

**The Effect of Computer-assisted Letter- sound Correspondence  
Training on Learning to Read in Zambia**

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# **The Effect of Computer-assisted letter-sound Correspondence Training on Learning to Read in Zambia**

## **ABSTRACT**

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The most effective method of acquiring reading skills is based on learning letter-sound correspondences. The problem of acquiring reading skills mainly hinges on deficiencies in phonological awareness, alphabetical mapping, and phonological decoding. These problems cut across languages and cultural boundaries. Research has shown that learning to read is much easier in highly transparent languages like Finnish and German than in highly opaque languages such as English. Research has equally shown that phonological training enhances reading skills both in transparent and opaque languages.

Zambia has seven approved local languages taught in schools. The challenge for Zambia is the use of English as a medium of instruction and as an official language. The use of English, which is a second language to most children in Zambia, has created problems in reading acquisition.

The introduction of a new policy on literacy where all first graders are required to learn to read in one of the seven local languages has not yielded the expected results. The problem has been compounded with inadequate resources to sustain the Primary Reading Programme (PRP) and lack of teaching methodologies that enhance phonological awareness which is fundamental to reading.

In this study, 46 grade 1 and 2 children with poor reading skills played a literate computer game adapted from the Finnish language to Cinyanja. The game provided training in letter-sound correspondences. A screening test was conducted to select participants for the study. Later pre and post-assessment tests were conducted to compare reading skills between the intervention and control groups. The objective of the study was to find out whether the computer game would improve the poor reading skills of grade 1 children.

The results indicated that grade 1 children in the intervention group in both spelling and orthography tests performed significantly higher than those in the control group. This confirms earlier studies that have shown that letter-sound correspondence training enhances reading skills. The results of grade two intervention group, however, did not improve, perhaps due confusing practice of teaching English and Cinyanja literacy at the same time in schools.

The implication of the results is that the Ministry of Education of Zambia should encourage interventions that encourage phonological awareness training and encourage more literacy research to improve teaching methods in view of teaching children to read in local languages.

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Keywords: Literacy, literate game, computer games, letter-sound correspondences, opaque and transparent languages

# 1. Introduction

Despite different studies and theories on children with poor reading skills, the main underlying deficit is phonological skills. McGuinness (2004) proposes that children fail to read because of mainly the environmental causes and not necessarily the biological ones. Researchers such as Snowling and Scanlon (2004) suggest further that problems of reading may be traced back to deficiencies in phonological awareness, alphabetic mapping, and phonological decoding. These deficiencies consequently lead to difficulties in establishing the connections between the spoken and written words. ‘Phonological awareness’ is commonly referred to as the ability to hear, remember and manipulate sound units within words or syllables. In other words it is the ability to be aware that spoken words are made up of sub-lexical segments of speech sounds, both individual speech sounds (phonemes) and a combination of speech sounds (syllables).

In order for children to learn how to read they have to learn new codes connecting grapheme and phonetic units. A phoneme is the smallest unit of speech sound that corresponds to individual consonants and vowels. Grapheme comprises both letters and digraphs that are used to symbolise speech sounds. A code is a writing system in which specific elements of a language are mapped systematically to graphic signs or symbols. Phonemes are the basis for the code and the letters (McGuinness, 2004). The English spelling system can be extremely difficult to teach because of its opaque writing system. McGuinness points out that poor teaching of a difficult code can create confusion and lead to reading problems and failure. An opaque writing system has multiple spelling for the same phoneme, and multiple decoding for the same letters and letter sequences.

## 1.1 Problems in Reading

Recent studies have shown that the rate of reading acquisition varies greatly in different alphabetic orthographies. In highly opaque (multiple spelling for the same phoneme) languages such as English, the grapheme-phoneme correspondences are complex and irregular. The most important generalised models of alphabetic literacy acquisition developed in research are often based on English language (Aro, 2005). Although there have been a lot of research in this area, English is still thought to be the most opaque orthography, with complex and context-sensitive grapheme-phoneme pairings, multi-letter

graphemes and inconsistencies (Lyytinen et al, 2006a).

English is one of the orthographies in which written script does not fully represent the phonemic structure of the spoken language. According to Ehri et al (2001:253), there are about 41 phonemes in English with a much higher number of graphemes. McGuinness (2004:41) points out that there are about 40 plus phonemes in the English language with about 176 common ways to spell them. As a result of insufficient letters to encode the phonemes, digraphs (letter combinations) are used for a single phoneme.

The other problem of the English language is that it originates from foreign languages including Anglo-Saxon, Danish, Norman French, Classical Latin and Greek. More than half of words of the present-day English vocabulary come from foreign origin, mostly from Latin and French (Aro, 2005). This implies that English represents these languages and their spelling systems which are superimposed on one another. Learning to read in an opaque orthography like English therefore is extremely difficult and takes a long time for beginning readers. This is because it requires the reader to supplement and replace grapheme-phoneme conversion strategies with recognition of units such as rime and whole word (Ziegler et al, 2001, Aro, 2005). In short, analytical methods are used to teach how to read English.

Winner and Goswami (1994) conducted a research on reading in which they compared 7-year and 9-year olds from Austria and England respectively. It was found that the 7-year old Austrian, despite receiving instruction in German alphabet (a highly transparent language) only for 1 year, read comparable materials eight times as rapidly and fluently as the 9-year old English child who received instruction in English alphabet for 4 years. Other cross-cultural comparisons reveal that the difficulties English children face in reading and spelling are due to the English spelling system and the way it is taught. That is the English code has a complex spelling code and teaching methods (Landerl, Winner, and Frith, 1997).

In highly transparent alphabet like Italian, German and Finnish, writing system is mainly one way to write (spell) and one way to decode (read) each letter or a pair of letters. That is all codes are reversible. Teaching children to read in highly transparent alphabets therefore is easier than the Opaque ones. Teaching methods also are not as complex as those in Opaque languages (McGuinness, 2004).

## 1.2 Basic Concepts in Learning to Read

Reading is the process of extracting and constructing meaning from written text. Spelling (encoding) is the basis of turning sounds (phonemes) into symbols (graphemes, letters). Reading involves decoding those symbols back into sounds in order to recover the words. Spelling a given word involves first identifying each phoneme in a sequence in ones mind, recalling how each phoneme in that particular word is spelled, and then writing it down. Reading and spelling are reversible processes and should be taught closely so that the reversibility is obvious McGuiness (2004). Reading and spelling are integrated at every step and this reinforces the code nature of writing system. Learning to read requires that the learner has sufficient spoken language and should also know how the written system of that language works.

To master reading and writing, we must understand the orthography (standardised spelling) of the language. In other words we should be sensitive to the way letters in written words are organised (Orthographic awareness). In short, the knowledge of what is legal and illegal writing is required in order to master reading and writing (Vellutino et al. 2004, McGuinness, 2004).

In most transparent (regular or consistent) alphabetic orthographies such as Finnish, Greek, Turkish and Italian, the development of phonological decoding seems to be close to ceiling after 1 year of reading instruction. This implies that the development of recoding skills takes place during the first grade. The development of phoneme awareness seems to be more rapid in transparent orthographies than in English. In these orthographies phonemic awareness reaches ceiling level relatively soon after the beginning of reading instruction (Aro, 2005).

Studies have also shown that phonological training enhances both phonological and reading skills and provides the long-lasting effects on reading skills, particularly when the training of phonological skills is combined with the use of letters (Bus & Ijzendoorn 1999; Ehiri, Nunes, Stahl & Willows, et al. 2001). Earlier studies have also proved that the combined training of phonology and reading produced the strongest gains on subsequent reading growth (Hatcher, Hulme, and Ellis1994).

The English code does not provide the consistent one-to-one mapping of letter to phonemes that one finds in Spanish or Finnish for example. Wong (1998) points out that the mapping in English between letters and phonemes often involves a deeper, more abstract level of linguistic representation. It combines phonemes and morphemes. The problem that readers of English encounter is that it sometimes fails to represent the phonetic representations with which one is more familiar. In this way, English reading often demands memorised representations of units larger than the phoneme from the beginning. (Rayner, et al. 2001).

### 1.3 Zambia's Background on Literacy

As early as 1928, four local languages, including Cibemba, Citonga, Citonga and Silozi, were approved as media of instruction for the first four years of primary education. In 1930, English was introduced to be used in schools only after children had acquired reading and writing skills. Learning in local languages then, fostered reading skills and promoted literature and a sense pride in the country's culture. In 1950, the language policy changed from using the four local languages as media of instruction from four to two years of primary education. From second to fifth year, only one dominant language in a given region was allowed to be used and thereafter English was to replace the local languages. In 1962, English was finally introduced as the medium of instruction from the first grade onwards. (Manchisi, 2004, Ministry of Education).

In 1966, two years after independence, the Zambian Government adopted English as the medium of instruction. Since then Zambia has remained one of the few Anglophone African countries which are still using English as medium of instruction in the early years of primary education. The use of English as a medium of instruction has negatively affected the acquisition of reading skills among Zambian children. (Manchisi, 2004, Kelly,1991, Ministry of Education, 1975). Kelly (1995) points out that the misguided policy has left Zambia culturally impoverished, since the outcome has been neglect of her linguistic heritage and a definite relegation of every Zambian language to a place of little status in the educational system.

As a result of the above policy, a study by SACMEQ (1997) revealed that there was considerable reading disability in both English and the selected local language, Cinyanja, among pupils in Grades 3, 4, and 6. For instance, only 25% of Grade 6 pupils could read at minimum levels and 3% at desirable levels. The study concluded that the reading proficiency in English is unlikely to permit the majority of pupils in Zambia to learn through reading in the formal system.

During the last forty years of using English as medium of instruction, government has come up with four primary education courses with a component on literature. The first was the Zambian Primary Course (ZPC), which ran from 1970 to 1990. The principle of teaching children to read under ZPC was 'whole word' and 'whole sentence' approach with a few phonetic teaching in the second grade. After 1990, the second course was Zambia Basic Education Course (ZBEC). The emphasis on reading was that the mother tongue (L1) should be replicated in the English (L2) course and that equivalencies between L1 and L2 should be established in terms of phonemes, graphemes and structural items. The third course, which is currently in use, is the Zambia Teachers Education Course (ZATEC) in which some local languages have been reintroduced as medium of instruction, but only in the first grade (Willian, 1993). However, English remain predominantly the medium of instruction after grade one and continues to be a lingua franca.

#### 1.4 The Current Zambian Policy on Literacy

In 1996, the Ministry of Education decided to introduce the seven local languages as media of instruction through which children in the first grade should learn to read. The reasons that prompted the Ministry to make such a decision were that:

- Primary school children were not reading at desirable levels.
- Secondary School children were exhibiting reading and writing inadequacies.
- Students in tertiary institutions exhibited reading and writing difficulties.
- There was a general decline in the reading culture in the country (Tambulukani, 2002).

The policy demands that pupils in their first year of primary education should learn to read and write in

a local language in their first grade of primary education and then transfer these skills into English during their second grade. The approved local languages to be used in schools include Cinyanja, Citonga, Icibemba, Silozi, Luvale, Kaonde, and Lunda. To reinforce the policy, Ministry of education launched a programme known as “Primary Reading Programme” (PRP) in 1999. The PRP was piloted in schools in the Northern part of the country using Icibemba. The project proved a success and it was later extended to other schools in the country under a new name “The New Breakthrough to Literacy” (NBTL).

### ***Aims of the New Breakthrough to Literacy***

The general aims of NBTL are that, at the end of the first year, children are expected to:

- read simple texts fluently and effectively
- write their own stories legibly, neatly and in straight lines
- develop collaborative and independent learning skills.

The responsibilities of the teachers are to ensure that each child receives optimum teaching in initial reading skills and gradually build on the skills gained to successfully achieve the set aims. On the other hand the child is expected to demonstrate understanding and knowledge of the writing system of their language, knowing that: letters make up words, words make up sentences. (i.e. from small units to big units)

They were also expected to arrange words in alphabetical order (i.e. letter identification), read simple stories from books (i.e. comprehension), and take dictation of words and simple sentences (i.e. identification of letters and letter sound (Ministry of Education, 2002).

### ***The success of the New Break Through to Literature***

During the pilot phase in the Northern Province of Zambia, the results in reading were quite successful. According to Tambulukani (2002: 4) “The Evaluation of the pilot of BTL (Breakthrough to Literature as it was called then) in 1999 produced excellent and pleasantly shocking results”. The evaluation revealed that 64% of the children that had gone through BTL in 1998 were able to read and write in Icibemba, the local language in which the pilot was conducted. The results encouraged the Ministry of Education and all the other stakeholders to call for the immediate extension of the BTL course to all the

other six local languages and move it to full scale. While the pilot, with all the resources and interventions that go with it, succeeded, the question remains; how successful is it now that it has covered all the 9 provinces of Zambia and being implemented in all the seven languages?

Previous studies after the evaluation results of NBTL, have indicated different reports. Kelly (2000) revealed that literacy levels had greatly improved since the launch of NBTL. Other studies have revealed that although there have been improvement in literacy levels compared to the period when children were taught to read in English, the levels were still too low to meet the set curriculum standards (Matafwali, 2005, Kalindi, 2005).

## 1.5 Methods of Literacy instruction in Cinyanja

Cinyanja is one of the seven major local languages taught in Zambian schools. It has five short contrastive vowels (a, e, i, o, u). Their sounds are regular (e.g /a/ as in *bala*, similar sound in the Finnish word *kala*). There are also long vowels in certain words like /i:/ as in the word *bviika* (soak in water), or /u:/ as in *buula* (groan with pain). There are traditionally 18 recognised consonants in Cinyanja (b, c, d, f, g, h, j, k, l, m, n, p, r, s, t, w, y, and z. In addition six more consonants (ph, th, ch, kh, bv, and dz) are commonly used bringing the total number to 24 approved consonants in Cinyanja (Ministry of Education, 1977). Some words sound similar but have different meaning and different in the length of vowels. Examples include *bvika* (thatch) and *bviika* (soak in water), *fula* (out) and *fuula* (shout). Double consonants such as *nn*, *mm* are a special kind of cluster consonants which are found in contractions (e.g. *nna*, [n:ena] (I say), *mmunda*, [m:unda], (in the field). Such words can pose problems if the reading instruction does not follow the synthetic method and stressing letter-sound knowledge. To emphasise the point, one of the Ministers of education argued that the fundamental rules that govern reading acquisition is the “Spelling rules and not grammar rules” He later spearheaded the standardisation of the orthography of the seven local languages taught in schools. (Ministry of Education, 1977: vii). The methods used in teaching children to read in Cinyanja are those recommended in the NBTL. The child is supposed to first learn letters and letter sounds, followed by syllables, and then words. These are the principles behind NBTL (Ministry of Education, 2003). However, as to whether or not these principles are being effectively implemented by teachers who, a few years ago, were teaching children to read in English remains a matter of investigation.

## 1.6 Methods of Literacy instruction in Finnish Language

This research has used Literate Computer Game originally developed in Finnish language. Both Cinyanja and Finnish have transparent orthographies. Research has shown that Finnish has highly transparent orthography and therefore it facilitates the acquisition of decoding skills in most children (Lyytinen, et al 2005, Hintikka, et al 2005). The Finnish language has regular and symmetric grapheme-phoneme correspondences. It has 21 phonemes including 8 vowel phonemes (/i/, /y/, /u/, /e/, /o/, /o/, /a/, and /a/ and 13 consonant phonemes (/p/, /t/, /k/ /m/, /n/, /l/ /r/, /s/, /h/, /j/, /v/,) plus /d/ and /n/. It also has three additional foreign consonant sounds (/b/, /g/, /f/) which are used in loan words. /n/ is marked with n in front of /k/ for short sound /nk/ and n in front of /g/ for long sound /ng/. The number of correspondence phonemes is 23. The Grapheme-Phoneme (G-P) correspondences are regular in both directions. All phonemes in Finnish, apart from /d/, /h/, /j/ and /v/ have two phonological lengths, long and short. As a result some words have two different meaning (e.g. *tuli* , [tuli] which means fire and *tulli*, [tul:li] which means customs. The long sound is indicated by doubling the corresponding letters. The articulation of the stop consonants /p/, /t/ and /k/ are lengthened by a longer voiceless acclusion before the explosion of the sound (Lyytinen, et al. 2005).

### ***The Finnish syllables***

The Finnish language has 10 types of syllables (CV, CVC, CVV, CVVC, VC, V, VV, CVCC, VVC, and VCC). The distinct syllables are estimated to be just above 3 000. Open syllables are more frequent in Finnish than closed ones. A syllable does not begin with a consonant cluster except for some loan words like *traktori* (tractor). Consonant clusters appear to at the end of the word. The longest syllables have 4 phonemes. According to Lyytinen (2005), the main stress of the spoken Finnish is placed on the first syllable and the secondary stress on the third, fifth, and so on. This means that on every second syllable of words (with some exceptions), the final syllable is always unstressed. An important rule in reading the Finnish language is that there is a syllable boundary before every CV combination. In Finnish the segmentation of syllables is straightforward and this forms the central basis of early reading and spelling.

### ***The Finnish words***

The majority of Finnish words are multi-syllabic. The total number of monosyllabic words is approximately 50. The word tends to be generally long due to high production of compounds and agglutinative and fusional morphology. The average length of a written word is 7.86 and approximately the same number of corresponding phonemes (Lyytinen, H., 2005, Paakkonen, 1990). An example of words with segments of multiple agglutinative and fusional morphological systems is *taloissani* which means “in my houses”. Thus *talo* (stem) + *i*(plural) + *ssa*(case) + *ni*(possessive). Similarly, *naytettyämme* which means “after we have shown” can be segmented thus: *nay*(stem) + *te*(derivative) + *tty*(past participle) + *a*(case) + *mme*(possessive).

The implication of the Finnish orthography for beginning readers is that it makes learning to read easier than other orthographies because of the obvious reasons: First, the number of phonemes is relatively small and the G-P conversion rules are perfectly regular. Second, the written word makes the abstract phonemic structure simple for the reader because they are single letter phonemes. As a result, the assembling of phonological elements becomes a simple task of putting the letter sounds together. Studies have revealed that, at international level, Finnish children are among the top in terms of reading achievement, comprehension, use and interpretation of written texts (Elley, 1994).

In contrast, the acquisition of phonological recoding skill appears to be difficult for beginning readers in irregular orthographies such as English. The English-based models of reading acquisition emphasise the separate process of phonological recoding and direct word recognition. In addition it has multiple spelling for the same phoneme and multiple ways of letters and letter sequences. This makes reading to read quite difficult for beginners (Seymour et al, 2003, McGuinness, 2004).

## **1.7 The challenge of Zambia’s Policy on Literacy**

Zambia has 72 dialects with a current population of eleven million people. English has served as the lingua franca since Zambia was colonised by Great Britain. After independence in 1964, Zambia has maintained to use English as the only official language and medium of teaching. There are seven major local languages that are taught in schools. These include; Silozi, Chitonga, Icibemba, Cinyanja, Kiiikaonde, Luvale, and Lunda.

It is important to note that it is easier to acquire initial reading skills when teaching is done in a transparent language like Finnish or German. Zambian languages are transparent and they use more or less the same alphabet code. Although they have one to one letter-sound correspondences, some local languages like Cinyanja have also complex syllable structures such as in the words madzi and mphasa. They have also rich vocabulary, similar structure, syntax, pronunciation, and close cultural backgrounds. It is therefore easier to teach the initial reading skills to Zambian children using the approved seven local languages in schools. The current policy of the Zambian Government of allowing schools to use the seven local languages to teach initial reading skills in the first grade is a mile stone on the road to addressing problems of reading in Zambia (National Reading Committee, 1995).

In spite of this recommendable decision, the Ministry of Education has maintained that English will continue to be used as the official medium of instruction but that teachers are encouraged where necessary and relevant to use the familiar language for explanations, questions and answers (Ministry of education, 1996). The seven official languages are also recommended for teaching in Secondary Schools. At this level however, local languages are taken as optional and not compulsory as the case is at primary level. At college level, all the ten Primary Colleges of Education teach local languages to their student teachers. The problem is at Secondary College of Education level where only one college (Nkrumah) out of three, offers local languages as a choice to its students. (Manchisi, 2004).

The policy has created confusion and barriers to the acquisition reading skills in Zambia for failure to make the use of local languages compulsory across the education system and for further maintaining English as a medium of instruction, (Manchisi, 2004). Earlier studies by Sharma, (1973), McAdam and Africa (1980) confirmed that English as a medium of exchange affected reading and Arithmetic skills (Ministry of education, 1975).

## 1.8 Research Questions

The purpose of the study was to find out the effectiveness of initial literacy teaching using local languages under the new policy on literacy. The study focussed on initial literacy teaching of first and second graders in Cinyanja, one of the seven major local languages taught in Zambian schools.

The Ministry of Education initiated the primary reading programme (PRP) in 1999 in order to address the problem of poor reading levels among Zambian primary school children. It was found that primary school children were not reading at desirable levels (i.e were not able to read materials of their grade levels). As a result students at secondary and tertiary levels exhibited reading and writing difficulties (Tambulukani, 2004).

Other studies had shown that children in grades 3 to 5 in both English and Cinyanja were reading at two to three levels below their own grade levels (Williams, 1993). Another study by Southern African Consortium of Education Quality (SACMEQ), 1995, indicated that 25% of the children tested were able to read at minimum levels, and only 3% were able to read at desirable levels. Furthermore, the PRP baseline study also showed that children were reading at levels two grade levels below their own grade in English and three levels below their own level in Zambia languages.

The main cause of poor reading levels in Zambian Primary schools was due to the language policy in education, which required that the language of initial literacy in grade one and the language of instruction from grade one up to tertiary level should be English. This policy had been in force since 1965 and it was found that the policy created undue pressure on the average child who had to negotiate two difficult skills at the same time. That is to acquire the literacy skills in a foreign language and to master a foreign language with a strange sound system (Ministry of Education – National Reading Forum, 1995.)

In order to find a solution to the reading problem, the Ministry of Education decided to change the language policy to one, which allows the development of initial literacy in a familiar language (i.e. the children's mother tongue) at grade 1 level and later transfer the initial reading skills acquired in the mother tongue to English at grade 2.

The new policy was developed in 1996 and in 1997 the Breakthrough to literacy (BTL) Course was developed. The piloting of the breakthrough to literacy course was done in 1998 in Icibemba, one of

the Zambian local languages. The evaluation of the pilot of BTL in 1999 showed that 64% of the children that had gone through BTL in 1998 were able to read and write in Ibibemba. The results encouraged the Ministry of Education to extend the BTL course to all the other six local languages and move it to full scale.

Although the evaluation of the pilot in 1999 showed a remarkable improvement in the initial reading skills among Zambian children, there have been no follow up studies to find out whether the 64% literacy rate achieved during the pilot, has been sustained. However, some studies related to the effect of NBTL have shown that the goals of the new curriculum have not been achieved. For instance, Matafwali (2004) conducted a study, in which 106 Grade 3 pupils who had done NBTL/PRP programme were tested for their English literacy skills. It was found that only 42.5% were able to recite all the letters in English alphabet, 46% were able to name the letters and 61% were able to identify the letters.

It was expected that under the new policy, children would find it easier to learn to read in highly transparent language (mother tongue) than in the opaque ones such as English. The current problems children are facing in acquiring initial reading skills under the NBTL require efficient teaching interventions, particularly for children with difficulties in acquiring reading skills and those at risk with dyslexia. The current reading problems therefore prompted this study to find more information that would explain why Zambian children are not performing well, despite the Zambian local languages being regular (transparent).

The study also tried to answer questions such as how can poor readers improve their reading skills? Could an educative literate computer game benefit Zambian children and improve their initial literacy skills? What would the game reveal about children's low performance in reading? What possible explanation could be drawn from children's reading performance using the game?

## 2. Methods

This study is part of the larger research conducted at the beginning of August 2005 in Lusaka, Zambia (discussed in Ojanen (2007), Kalindi (2007), Kaoma (2008), Kachenga (in preparation) and Mando (in preparation)). The sample of the larger research was 1300 pupils from Grades 1-4 in three government schools and one Private International school. Pupils at the International school studied literacy skills in English only while those in three government schools used English and a Zambian Language called Cinyanja. The general purpose of the study was to gather data and use it to observe the learning and teaching process in literacy skills in both languages and more importantly to find out the benefit of the literate computer game to initial reading skills of the Zambian children. The main objectives were to identify critical difficulty areas in reading Zambian children face and try to find possibilities of providing teaching methods that can improve the quality of literacy skills for dyslexic children and those at risk. This study in particular concentrated on 46 pupils comprising grades one and two who studies their initial literacy skills in Cinyanja.

### 2.1 Hypothesis

In this study the hypothesis is that the literate computer-based training which is based on linking the phonological and orthographic codes can help children with low pre-reading skills improve their letter knowledge and efficiency in grapheme-phoneme skills. The study further seeks to investigate, whether this type of training has an effect on reading skills for first and second graders. It was anticipated that the program was relatively more effective among children whose pre-reading skills were low and who therefore were less ready to benefit from ordinary reading instruction provided in the school.

### 2.2 Participants

A group of grade 1 and 2 pupils from eight classes (4 classes of grade 1 and 2) of a Basic School located in the central part of Lusaka, Zambia were included in this study. A month before the intervention was conducted the researcher and the class teachers conducted screening tests in Spelling

and Orthography to a total number of 219 pupils (105 grade ones and 114 grade twos). The screening was done in July. After the screening results, 46 pupils (N=25 grade 1, and N=21 grade 2 pupils) whose results were extremely poor (15% and below) were selected to participate in the study. The 25 grade 1 pupils consisted of 13 boys and 12 girls. The 21 grade 2 pupils comprised 11 boys and 9 girls. The age range for grade ones was from 6 to 7 years and their mean age was 6.2 years. The age range for grade twos was 6 to 10 and their mean age was 8.4 years. The data shows that more children in grade two started school at the approved age of 7 years, than grade ones.

The researcher was interested in manipulating one group(intervention group) and controlling the other (control group) in order to make comparisons in the performance of participants between the pre-test and post-test. This was achieved by dividing each grade into the intervention group (12 grade ones & 9grade twos) and the control group (13 grade ones and 12 grade twos).

### 2.3 Assessment methods

The study consisted of a screening test, a pre-test, a training period, and a post-test. There was no follow up assessment conducted. The screening test was conducted in July 2005 to select participants for the study. Due to the large number of classes involved in the initial group, screening took one week. The pre-test was conducted three weeks after the screening test. The training was conducted for 4 weeks (November, 2005). The post-test was conducted in December.

Two types of assessment were made: the Spelling and Orthography skill assessments. The Spelling skill assessment had a maximum number of 20 items increasing in order of difficulty from single letters to four letter-words. (e.g. C, V, CV, VCV, CVCV, CCVV, VCCV). The items comprised 5 letters, 5 syllables, 5 three-letter words and 5 four-letter words. The aim was to test letter knowledge. Pupils were required to listen to phonemes dictated by their class teachers and write down the corresponding words and letters they had heard. It was expected that the best grade ones would get 10 points while grade twos 20 points.

The Orthography assessment consisted of 100 test items increasing from simple letters to more difficulty words. (e.g. V,C,CV, VCV, CVCV). The test also consisted of pseudo words and some meaningless symbols which were used as destructors (CCV, VVC,ϕ, ,⊕). The aim was to test reading

skills. Pupils were required to read letters and words silently and underline the incorrect items such as pseudo words and meaningless items.

## 2.4 Pre-intervention assessment

The same reading tests of Spelling and Orthographic fluency described above were also used as screening test and were later used as pre-test. It was found that the performance of both the control and the intervention groups in both tests was at the same level. It implies that before the intervention group was exposed to literate training both groups were at par. The Spelling test comprised of 20 items (five single letters, five 2 letter-words, five 3 letter-words, five four-letter words). The Orthography test had 100 items but in a similar fashion it had single letters, two-four letter-words including destructors. The researcher designed the test items according to the estimated performance level of pupils who have sufficiently acquired initial reading skills in Cinyanja at grade 1 level.

## 2.5 Testing Procedures

Tests were conducted in groups of 20 pupils per class. Each class was administered by its class teacher (as examiner). This was done to avoid unfamiliar voices and pronunciation giving unclear dictation and instructions which could have negatively affected pupils' performance. Individual examiners in their respective classes read out instructions clearly and ensured that all pupils had pencils and paper. In the Spelling test, the examiner started dictating and simultaneously switched on the stopwatch which was later stopped after 3 minutes. Answer scripts were immediately collected from pupils and later taken for recording and subsequent analysis. The Orthography test was conducted in a similar manner, except that pupils were required to read and underline non-readable words and items. This test took 5 minutes. The playing time for each participant in the experimental groups was between 10-20 minute sessions daily and each participant had a total of not less than 3 hours during the whole period training.

## 2.6 Training Procedure

### *Intervention Group.*

After the pre-test, class teachers of the selected 46 participants were clearly and carefully informed about the purpose of the study. Teachers together with the researcher went through the instructions. The instructions were that each player should be allowed training sessions of about 15-20 minutes of

playing time each day. After playing sessions, players went back to classes to continue with the normal classroom instructions until the next session as dictated by both the school and the Literate Computer Game timetables. Players were also informed about the purpose of the study and were given instructions on how to play the literate computer game. At the end of training, the actual playing time for grade 1 was about one hour while grade 2 was about one and half hours. The mean trials for grade 1 were 1137 and for grade 2 were 1688. The highest level achieved by grade 1 was 16 and by grade 2 was 18.

### *Control Group*

The control groups were not allowed to play the Literate Computer Game. They, however, were exposed to reading and language school instruction in their normal classes.

## **2.7 About the Literate Computer Game**

The 'Literate' computerised training programme is a computer software game developed at the University of Jyväskylä by Professor Lyytinen and his team (Lyytinen, et al, 2005). The original software is in Finnish language but for the purposes of this study it was translated into Cinyanja and English. The main goal of the programme is to enhance the accuracy of processing the phonemic sounds and to learn to connect these fluently to their orthographic equivalent. In this game, the player makes a choice and then a single auditory stimulus is delivered (through high quality headphones) concurrently with a number orthographic items (which are targets and distracters in form of balls), that appear at the top of the computer screen.

These balls immediately start dropping downwards on the computer screen and the task of the player at this stage is to hone in on the relevant orthographic item by trying to catch it using the cursor by moving the mouse in the appropriate direction. If the player fails to 'catch' the correct spelling just before the balls hit the ground or by mistake the player clicks on the incorrect spelling, then the target item is repeated in the next trial. But if the player 'catches' the correct spelling, then the correct response is highlighted in colour (green) and there will be a nice bling- sound and the correct chosen balls will go the right side of the screen. The player will then get more points. At every stage the computer gives feed back in a much more friendly way than a human being would do. This gives the child more encouragement to concentrate on playing. Children, once they are told what to do they learn

faster and discover that the game is so interesting that in the process of playing they unconsciously/consciously learn the reading skill.

There are 25 levels in this programme version (see Appendix 3). They start from grapheme-phoneme (letter sound) level and run through to syllables and words. The game is so adaptable that it changes according to child's skills: the game is slow and has few options if the player is not that skilled, and gets faster and more complicated if the child plays well. In this way the child does not become frustrated when wrong choices are made but gets good amount of positive feedback. The programme also saves data to allow the child continues to the next level and also to enable the researcher obtain the required data and use it for analyses.

## 2.8 The Literate Computer Game in Cinyanja – Sewero Lamau

First it is important to note that Cinyanja local language was chosen for the study because it is a transparent language similar to Finnish language which has been used in the Literate Computer Game in the previous studies. Second, Cinyanja is also one of the seven major official languages widely spoken in Lusaka province and used in schools. Cinyanja Literate Computer Game was a translation of the original Finnish version designed at the University of Jyvaskyla for Finnish children (Hintikka, 2005). The technical structure of the translated Cinyanja version was kept as close to the original Finnish version as possible. An experienced Zambian Cinyanja teacher and curriculum Specialist was contracted to help in the translation of the game. Her mother tongue is also Cinyanja. She worked with Ojanen (2007) ensuring that the game items such as letters, syllables, and words were carefully changed to match with the Cinyanja alphabet system and vocabulary. The game had twenty five (25) levels (Appendix 3). The child was required to score 100% of the correct response to proceed to next level.

### 3. Results

Initially, 8 classes (N=219 pupils) from this school were exposed to a screening test to choose poor readers to participate in the study. The Spelling and Orthography tests were conducted and their scores were computed as percentiles. Forty six (46) pupils who scored 15% and below were chosen to participate in the study. The group was then randomly divided into control (N=13 grade ones, N=12 grade twos) and intervention (N=12 grade ones, N=9 grade twos) groups according to grade level. Then a pre-test was done to both groups (control and intervention) followed by training the intervention group only. Meanwhile the control group continued to follow the school instruction. After training the pre and post-tests were conducted to both groups. The scores in both tests were analysed using the means, standard deviation and t-test.

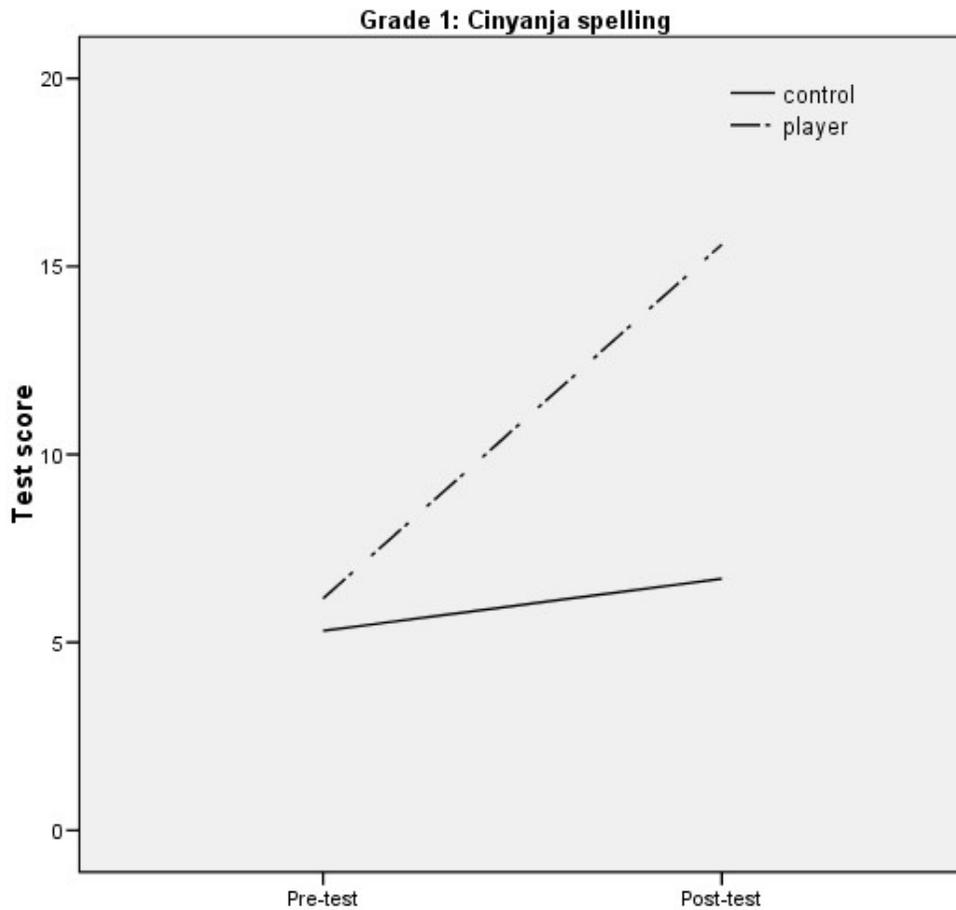
#### 3.1 Spelling Test Results

In the spelling pre-test, the difference between the groups was tested on Grade 1 with the independent samples T-test. Between the control group (n= 13, M=5,31, SD=4,35) and the player group (n= 12, M= 6,17, SD= 3,93) and the difference between the groups was not significant ( $t(23)=-.517$ ,  $p=.610$ , 2-tailed). This means that the groups were at same performance level before the intervention.

The results of the intervention are as follows: the difference of mean gains between the control (M= 1.38, SD = 6.86) and the player (M= 9.42, SD= 4.32) group was tested also with the independent samples T-test. There was a difference in the equality of variance ( $F(23)=6.08$ ,  $p=.022$ ) and the difference between the groups was significant ( $t(20.4)=-3.53$ ,  $p=.002$ , 2-tailed). This means that the player group got significant benefit from the intervention in improving spelling skills.

Multivariate regression was also done in Grade 1 Cinyanja spelling results with a design where pre-test and group (control=0, player=1) were entered to model. In the result the pre-test became significant ( $t(22)=-3.58$ ,  $p=.002$ ) and the estimate (B=-.846) was negative, which can be interpreted that the lower the pre-test scores, the better the gain score. The group effect was significant ( $t(22)=-4.63$ ,  $p<.001$ ) and the estimate (B) was 8.76. The group estimate can be interpreted as the players achieve 8.76 points more than the controls in gain scores when the pre test covariates. The regression model explained

58.5% of the gain variance. This means that children who had most difficulties in spelling benefited most from the intervention.

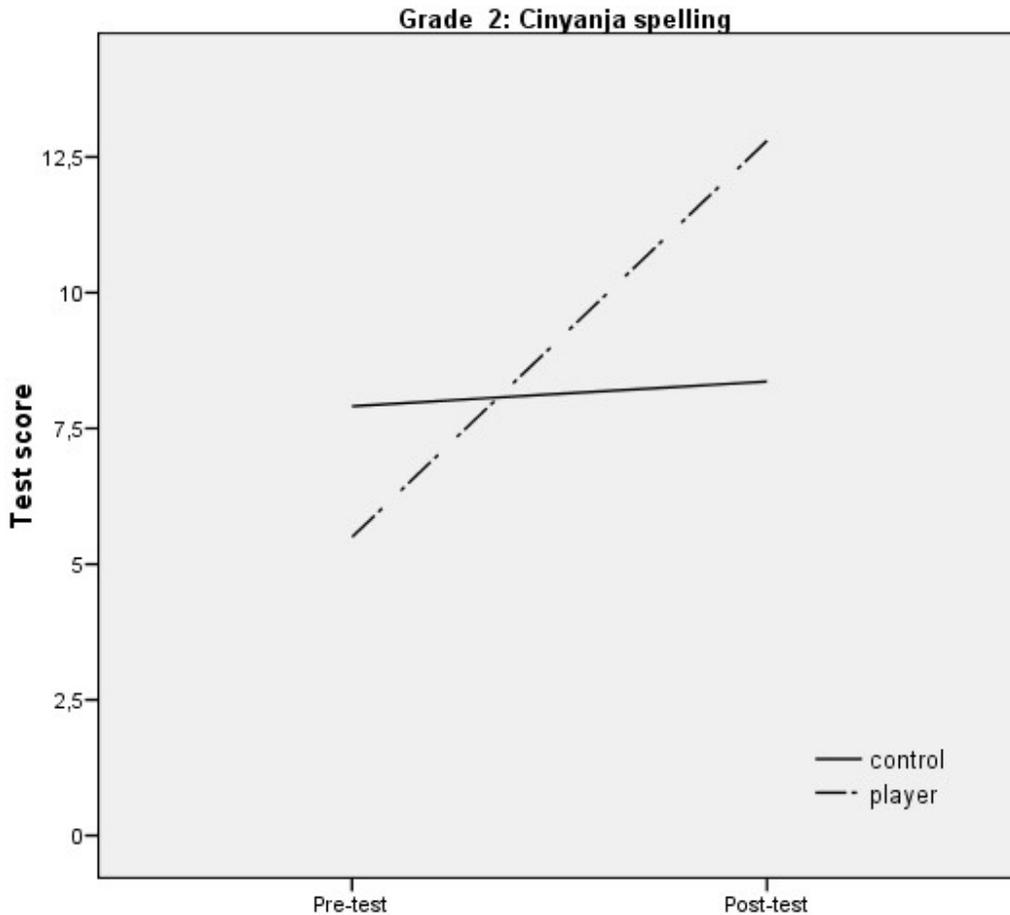


*Illustration 1: Grade 1 Cinyanja spelling test*

In the spelling pre-test, the difference between the groups was tested on Grade 2 with the independent samples T-test. Between the control group (n= 11, M=7.91, SD=4.46) and the player group (n= 10, M= 5.5, SD= 3.44) and the difference between the groups was not significant ( $t(19)=1.38$ ,  $p=.185$ , 2-tailed). This means that the groups were at the same performance level before intervention.

The results of the intervention are as follows: the difference of mean gains between the control (M= .455, SD = 8.56) and the player (M= 7.30, SD= 6.58) group was tested also with the independent samples T-test. The difference between the groups was not significant ( $t(19)=-2.04$ ,  $p=.056$ , 2-tailed). This means that the player group did not get benefit from the intervention.

Multivariate regression was also done in Grade 2 Cinyanja spelling results with a design where pre-test and group (control=0, player=1) were entered to model. In the result the pre test became significant ( $t(18)=-3.52$ ,  $p=.002$ ) and the estimate ( $B=-1.23$ ) was negative, which can be interpreted as the lower the pre-test scores were the better was the gain score. The group effect was not significant ( $t(18)=1.40$ ,  $p=.179$ ) and the estimate ( $B$ ) was 3.90. The regression model explained 71.7% of the gain variance. This means that children who had most difficulties in spelling benefited most from the intervention.



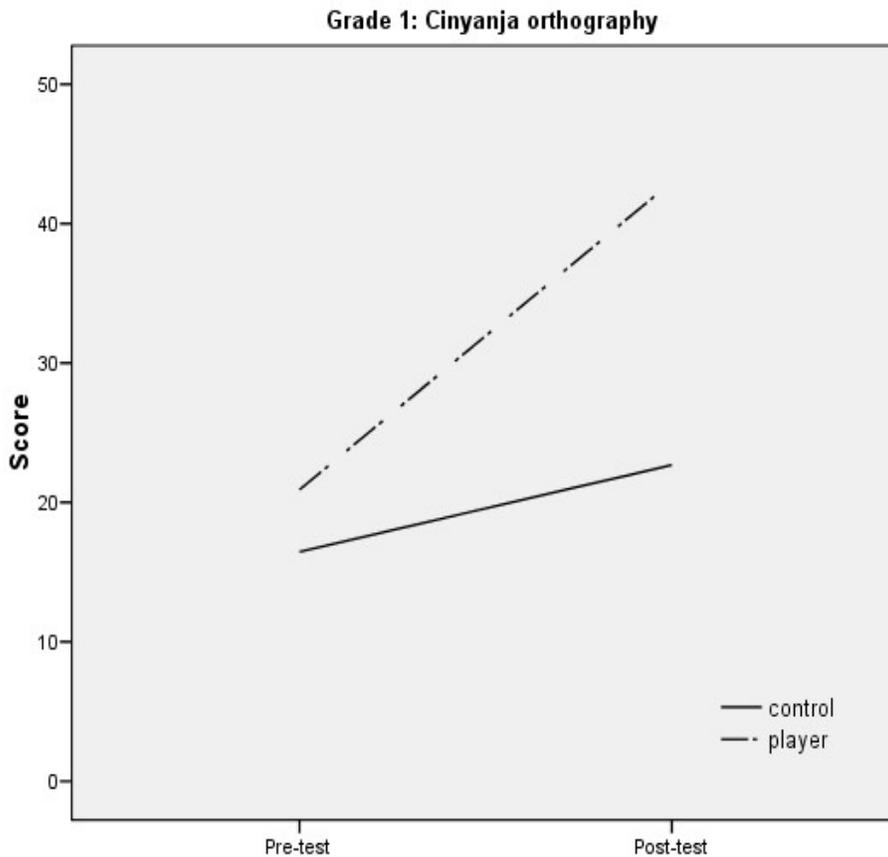
*Illustration 2: Grade 2 Cinyanja spelling test*

### 3.2 Orthography Test Results

In the orthography pre-test, the difference between the groups was tested on Grade 1 with the independent samples T-test. Between the control group ( $n= 13$ ,  $M=16.5$ ,  $SD=5.70$ ) and the player group ( $n= 12$ ,  $M= 20.9$ ,  $SD= 8.23$ ) and the difference between the groups was not significant ( $t(23)=-1.59$ ,  $p=.127$ , 2-tailed). This means that the groups were at the same performance level before intervention.

The difference of mean gains between the control ( $M= 6.23$ ,  $SD = 9.92$ ) and the player ( $M= 22.1$ ,  $SD= 8.48$ ) group was tested also with the independent samples T-test. The difference between the groups was significant ( $t(23)=-4.28$ ,  $p<.001$ , 2-tailed). This means that the player group got significant benefit from the intervention in improving orthography skills.

Multivariate regression was also done in Grade 1 Cinyanja orthography results with a design where pre-test and group (control=0, player=1) were entered to model. In the result the pre-test became significant ( $t(22)=-4.79$ ,  $p<.001$ ) and the estimate ( $B=-.942$ ) was negative, which can be interpreted as the lower the pre test scores, the better the gain score. The group effect was significant ( $t(22)=7.18$ ,  $p<.001$ ) and the estimate ( $B$ ) was 20.0. The group estimate can be interpreted as the players achieve 20.0 points more than the controls in gain scores when the pre-test covariates. The regression model explained 72.7% of the gain variance. This means that children who had most difficulties in orthography benefited most from the intervention.

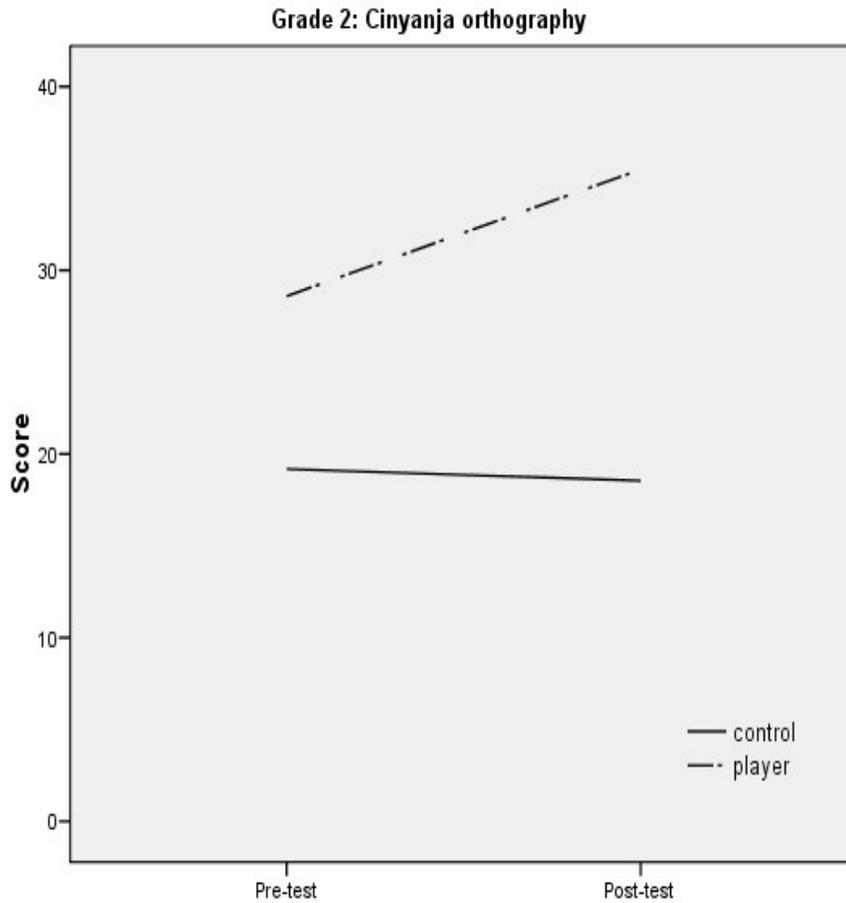


*Illustration 3: Grade 1 Cinyanja orthography test*

In the orthography pre-test, the difference between the groups on Grade 2 was tested with the independent samples T-test. Between the control group (n= 11, M=19.2, SD=7.99) and the player group (n= 10, M= 28.6, SD= 8.98) and the difference between the groups was significant ( $t(19)=-2.54$ ,  $p=.020$ , 2-tailed). This means that the groups had different performance levels before the intervention. The difference of mean gains between the control (M= -.636, SD = 6.14) and the player (M= 6.90, SD= 15.2) group was tested also with the independent samples T-test. There was a difference in the equality of variance ( $F(19)=12.2$ ,  $p= .002$ ) and the difference between the groups was not significant ( $t(11.6)=-1.47$ ,  $p=.169$ , 2-tailed). This means that the player group did not get benefit from the intervention.

Multivariate regression was also done in Grade 2 Cinyanja orthography results with a design where pre-test and group (control=0, player=1) were entered to model. In the result the pre test became

significant ( $t(18)=-3.66$ ,  $p=.002$ ) and the estimate ( $B=-.875$ ) was negative, which can be interpreted as the lower the pre test scores, the better the gain score. The group effect was significant ( $t(18)=3.54$ ,  $p=.002$ ) and the estimate ( $B$ ) was 15.8. The group estimate can be interpreted as the players achieve 15.8 points more than the controls in gain scores when the pre test covariates. The regression model explained 48,9% of the gain variance. This means that children who had most difficulties in orthography benefited most from the intervention.



*Illustration 4: Grade 2 Cinyanja orthography test*

## 4. Discussion

Before the beginning of this study, all the 46 pupils in the study underwent a screening test in spelling and orthography. The purpose was to select participants whose reading skills were highly compromised. The results of the 46 pupils showed that they had compromised reading skills. Their performance was 15% or below in both tests. This means that children who were involved in this study were poor readers and at risk with dyslexia.

Although the study had planned to select participants from a group of poor readers after screening, the study did not anticipate to find pupils performing at 15% and below in reading, particularly the second graders who, at the time of screening were 1 years in school. Similarly first graders were also not expected to perform at such a low level after being in school for almost six months. The poor performance noticed during the screening sessions could be attributed to a number of factors. The major factor could be due to a mixture of teaching methods that teachers employ during their teaching. Even after the introduction of the new policy on literacy instruction in Zambian local languages, teachers were still applying methods of teaching to read English to local languages. According to Ojanen (2007), some grade one teachers were still applying analytical methods used in teaching children to read in English while teaching children to read in cinyanja. Instead of teaching children from small units to big units, teachers teach in reverse. They start from sentences, words, syllables and end with phonemes and there is very little emphasis on teaching letter-sound correspondences. Teaching children in this abstract way is not only difficult but confusing too. According to McGuinness (2004), letter-sound correspondence is the key to teaching children to read. Children must be made aware that specific sound units (phonemes) in a language are the basis for a written code, and that symbols representing these sounds constitute the code. It should be clear that sounds are real and letters are arbitrary (unreal). Teachers should therefore teach children to learn how to read from phonemes, syllables, words and sentences.

Cinyanja, is a very transparent language like most Zambian languages. It would be easier to teach children to read by introducing letter-sound correspondences than ‘whole’ word or sentences. It was expected that children would perform as well as their colleagues elsewhere where a transparent

language like Cinyanja is used to teach children to read.

After the training period, a post-test was given to both the intervention and the control groups. The grade 1 results for the intervention group showed that there was significant improvement in both the spelling and orthography tests. The players were able to acquire basic literacy skills within a period of 1 hour of training. Generally it takes 2 hours of training to get significant results with the computer game. It was remarkable that grade ones were able to improve so much within a short period. This demonstrates that children are able to learn basic literacy skills within record time, regardless of their poor performance in class, when letter-sound correspondences are taught correctly and materials presented in a logical order. The results also showed that there was no improvement at all in the grade 1 control group, despite following the normal classroom instruction. The classroom instruction therefore did not have an effect on learning to read basic literacy skills.

The spelling results for grade 2 intervention group was not significant. In the orthography test, the results showed that intervention and the control groups started at different levels. The post test, however, showed that the grade 2 intervention group did not benefit from the computer game. According to Ojanen (2007), grade 2 pupils had difficulties in Cinyanja because they were confused between two contradictory alphabet codes and this might have contributed to the lack of improvement for grade 2 in this study.

Generally, the grade 1 intervention group benefited significantly from the computer game and the grade two did not. The results also showed that children who had more difficulties and poor results in the post-test got relatively more benefit from the intervention.

Grade two's were expected to have performed better because they were supposed to transfer their reading skills acquired in Cinyanja in the first grade in learning to read English in the second grade. This was quite difficult to some second graders, perhaps because of the reasons discussed earlier and also due to poor foundation in reading skills. However, the fact that the 46 pupils selected were highly compromised in basic reading skills, it gave the study a good starting point in trying to determine the effectiveness of literate computer game.

The spontaneous acquisition of letter names and letter sound association by grade 1 children under training using consistent Cinyanja orthography was evidence of the effectiveness of the literate computer game. Children who, before the training had compromised reading skills, were able to read letters, syllables, words and non-words after an average of 1 hour of training. This study is in line with the study by Von Daal and Raitsma (2002) who reported that kindergartners who received approximately 3 hours of computer-assisted training in vocabulary, phonological skills, letter-sound connections, reading and spelling showed significant gains. The gains were also shown in reading of both words and non-words. A study by Hedit and Close (2002) also support results of the study. The two researchers conducted an analytic and synthetic phonemic awareness with computer-assistance to kindergarten age children and observed significant gains in literate skills such as blending, reading and invented spelling.

#### 4.1 Conclusion

The change of policy on literacy by Ministry of Education of Zambia from teaching grade ones to read in English to local languages was a step in the right direction. English is generally thought to be the most opaque alphabetic orthography and it has proved to be more difficult to learn to read than transparent languages such as Spanish, Finnish or Swedish (Winner and Aro, 2003). Zambian languages are transparent and therefore it is easier to learn to read using these languages.

This study focused on 46 children who were screened and found to have low literacy skills. The language of instruction for grades ones was Cinyanja and grade twos received their instruction in both Cinyanja and English as they were moving from grade 1 to 2. The language used in the study was Cinyanja. The objective of the study was to find out how a literate computer game could improve reading skills for children with comprised reading skills. Previous studies have shown that children with compromised reading skills have significantly improved after 2-3 hours of training using computer game (Hedit and Close, 2002; Von Daal and Raitsma, 2002; Lyytinen et al, 2007).

The results of this study have shown that computer assisted instruction in learning how to read can greatly assist Zambian children on how to read with minimum supervision from teachers and within a short period. Earlier studies have also shown that computer-assisted training can improve children's

initial reading skills and can easily be made available to every child regardless of whether trained mediation personnel are available or not (Lyytinen et al, 2007). It is important to note that the computer-assisted instruction taught in this study employed synthetic method. That is, from phonemes, syllables, simple words to more complex words, phrases and sentences. This is lacking in the PRP/NBTL strategies.

The current policy in itself will not improve the literacy levels in Zambia if little is done by linguists, curriculum designers and researchers to structure the Zambian languages so that children learn how to read using the right methods. Currently, teachers still apply analytical English methods of teaching children how to read in local languages. This only confuses children (Ojanen, 2007). The Zambian languages are so transparent that if the right methods are followed, children will be able to learn to read within a short time.

The new policy should not have exceptions to the rules where private schools still follow the old policy and only government schools are trying to implement the new policy. This weakens the implementation of policy. While parents and policy makers are free to send their children to private schools so that they can quickly speak English, it should be clear that knowing to speak a language fluently is not the same as knowing to write. Mc Guinness (2004) observed that while English is the most expressive languages in the world, it is unfortunately one of the highest functional illiteracy rates among literate nations. She further observed that the high functional illiteracy rate in English speaking countries is largely due to a product of formidable spelling code and the way it is taught. It is therefore not surprising that 33% of Zambia's population over the age of 15 are illiterate and 43% of the women are illiterate, and almost 50% of children leave school unable to read (SACMEQ, 1997).

Although literacy levels had greatly improved after the launch of PRP/NBTL programme (Kelly, 2000), the screening and pre-tests in this study reviewed that pupils' performance was still very low. Earlier studies have also shown that pupils' performance was still at very low level (Matafwali, 2005, Kalindi, 2005) despite the change in language instruction for initial literacy from English to local languages. The policy should therefore go a step further by making local languages as media of instruction compulsory in both government and private schools from grade 1 to grade 4 while maintaining English as a lingua franca. Perhaps in future, a compromise should be reached to select one local language as an

official language. This will not only enhance literacy levels like Kiswahili in Tanzania (Ngorosho et al, 2003), but will also foster development as concepts in science and technology will easily be understood in the local context using the local language like in Japan , Finland, China and other advanced countries where local languages are used as official languages and languages of instructions.

While it is acknowledged that Africa as a whole and Zambia in particular (with 73 ethnic groupings and languages) are among the most linguistically complex regions of the world, and that it is difficult in education to select one local language as a medium of instruction due to different languages and ethnic backgrounds, it is not impossible to reach a compromise in language policies. In terms of language policy, government has already achieved one major policy of reducing 73 languages to 7 official languages to be taught in schools. This can further be reduced. Unless this is done, Zambia will always rely on English for both as official language and as a language of instruction.

The Zambian Ministry of Education should improve and strengthen the teaching methods of basic literacy skills in local languages. It should also consider introducing the use of literate computer game in schools to enhance basic literacy skills. This will greatly assist Zambian children with low reading skills to learn to read within a short period. Computer-assisted letter-sound correspondence training has obvious advantages; it is very interesting to children and therefore the more they play the game, the more they acquire the reading skills. It takes a short period for children to master letter-sound correspondences, which is key to learning to read. The use of literate computer game is critical in schools and more importantly in circumstances where teachers in short supply. A combination of classroom teaching and computer game would therefore greatly enhance literacy teaching in schools.

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## References

- Aro, M. (2005).** Learning to Read: The Effect of Orthography. Chapter in Joshi, R. Malts, Arron P.G.: *Handbook of Orthography and literacy*. Mahwah, NJ: LEA.
- Duncan, K. (1995).** *The Molteno Programme for Teaching Initial Literacy in the Mother Tongue*. Molteno Project
- Ehri, L.C. (2005).** Learning to Read Theory, Findings, and issues. *Scientific studies of reading*. Vol. 9(2)pp.167-188.
- Elley W., (1994).** The IEA study of Reading Literacy: *Achievement and instruction in thirty-two school system*. Oxford: Pergam.
- Mc. Guinness, D. (2004).** Early Reading Instruction. What Science really Tells us about How to teach Reading: Cambridge, MA: MIT Press.
- Hatcher P.J., Hulme, C. & Ellis, A.W. (1994).** Ameliorating Early Reading failure by Integrating the Teaching of reading and Phonological skills. *The Phonological Linkage Hypothesis; Child Development*, 65, 41-57.
- Hintikka, S., Aro, M., Lyytinen, H. (2005).** Outcomes of a Computerized Training of Correspondences between Phonological and orthographic Units: *Do Children with Low Pre-Reading Skills Profit? Written Language and Literature*, Volume (8) pp: 79-102.
- Holopainen, L. (2002).** Development in Reading and Reading Related Skills: *A follow up Study from Pre-school to the Fourth Grade*. Jyvaskyla: University of Jyvaskyla.
- Kalindi, S., (2005).** The impact of new reading Programme on the poor readers. Unpublished M.Ed. Dissertation. Lusaka: University of Zambia.
- Kelly, M., J., (2000).** Reading Comes First. Primary Reading Programme. Baseline Reading study. Lusaka: Ministry of Education and Department of International Development.
- Kelly, M. (1995)** Improving Learning: *Perspectives for Primary Education in Rural Africa*, UNESCO/World Bank Workshop, Lusaka.
- Kelly,M.,J., (1991).** *Education in Declining Economy. The Case of Zambia*. 1975-1985. Washington: The International Bank for Construction/World Bank.
- Lyytinen, H. Erskine, J. Aro, M., & Richardson, U. (2006a).** Reading and reading disorders. In E. Hoff & M Shatz (Eds.). *Handbook of Language Development*. Blackwell Publishers.

- Lyytinen, H., Mikko, A., Holopainen, L. (2005).** *Children's Language Development and Reading Acquisition in a Highly Transparent Orthography*. Jyvaskyla: University of Jyvaskyla.
- Manchisi P.C. (2004).** *The Status of Indigenous Language in Institutions of Learning in Zambia: Past, Present, and Future*. Lusaka: University of Zambia.
- Matafwali, B, (2005).** Nature and prevalence of reading difficulties in Third Grade: The Case of Lusaka. Unpublished M.Ed. Dissertation. Lusaka: University of Zambia.
- Ministry of Education, (1999).** *An Evaluation of the Breakthrough to Icibemba Pilot Project*. Lusaka: MoE .
- Ministry of Education, (1989).** *Language Policy in Zambia*. Lusaka: Ministry of Education.
- Ministry of Education, (1996).** *Educating Our Future: National Policy on Education*. Lusaka: Ministry of Education.
- Ministry of Education (2003).** *Primary Reading Programme*, Lusaka: Ministry of Education.
- Ministry of Education, (2002).** *The Basic School Curriculum Frame work*. Lusaka: Ministry of Education.
- Nogorosh, D. and Alcock K.J. (2003),** Learning to spell a regularly spelled language is no a trivial task – Patterns of errors in Kiswahili. London: City University.
- Ojanen, E. (2007)** *Sewero La-ma-u – A Phonetic Approach to Literacy Teaching in Zambia*. Unpublished Master's thesis. Department of Psychology. University of Jyväskylä
- SACMEQ (1997)** *Southern African Consortium for Monitoring of Educational Quality (The Analysis of Education Research Data for Policy Development: The Zambian Case.)* Paper prepared by IIEP, and Ministry of Education, Zambia.
- Seymour, P.H.K., Aro,M., & Erskine,J.M. (2003).** *Foundation of Literacy Acquisition in European Othographies*. British Journal of Psychology, 94, 143-174.
- Snowling, M.J.(1980).** *The Development of Grapheme-Pohneme correspondences in normal and dyslexic readers*. Journal of Experimental Child Psychology, 29:294-305.
- Tambulukani, G. (2002).** The Primary Reading Programme: *The Zambian Exeprience going to Scale in Reaching. Out-Reaching All – Sustaining Effective Policy and Practice for Education in Africa*, ADEA. Brenial Meeting, Arusha, October, 2001. Arusha:Association for Development of Education in Africa (ADEA).
- Velluntino F.M., Fletcher, J.M., Snowling, M.J. & Scanlon,D.M. (2004).** *Specific Reading Disability (Dyslexia): What have we learnt in the past four decades?* Journal Psychology and Psychiatry 45:2-40.

**Williams, E. (1993).** *Education Research, Report on Reading in English in Primary Schools in Zambia*, London: University of Reading

**Williams, E., (1993).** *Report on Reading in English in Primary Schools in Malawi*. (Education Report Serial N0. 4) London: Overseas Development Administration.

**Winner, H. & Goswami, U. (1994).** *The influence of Orthography Consistency on Reading Development: Word Recognition in English and German children*. *Cognition*, 51, 91-103.

**Wong B. (1998).** *Learning About Learning Disabilities*. London: Academic Press.

**Zambia National Reading Committee (1995)** *The Zambia National Reading Forum: Final Report and Recommendations*. Lusaka: MoE

**Zambia National Reading Committee, (1997)** *Report of Reading Levels in Four Primary Schools in Lusaka*, Ministry of Education, Lusaka

**Zambia National Reading Committee, (1998)** *Breakthrough to Icibemba Monitoring Report*. Lusaka: MOE

## Appendix 1: Spelling Test

Screening and pre-test	Post-test and follow-up
<b>B</b>	<b>D</b>
<b>D</b>	<b>M</b>
<b>A</b>	<b>I</b>
<b>I</b>	<b>B</b>
<b>M</b>	<b>A</b>
<b>Be</b>	<b>ta</b>
<b>Ni</b>	<b>ni</b>
<b>Ma</b>	<b>pa</b>
<b>Ta</b>	<b>be</b>
<b>Pa</b>	<b>ma</b>
<b>Ona</b>	<b>uka</b>
<b>Ako</b>	<b>ima</b>
<b>Ima</b>	<b>ona</b>
<b>Uka</b>	<b>ako</b>
<b>Eka</b>	<b>eka</b>
<b>Koma</b>	<b>imba</b>
<b>Mseu</b>	<b>amai</b>
<b>Imba</b>	<b>koma</b>
<b>Taya</b>	<b>taya</b>
<b>Amai</b>	<b>mseu</b>

## Appendix 2: Orthography Test

Post-test

Code:

NAME: \_\_\_\_\_  
GRADE: \_\_\_\_\_  
SCHOOL: \_\_\_\_\_

u = f > g  
imbe uli pola enda

---

a e ɹ c d ^^ t w s #

u h } Δ ∞ k & p l v

j z ƞ b √ u y c n Ω

ad om fo nu em zi ec ma ne co

uka ema ava aco iai ine uwa nma uli uza

iwe ima una ipa gfa cao nbi ola ali ika

tola laca lira sopo iday lova imba gmoa buku kana

bola yase moto sita bebi cisa lera maso kama inde

taya pesa mesu uvbe basi gulu caka tula bala toto

koka tapa tula gulu bowa guza kelo lero suta mesa

tuma unga mere leka kita ceba cule pita tate mena

kubya cenga bwala tenga wmana mbale menya mpeni atate konda

itana bwera ulola sanza phika nhosi manzi caini lesi bande

dzitu njala jnoka mwana tunga bwino kwera ulaki kawma mbuzi

lemba bwalo patca tsuka penay mvula dzina tcala tsiku phala

ngombe buluku nuymba nsomba cikomo kuseka mtengu dilesi ampndo kuriya

tsitci pumula milono njanga mhpika tsamba zobvala tumiza nkhuku cisote

## Appendix 3: Literate Computer Game contents

(Sewero La-ma-u contents)

Level 1: **A I T N**

Level 2: **A I T N S E L**

Level 3: **T L E K U Z O**

Level 4: **K Z U M P R C**

Level 5: **P R D F G Y W**

Level 6: **J H Y T D B V**

Level 7: **S U R U M U C U N U P U K U**

Level 8: **N U P U K U M I T I Z I F I**

Level 9: **T I Z I F I D O G O L O W O**

Level 10: **D O G O L O W O B E V E Y E**

Level 11: **N E N Y E N D E N G E N Z U N J U N K H U**

Level 12: **N Z U N J U N K H U K A K H A K W A G W A**

Level 13: **K H A K W A G W A B W A M W A D W A M P H A**

Level 14: **P H I P H A P H E P H O P H U M P H U**

Level 15: **P H I P H A T H U T H E K H O K H E N K H A**

Level 16: **Z I D Z I N Z I B Z I C I T S I S I**

Level 17: **D I D Z I B E B W E N O N G O**

Level 18: **G E G W E E M A M B A A P U P H U U**

Level 19: **U-ZA U-MA U-SA U-CI U-FA U-VE U-WA**

uza [tell/inform], uma [to dry up], usa [to rest], uci [honey], ufa [mealie meal],  
uve [dirty], uwa [barking]

Level 20: **U-CI U-FA U-ZA A-NA O-NA I-NE I-WE**

ana [children], ona [to see], ine [me], iwe [you]

Level 21: **DU-WA CA-LA FU-NA CI-SA TA-TE BU-KU GA-LU**

duwa [flower], cala [finger], funa [to look for], cisa [honeycomb], tate [father],  
buku [book] galu [dog]

Level 22: **MA-DZI DZI-NA MUD-ZI PHA-LA KHA-LA BZA-LA MA-NJA**

madzi [water] dzina [name] mudzi [village] phala [porridge] khala [to sit] bzala  
[plant] manja [hands]

Level 23: **GA-MI-ZA MI-SI-KA SE-WE-RA MA-KO-LO FU-PI-KA KA-VA-LO**

gamiza [think] misika [markets] sewera [play] makolo [parents] fupika [short]  
kavallo [horse]

Level 24: **KU-MBU-KA MA-SA-MBA CI-MA-NGA PHU-NZI-RA NYE-NYE-ZI  
ZI-THU-NZI**

kumbuka [to remember] masamba [leaves] cimanga [maize] phunzira [learn] nyenyezi [star]  
zithunzi [pictures]

Level 25: **CAKA CALA | DZIRA DZIWA | MVEKA MVERA | BWALO BWATO |  
MWINI MWINA | ULEMA ULEMU**

#### Appendix 4: Comparison of alphabet code in English, Finnish and Cinyanja

	English letter name and pronunciation	Finnish letter name and IPA pronunciation	Finnish phoneme	Cinyanja phoneme	Cinyanja phonemes in English words
<b>A</b>	ay [ei]	Aa [a:]	/a/	/a/	as a in father
<b>B</b>	bee [bi:]	Bee [be:]	/b/	/b/	as b in babble
<b>C</b>	see [si:]	See [se:]	/s/	/tʃ/	as ch in chin
<b>D</b>	dee [di:]	Dee [de:]	/d/	/d/	as d in doubt
<b>E</b>	ee [i:]	Ee [e:]	/e/	/e/	as e in elbow
<b>F</b>	eff [ef]	Äf [æf]	/f/	/f/	as f in find
<b>G</b>	gee [dʒi:]	Gee [ge:]	/g/	/g/	as g in good
<b>H</b>	aitch [eitʃ]	Hoo [ho:]	/h/	/h/	as h in hat
<b>I</b>	eye [ai]	Ii [i:]	/i/	/i/	as ee in meet
<b>J</b>	jay [dʒei]	Jii [ji:]	/j/	/dʒ/	as j in joke
<b>K</b>	kay [kei]	Koo [ko:]	/k/	/k/	as k in kid
<b>L</b>	el [el]	Äl [æɫ]	/l/	/l/	as l in last
<b>M</b>	em [em]	Äm [æm]	/m/	/m/	as m in mood
<b>N</b>	en [en]	Än [æn]	/n/	/n/	as n in near
<b>O</b>	ou [əʊ]	Oo [o:]	/o/	/o/	as o in boss
<b>P</b>	pee [pi:]	Pee [pe:]	/p/	/p/	as p in puppy
<b>Q</b>	cue [kju:]	Kuu [ku:]	/k/		(not in the game)
<b>R</b>	ar [a:ʔ]	Är [ær]	/r/	/r/	as r in sorry
<b>S</b>	es [es]	Äs [æs]	/s/	/s/	as s in sun
<b>T</b>	tea [ti:]	Tee [te:]	/t/	/t/	as t in toe
<b>U</b>	u [ju:]	Uu [u:]	/u/	/u/	as oo in boot
<b>V</b>	vee [vi:]	Vee [ve:]	/v/	/v/	as v in verse
<b>W</b>	double-v [dʌbəlju:]	Kaksois-vee [kaksoisve:]	/v/	/w/	as w in we (or wh in white)
<b>X</b>	eks [eks]	Äks [æks]	/ks/		(not in the game)
<b>Y</b>	why [wai]	Yy [y:]	/y/	/j/	as y in you
<b>Z</b>	zed [zed]	Tset [tset]	/ts/	/z/	as z in zoo
		(ng or n)	/ŋ/	/ŋ/	as ng in singing
		there is also letters Ö, Ä and Å in Finnish			

	<b>English letter name and pronunciation</b>	<b>Finnish letter name and IPA pronunciation</b>	<b>Finnish phoneme</b>	<b>Cinyanja phoneme</b>	<b>Cinyanja phonemes in English words</b>
		alphabet			

**(from Ojanen, 2007)**