka olivat heille vaikeita.

Kokonaisuudessaan tämä väitöstutkimus osoittaa, että GraphoGame on yksi lupaava väline etsittäessä ratkaisuja lukutaidon edistämiseen ja yksilölliseen lukutaidon tukemiseen Namibiassa. On myös rohkaisevaa, että lapsilla, joilla on lukivaikeutta, voi olla vahvuutena myönteinen minäkuva ja kiinnostus oppimiseen.

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APPENDICES

Appendix 1   Definition of terms as related to language

A number of terms as related to language are used in this study that may be used in a specific manner in Namibia. This section clarifies concepts that could be confusing to the reader.

Mother tongue: The language that a child acquires in the home (Ministry of Basic Education Sport and Culture, 2003).

Home language: The language that is used in the home, usually the mother tongue

Official language: The language used in government and for official purposes. For Namibia, English is the official language (Ministry of Basic Education Sport and Culture, 2003).

The terms, first, second and foreign languages are used particularly in the school context in Namibia.

First language: The advanced level at which a language is offered at school. It is expected that the child who takes a language at this level either has this language as a mother tongue or home language.

Second language: As Namibia is a multilingual society, most Namibian speak two or more languages. It is expected that the second language is familiar to the child, a language of the community (Ministry of Basic Education Sport and Culture, 2003).

National language: In the Language Policy for Schools in Namibia, a national language is regard as a language spoken by Namibians as a mother tongue (Ministry of Basic Education Sport and Culture, 2003).

Foreign language: This is a language that a child will have no knowledge of and is typically not a language that is native to Namibia. German is the exception as it is a national language and the home language for almost 1% of the Namibian population, but is regarded as a foreign language for other Namibians. For the state schools foreign languages are offered from grades 8 to 12 (Ministry of Basic Education Sport and Culture, 2003).

Appendix 2 Distribution of households by the main language spoken

Main language spoken	Number of households	Percent
Namibia	464 839	100
Oshiwambo languages	227 103	48.9
Khoekhoegowab (Nama/Damara)	52 450	11.3
Afrikaans	48 238	10.4
Otjiherero languages	40 000	8.6
Kavango language	39 566	8.5
Caprivi languages	22 484	4.8
English	14 912	3.4
Other African languages	5 795	1.3
German	4 359	0.9
San languages	3 745	0.8
Other European languages	3 306	0.7
Setswana	1 328	0.3
Asian languages	461	0.1
Don't know	92	0

(Namibia Statistics Agency, 2013)

Appendix 3   Afrikaans Literacy Schedule for Grades 1 and 2 (per school week)

This schedule for teaching letters was taken from the Grades 1 and 2 syllabi for Afrikaans and the IPA (International Phonetic Alphabet) added

GRADE 1

Week	Letter	IPA
1	s, m	/s/, /m/
2	v, r	/f/, /R/ /r/ or /ɾ/
3	y	/əi/
4	Revision of s, m, v, r, y	
5	e	/ɛ/
6	differences between y and e	
7	b, n	/b/, /n/
8	w, k	/v/ /w/*(after consonant, e.g. 'kwart'), /k/
9	d, g	/d/ /t/* (final position), /x/ /g/*
10	a, f	/ɐ/, /f/
11	i, h	/ə/ /i/*, /h/
12	j	/j/
13	o, l	/o/, /l/
14	p, t	/p/, /t/
15	u	/ʊ̞/ or /œ/
16	aa, oo	/ɑː/, /uə̞/
17	ee, uu	/iə̞/ or /eə/, /y/
18	Evaluation Week	
19	ie	/i/
	ei	/ɛi/
20	oe	/u/
21	ou	/əu/
22	ui	/œj/
24	eu	/eø/
25	Revision	
26	Revision	
27	Revision	
28	Revision	
29	Revision	
30	Revision	
31	Revision	

* Less likely use in Grade 1 initially so as to avoid confusion to learners

GRADE 2

Week	Letter	IPA
1	three-letter words	
2	Revision of a, e, i, o, u, y	
3	Revision of aa, ee, oo, uu	
4	Revision of oe, ui, eu, ou	
5	Revision of ie en ei	
6	aai, ooi	/ɑːi/, /ɔːi/
7	oei, eeu	/ui/, /iu/
8	bl-, br-	/bl/, /br/

9	dr-, dw	/dr/, /dw/
10	fl-, fr-	/fl/, /fr/
11	gl-, gr-	/xl/, /xr/
12	kl-, kr-	/kl/, /kr/
13	kn-, kw	/kn/, /kw/
14	pl-, pr-	/pl/, /pr/
15	sk-, sl-	/sk/, /sl/
16	sm-, sn-	/m/, /sn/
17	sp-, st-	/sp/, /st/
18	sw-, tr-	/sw/, /tr/
19	tw-, vr-	/tw/, /vr/
20	-ng, -nk	/ŋ/, /nk/
21	-ld, -lk	/ld/, /lk/
22	-lp, -nd	/lp/, /nd/
23	-ns, -nt	/~s/, /nt/
24	-mp, -ms	/mp/, /ms/
25	-rg, -rk	/rx/, /rk/
26	-rm, -rp	/rm/, /rp/
27	-rf, -rs	/rf/, /rs/
28	-rt, -ts	/rt/, /ts/
29	spr-	/spr/
30	skr-	/skr/
31	str-	/str/

Appendix 4   Questionnaire on Teachers' Knowledge and Perceptions of Teaching Reading in Grade 1

<u>To be completed by the Researcher/Research Assistant</u>

Date:……/……. /…….

School :………………...

Circuit:…………………………………………..

Region:…………………………………………………….

Area :

		Urban area
		Rural area

Nature of the school:

		Public
		Private

Size of the school:
  Number of learners …………...
  Number of teachers ………….

Stamp of the School:

This investigation is strictly confidential. It is a research project investigating how teachers perceive teaching reading in Grade 1 in Namibia. The findings will be taken into consideration when improving the training in reading instruction that students in lower primary will receive at the University of Namibia. Your honest responses to the questions that follow are very important. Please do not discuss the questionnaire with your colleagues during the time of completing it.
Thank you for taking the time to respond to the questionnaire.
Pamela February (Lecturer, University of Namibia & PhD Candidate, University of Jyväskylä, Finland)

Section 1:
DETAILS OF THE TEACHER
A.PERSONAL DETAILS

1. Gender:

		Male
		Female

2. Age in years at last birthday:

		up to 21 years

		22 – 29 years
		30 – 49 years
		50 -60 years
		above 60 years

3. What is your mother tongue? (i.e. the first language you mastered as a child)

……………………………………………………………….....

4. What other languages (in order of proficiency) do you speak, if any?

1. ……………………………………………………………
2. ……………………………………………………………
3. ……………………………………………………………
4. ……………………………………………………………
5. ……………………………………………………………

5. What language do you speak mostly?

……………………………………………………………

6. What is your current position at your school?

		Principal
		Deputy Principal
		Head of Department
		Subject Head
		Teacher
		Temporary Teacher
		Other *(specify)*:

7. Highest Academic Qualification:

		Grade 8
		Grade 10
		Grade 12
		Certificate in a field other than Education
		Diploma in a field other than Education
		Degree in a field other than Education
		Other (specify):

B. TRAINING

8. Highest Professional Qualification:

		No professional qualification
		Teaching Certificate
		Teaching Diploma
		Bachelor of Education
		Postgraduate Diploma in Education
		Honours
		Master of Education
		Other University Qualifications in Education*(specify)*:

9. In which year did you obtain your highest professional qualification? ………………

10. At which institution did you receive your professional qualification?

………………………………………………………………………………………………

11. Overall teaching experience in years:

		1st year
		2nd year
		3rd year
		4th year
		5th year
		6-10 years
		11-15 years
		16-20 years
		20+ years

12. Were you a trained teacher at the beginning of your career?

		Yes
		No > *go to question 15*

13. If yes, when did you start this training (year)?: ………………..

14. What was the duration of your training?: *(specify: days, weeks, months, years)*

....

15. Given you teaching experience, do you find the training that you received:

		Very relevant
		Rather relevant
		Of little relevance
		Not relevant at all

16. Explain you answer in 11.

....
....
....
....

17. Did you receive any in-service training in the last two years?

		Yes
		No

18. If yes, in which form was it?

		Workshop/Seminar Duration ....
		Short Course Duration ....
		Further professional studies (e.g. diploma, degree, masters) Duration ....
		Other: *specify* .... Duration ....

19. Have you received specific training in teaching reading, whether through your professional training or in-service training?

		Yes
		No

20. How long have you been teaching at this school?

		less than 1 year
		1–5 years
		6–10 years
		10–20 years
		more than 20 years

21. How long have you been teaching Grade 1?

		1st year
		2nd year
		3rd year
		4th year
		5th year
		6-10 years
		11-15 years
		16-20 years
		20+ years

22. What is the Medium of Instruction in your Grade 1 class? Only select ONE, please.

		Afrikaans
		English
		German
		Khoekhoegowab
		Oshikwanyama
		Oshindonga
		Otjiherero

23. What is the second language that is taught to your class as a subject in Grade 1? Only select ONE, please.

		Afrikaans
		English
		German
		Khoekhoegowab
		Oshikwanyama
		Oshindonga
		Otjiherero

24. Which type of class do you teach this year?

		Regular class
		Double shift (morning/afternoon session)
		Multigrade
		Project school class
		Special class in a regular school

25. How many learners do you have in your largest class?

		less than 25 learners
		25 – 40 learners
		more than 40 learners

C. QUESTIONS ON TEACHING PROBLEMS

26. Do you have problems teaching learners of different age groups in your class?

		Yes
		No

27. Do you have difficulties with finishing the syllabus in a year?

		Yes
		No

28. Do you have problems teaching learners from disadvantaged background (like a lack of concentration of the learners due to hunger, a lack of interest in education)?

		Yes
		No

29. Is there a high degree of learner absenteeism in your classes?

		Yes
		No

30. Do you lack teaching and learning material (schoolbooks, teaching guide, etc)

		Yes
		No

31. Do you have difficulties in managing your class because there are too many learners?

		Yes
		No

32. Do you have difficulties implementing the curriculum/programs designed by the Ministry of Education?

		Yes
		No

33. Are you given heavy administrative loads which take much time and which prevent you from effectively undertaking your teaching activities?

		Yes
		No

34. Would you say that your professional situation is...

		Very satisfactory
		Satisfactory

		Not too satisfactory
		Not satisfactory at all

35. If you were given the opportunity, would you choose the same job?

		Yes
		No

Section 2:
SPECIFIC TRAINING IN READING INSTRUCTION

Now we will take a few minutes to talk about specific training that you have received in teaching early language and literacy. If you answered that you have NOT received any training in teaching reading, whether pre-service or in-service, DO NOT answer this section.

36. What quality of training did you receive to provide you with an understanding of children's language development?

		excellent
		above average
		average
		below average
		extremely poor
		no training

37. What quality of training did you receive to provide you with an understanding of the role of language as a foundation for literacy?

		excellent
		above average
		average
		below average
		extremely poor
		no training

38. What quality of training did you receive in order to be proficient in teaching language and literacy skills across the curriculum?

		excellent
		above average
		average
		below average
		extremely poor
		no training

39. What quality of training did you receive to provide you sufficient knowledge of language and literacy skills across the age groups, so that you are able to adapt your teaching for different age groups as well as learners with a range of abilities?

		excellent
		above average
		average
		below average
		extremely poor

			no training

40. What quality of training did you receive to provide you with a good knowledge and understanding of phonics and how this supports reading and spelling?

		excellent
		above average
		average
		below average
		extremely poor
		no training

41. What quality of training did you receive in order to assess learning in language and literacy accurately and understand what to teach next to enable learners to progress quickly?

		excellent
		above average
		average
		below average
		extremely poor
		no training

42. What quality of training did you receive to ensure that you are a good model of spoken as well as written language?

		excellent
		above average
		average
		below average
		extremely poor
		no training

43. What quality of training did you receive to ensure that you use accurate and precise pronunciation?

		excellent
		above average
		average
		below average
		extremely poor
		no training

44. What quality of training did you receive to provide you with the ability to blend and segment words when teaching phonics?

		excellent
		above average
		average
		below average
		extremely poor
		no training

45. What quality of training did you receive to provide you with a good knowledge and understanding of phonics and how this supports reading and spelling?

		excellent
		above average

		average
		below average
		extremely poor
		no training

46. **What quality of training did you receive to provide you with strategies for locating, selecting, and evaluating resources and materials for use in classroom literacy programs?**

		excellent
		above average
		average
		below average
		extremely poor
		no training

47. **What quality of training did you receive to provide you with strategies for selecting texts that appeal to reluctant readers and learners with special needs?**

		excellent
		above average
		average
		below average
		extremely poor
		no training

Section 3:
READING METHODS AND MATERIAL

Now, we ask you to provide us with your experiences in using different reading methods and materials in Grade 1.

48. **Which one of these applies to your teaching experience when teaching reading to Grade 1 learners? (Please tick the one that best describes your teaching situation.)**

		I use one successful teaching method, specific materials and classroom tasks for reading instruction.
		I use a range of teaching methods, materials and classroom tasks matched to the needs of the specific children I am teaching
		I use other strategies
		I don't understand these concepts

49. **How do you make your learners aware of the structure of spoken language? Do you develop their understanding of 'phonological units'….**
(Please tick the one that best describes your teaching situation.)

		from smaller units of speech (morphemes, phonemes) to larger units of speech (words, syllables)?
		from larger units of speech (words, syllables) to smaller units of speech (morphemes, phonemes)?
		I use other strategies
		I don't understand these concepts

50. **Indicate which of the following you teach to your learners. <u>Please tick as many</u> <u>that apply to your teaching situation.</u>**

		Sound-symbol correspondences, e.g. the most usual pronunciations of letters and letter groupings, letter recognition, etc.
		Word features and their structures, for example, syllables, prefixes, suffixes, inflections etc.
		Spelling patterns
		Vocabulary and word study, e.g. looking at synonyms, exploring word origins, vocabulary broadening
		Punctuation, e.g. the effects of punctuation signs such as commas and question marks on text meaning
		Grammatical constructions, e.g. subject-verb agreement, conjunctions
		Text structures, e.g. narrative elements such as plot, setting, character, expository text features such as argument structure
		All of these practices
		None of these practices
		I don't understand these concepts

51. In order to create a 'literate environment' you do the following with your learners. Please tick as many that apply to your teaching situation.

		encouraging children to write for a range of audiences
		provision of literacy materials in dramatic play areas
		use of labels and notices to draw children's attention to the use of literacy, etc.
		All of these practices
		None of these practices
		I don't understand these concepts

52. In order to encourage poor readers to read you do the following with these learners. Please tick as many that apply to your teaching situation.

		provide them with easy, simple texts so that they can experience success
		provide them with provide them with more difficult texts so that they can strive to improve their reading
		provide them with texts that are of interest to them
		All of these practices
		None of these practices

53. Learners learn much more during small-group instruction. Which strategies do you use to facilitate small-group instruction on a regular basis? (Pick one or more of the following which best describes the strategies that you use)

		divide the class into small groups with similar reading abilities
		texts and instruction are matched to the small group so that the level is challenging but not overwhelming
		evaluate learners regularly and regroup as their progress changes
		plan meaningful tasks for the rest of the class while you are busy with a small group
		the large number of learners that I have in my class prevent me from having small group instruction
		All of these practices
		None of these practices

54. When you teach phonics to your learners you use the following strategies? (Pick one or more of the following which best describes the strategies that you use)

		teaching letter-sound correspondence
		how to blend (synthesise) individual sounds in order to read words
		how to break up (segment) the individual sounds in words in order to spell words

		All of these practices
		None of these practices

Section 4:
TEACHER'S BELIEFS ABOUT EARLY READING AND SPELLING INSTRUCTION

As a teacher, think about what you believe about early reading and spelling instruction. Select the response that best indicates to what degree you agree with each item

55. Pre-school and lower primary school teachers should know how to assess and teach phonological awareness (i.e., knowing that spoken language can be broken down into smaller units, words, syllables, phonemes)

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

56. Literacy experiences in the home contribute to early reading success.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

57. Controlling text through consistent spelling patterns (The fat cat sat on a hat.) is an example of an effective method for children who struggle to learn to identify words.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

58. Poor phonemic awareness (awareness of the individual sounds in words) contributes to early reading failure.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

59. Materials for struggling readers should be written in natural language with little regard for the difficulty of vocabulary.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree

		Disagree
		Strongly Disagree

60. Time spent reading contributes directly to reading improvement.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

61. Learning to use context clues (syntax and semantics) is more important than learning to use graphophonic cues (letters and sounds) when learning to read.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

62. If a beginning reader reads 'house' for the written word 'home', the response should not be corrected.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

63. Children should read different types of text for different instructional purposes.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

64. Pre-school and lower primary school teachers should know how to teach phonics (letter/sound correspondences).

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

65. Picture cues can help children identify words in the early stages of reading.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree

		Disagree
		Strongly Disagree

66. It is important for teachers to demonstrate to struggling readers how to segment words into phonemes when reading and spelling.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

67. Adult-child shared book reading enhances language and literacy growth.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

68. Phonics instruction is beneficial for children who are struggling to learn to read.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

69. All children can learn to read using literature-based, authentic texts.

		Strongly Agree
		Agree
		Mildly Agree
		Mildly Disagree
		Disagree
		Strongly Disagree

> Section 5:
> KNOWLEDGE OF LANGUAGE STRUCTURE

Select the answer that you think is correct to the best of your knowledge. If you don't know the answer, please feel free to state that, so that the research findings accurately reflect the situation of the Khomas region and appropriate recommendations for training can be made.

70. Which word contains a consonant digraph?

		flop
		bang
		sink
		box
		None of the above
		I don't know

71. How many morphemes are in the word 'unhappiness'?

		two
		three
		four
		one
		I don't know

72. A phoneme refers to:

		a single letter
		a single speech sound
		a single unit of meaning
		a grapheme
		I don't know

73. A pronounceable group of letters containing a vowel sound is a:a. Phoneme b. grapheme c. syllable d. morpheme?

		phoneme
		grapheme
		syllable
		morpheme
		I don't know

74. A combination of two or three consonants pronounced so that each letter keeps its own identity is called a:

		silent consonant
		consonant digraph
		diphthong
		consonant blend
		I don't know

75. Two combined letters that represent one single speech sound form a:

		schwa
		consonant blend
		phonetic
		digraph
		diphthong
		I don't know

76. How many speech sounds are in the word 'box'?

		one
		two
		three
		four
		I don't know

77. How many speech sounds are in the word 'think'?

		two
		three
		four
		five
		None of the above
		I don't know

78. How many speech sounds are in the word 'eight'?

		two
		three
		four
		five
		None of the above
		I don't know

79. If 'tife' were a word, the letter 'i' would probably sound like the 'i' in?

		if
		beautiful
		find
		ceiling
		None of the above
		I don't know

80. A reading method that focuses on teaching the application of speech sounds to letters is called:

		phonics
		language
		orthography
		morphology
		phonological awareness
		None of the above
		I don't know

81. According to the rules of syllable division, which one of these words is incorrectly divided?

		un-bro-ken
		un-der-stand
		un-i-form
		un-til
		None of the above
		I don't know

82. Research suggests that difficulties with rapid automatic naming are predictive of problems with:

		reading comprehension
		answering wh- (what, why, where, when) questions
		phonemic fluency
		reading fluency
		All of the above
		I don't know

83. Which of the following words does NOT contain an open syllable:

		open
		table
		fever
		market
		she

		None of the above
		I don't know

84. A diphthong is:

		A vowel sound comprised of two parts that glide together
		A vowel sound spelled with two vowel letters
		A set of two or three consonant letters pronounced together
		Two consonant letters that represent one consonant sound
		A spelling pattern with a silent letter
		All of the above
		None of the above
		I don't know

85. Which of the following demonstrates phoneme segmentation?

		Say this word slowly. Listen for all the sounds. 'Caaaaaaasssst'
		Say 'catnip' without 'cat'
		Let's break this word down, 'stem' - /st-em/
		Let's say the sounds in 'place': /p/ /l/ /a/ /s/
		Put these sounds together and tell me the word: /f/ /i/ /sh/ - fish
		None of the above
		I don't know

This is the end of the questionnaire. Thank you very much for your cooperation.

Appendix 5   Teacher responses: teacher training, reading training, classroom reading practices & literate classroom environment

Training in reading instruction as related to teacher training

Highest_Professional_Qualification * Received_Training_in_Reading_Instruction Crosstabulation			
	Received Training in Reading Instruction		Total
	Yes	No	
No Professional Qualification	3 (60%)	2 (40%)	5 (100%)
Teaching Certificate	5 (71.4%)	2 (28.6%)	7 (100%)
Teaching Diploma	69 (65.1%)	37 (34.9%)	106 (100%)
Teaching Diploma and Advanced Certificate in Education	1 (100%)	0 (0.0%)	1 (100%)
Teaching Diploma and Advanced Certificate in Learning Support	1 (100%)	0 (0.0%)	1 (100%)
Degree and Postgraduate Diploma in Education	2 (100%)	0 (0.0%)	2 (100%)
Bachelor of Education	4 (80.0%)	1 (20.0%)	5 (100%)
Bachelor of Education Honours	3 (100%)	0 (0.0%)	3 (100%)
Total	88 (67.7%)	42 (32.3%)	130 (100%)

(Row label at left side: Highest Professional Qualification)

Quality of reading training received

Training received in teaching early language and reading		Quality of reading training received						Total (1 missing)
		no training	extremely poor	below average	average	above average	excellent	
Understanding children's language development	count	13	1	3	55	35	24	131
	%	9.8	.8	2.3	42	26.7	18.3	100
Adapt teaching to ages and abilities	count	16	0	5	53	36	21	131
	%	12.2	0	3.8	40.5	27.5	16	100
Understanding of phonics	count	11	1	7	44	37	31	131
	%	8.4	.8	5.3	33.6	28.2	23.7	100
Selecting texts for poor readers	count	22	2	13	52	28	14	131
	%	16.8	1.5	9.9	39.7	21.4	10.7	100
Good model of spoken lan-	count	19	1	6	54	35	16	131

guage	%	14.5	.8		4.6	41.2	26.7	12.2	100	
	count	16	2		5	51	38	19	131	
Good model of written language					3	3	2	14.	10	
	%	12.2	1.5	.8	8.9	9.0	5	0		
Average %					4	3	2	15.		
		12.32	0.90	.95	9.32	6.58	9			

Teachers' recognition of good reading practices

Teachers' beliefs about early reading and spelling instruction

Beliefs	Strongly Agree	Agree	Mildly Agree	Mildly disagree	Disagree	Strongly disagree	Missing	Total
Teachers should know how to assess and teach phonological awareness	103 (78.0%)	25 (18.9%)	2 (1.5%)	0 (0%)	0 (0%)	0 (0%)	2 (1.5%)	132 (100%)
Literacy experiences in the home contribute to early reading success.	92 (69.7%)	34 (25.8%)	2 (1.5%)	0 (0%)	2 (1.5%)	0 (0%)	2 (1.5%)	132 (100%)
Controlling text through consistent spelling patterns is an effective method for struggling children who struggle.	72 (54.5%)	45 (34.1%)	9 (6.8)	1 (0.8%)	2 (1.5%)	3 (2.3%)	2 (1.5%)	132 (100%)
Poor phonemic awareness contributes to early reading failure.	79 (59.8%)	41 (31.1%)	4 (3.0%)	1 (0.8%)	1 (0.8%)	3 (2.3%)	3 (2.3%)	132 (100%)
Time spent reading contributes directly to reading improvement.	92 (69.7%)	29 (22.0%)	8 (6.1%)	0 (0%)	1 (0.8%)	0 (0%)	2 (1.5%)	132 (100%)
Children should read different types of text for different instructional purposes.	72 (54.5%)	52 (39.4%)	4 (3.0%)	2 (1.5%)	0 (0%)	0 (0%)	2 (1.5%)	132 (100%)
Teachers should know how to teach phonics	113 (85.6%)	15 (11.4%)	2 (1.5%)	0 (0%)	0 (0%)	0 (0%)	2 (1.5%)	132 (100%)
Teachers need to demonstrate to struggling readers how to segment words into phonemes when reading and spelling.	92 (69.7%)	37 (28.0%)	1 (0.8%)	0 (0%)	0 (0%)	0 (0%)	2 (1.5%)	132 (100%)
Adult-child shared book reading enhances language and literacy growth.	70 (53.0%)	44 (33.3%)	12 (9.1%)	0 (0%)	3 (2.3%)	1 (0.8%)	2 (1.5%)	132 (100%)
Average percentage	66.06%	27.11%	3.7%	0.34%	0.77%	0.6%	1.59%	

Creating a literate classroom environment

Encouraging children	Literacy materials	Use of labels and	None of these prac-	Don't understand	Use other strategies

	to write for a range of audiences	in dra-matic play areas	notices	tices	these con-cepts	
Selected	47 (35.6%)	67 (50.8%)	105 (79.5%)	3 (2.3%)	1 (0.8%)	5 (3.8%)
Did not select	85	65	27	129	131	127
Total	132	132	132	132	132	132

Appendix 6   Afrikaans Expressive Letter Sound Knowledge Assessment

SCORESHEET

GRADE 1	RESEARCHER:	LEARNERS (Surname, Name)									
											0
SCHOOL NAME:	DATE:										
1	A										
2	B										
3	D										
4	E										
5	F										
6	G										
7	H										
8	I										
9	J										
10	K										
11	L										
12	M										
13	N										
14	O										
15	P										
16	R										
17	S										
18	T										
19	U										
20	V										
21	W										
22	Y										
23	Z										
RAW SCORE out of 23											
PERCENTAGE											

Appendix 7   Phonological Awaresesss Assessment

FONOLOGIESE TAKE

SCHOOL: _____ GRADE 1 _____ RESEARCHER:_____	LEARNERS (Surname, Name)									10
	Indicate whether correct or not (√ or X)									
1. Hoeveel lettergrepe het hierdie woor-de. Klap jou hande om die lettergrepe te tel, b.v. tafel (ta-fel) het 2 lettergrepe. *(b.v. boeke (boe-ke: 2 lettergrepe)*										
a vakansie (va-kan-sie):										
b. elektrisiteit (e-lek-trie-si-teit):										
2. Wat is die beginklank in die volgende woorde:	**(a)**									
	(b)									
a. **s**on b. **i**ngang c. **e**mmer	**(c)**									
3. Wat is die eindklank in die volgende woorde:	**(a)**									
	(b)									
a. ma**t** b. pe**n** c. hon**d**	**(c)**									
4. Syllable Deletion: bv Sê die woord HARDLOOP. Nou sê die woord sonder dit sonder HARD. [LOOP]										
Sê die woord KAMEELPERD. Nou sê dit sonder dit sonder KAMEEL. **[PERD]**										
Sê die woord POLISIEDIENS. Nou sê dit sonder dit sonder DIENS. **[POLISIE]**										
5. Phoneme Identification: Watter klank is dieselfde in al die woorde? b.v. pen, pad, pot. Ons hoor /p/ in al drie woorde										

a. fees, vel, venster **[/f/]**									
b. vet, mat, sit **[/t/]**									
6. *Phoneme Addition: Ek gaan 'n woord sê en dan moet jy die woord sê met 'n extra letter, bv, Sê die woord 'LOU . Nou sê dit weer met /f/ voor dit.= Nou is die woord FLOU*									
a. Sê die woord 'rys'. Nou sê dit weer met /g/ voor dit. **[GRYS]**									
b. Sê die woord 'lank'. Nou sê dit weer met /k/ voor dit. **[KLANK]**									
7. *Phoneme Substitution: Ek gaan 'n woord sê en dan gaan ons een van die klanke in die woord ruil met 'n nuwe klank. Jy moet dan die nuwe woord gee. B.v., Sê 'man', nou ruil die /m/ vir /k/. Die nuwe woord is KAN.*									
a. Sê 'rek', nou ruil die /r/ vir /h/. Die nuwe woord is …….									
b. Sê 'koop', nou ruil die /p/ vir /l/. Die nuwe woord is …….									
RAW SCORE out of 16									
PERCENTAGE									

Appendix 8   Word Reading Assessment

HARDOPLEES
(Reading Words)

GRADE 1	RESEARCHER:	LEARNERS (Surname, Name)									
SCHOOL NAME:	DATE:										
1	in										
2	om										
3	ry										
4	af										
5	vyf										
6	eet										
7	vra										
8	jou										
9	asof										
10	opsy										
11	vere										
12	bure										
13	gebede										
14	opgery										
15	belowe										
16	helderder										
17	opgewonde										
18	verbeterde										
19	hemelskare										
20	vergenoegde										
RAW SCORE out of 20											

Appendix 9   Spelling Assessment

		Skriftelike Spel (Spelling)
	1	is
	2	op
	3	ag
	4	ma
	5	dof
	6	see
	7	dra
	8	vou
	9	byna
	10	ysig
	11	nege
	12	vure
	13	genade
	14	bewyse
	15	belofte
	16	versigtig
	17	opgetelde
	18	verdedigde
	19	opwindende
	20	verteringsap

Appendix 10   Mathematics Assessment Tasks

GRADE 1 _____	RESEARCHER: _____	LEARNERS (Surname, Name)								
SCHOOL NAME:	**DATE:** _____									
A. TEL:										
1. Tel vanaf 1 tot 30 /3/ Een punt vir elke afdeling:[1-10] [11-20] [21-30] **Count from 1 to 30. (one mark for each section)** *(timed for 30 secs)*		[1-10]								
		[11-20]								
		[21-30]								
2. Tel vorentoe vanaf 34 tot 44 /2/ Een punt vir elke afdeling: [35-39] [40-44] **Count forwards from 34 to 44 (one mark for each section)** *(timed for 20 secs)*		[35-39]								
		[40-44]								
3. Tel terug vanaf 22 tot 12 /2/ Een punt vir elke afdeling: [21-17] [16-12] Count backwards from 22 to 12 **(one mark for each section)** *(timed for 20 secs)*		[21-17]								
		[16-12]								
4. Tel in twee'e/twees vanaf 26 tot 36 /1/ Een punt **Count in twos from 26 to 36** *(timed for 20 secs)*										
5. Tel terug in twee'e/twees vanaf 16 tot 6 /1/ **Count backwards in twos from 16 to 6** Een punt *(timed for 20 secs)*										
B. ADDITION: een punt elk /3/										
6. 2 + 3 =										
7. 5 + 4 =										
8. 9 + 1 =]										
C. SUBTRACTION: een punt elk /3/										
9. 5 – 4 =										
10. 6 – 3 =										
11. 10 – 7 =										
D. PROBLEM SOLVING										
12. Ma skil 5 aartappels vir aandete. Toe daag gaste op en sy skil nog 3 aartappels. Hoeveel aartappels het Ma altesame geskil? **/1/** **Mother peels 5 potatoes for dinner. Unexpected guests arrive and she peels 3 more potatoes. How many potatoes did mother peel altogether?**										
13. Selma se Pa gee vir haar 6 lekkers om met haar maats by die skool te deel. Op pad skool toe val 3 van die lekkers uit haar skoolsak. Sy huil baie hard en Juffrou gee vir haar 4 lekkers. Hoeveel lekkers het Selma nou? **/1/** **Selma's father gives her 6 sweets to share with her friends at school. On the way 3 sweets fall out of her school bag. She was upset and cried, so her teacher gave her 4 sweets. How many sweets does Selma have now?**										
RAW SCORE out of 20										