

Developing an Android application to help parents keep their child interested in learning

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Statement of Originality

"I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person or material which has been accepted for the qualification of any other degree or diploma of a university or other institute of higher learning."

Yours sincerely,

Asra Rahimi

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Abstract

Parents, especially those with early school entrance children, are interested in their children's educational development and try to involve themselves in their academic activities. One of the main parental interventions in children's academic work involves assisting with and supervising homework. Despite efforts parents make in order to engage with their children's educational development, most parents, mainly those with more than one child, do not have enough time to oversee children's homework, mostly due to their busy lifestyle. There are other problems related to parental involvement. For example if parents do not have adequate education, their involvement in their children's homework may cause more harm than good. In addition, if parents are not aware of the correct approach to identify their children's academic needs and assist with meeting them, parents may cause confusion by using instructional techniques different from those children have been taught to use at school. Additionally, most children are not very interested in doing homework and this often leads to arguments with parents.

This study has addressed these issues by designing a software application that aims to make homework interesting and at the same time preserving the advantages of paper-based homework while using a technology based approach. Moreover, the application helps reduce the need for parents to guide children through the homework process thus, freeing time for parents to engage in other activities and also helping avoid 'wrong' guidance.

An interview questionnaire was developed and employed to interview primary school teachers in order to identify the factors that would assist designing high quality homework activities similar to the paper homework normally assigned to students in New Zealand public schools. Information provided by the teachers assisted in designing the application and teachers' feedback on the designed application helped fine tune some of its features. The activities embedded in the application were linked to New Zealand public school curriculum and provided support for different levels of learning needs.

The application (a prototype) was tested by nine parents of 'Year One' and 'Year Two' students. The results showed that the application met the research objectives of making homework interesting and engaging for children in order to save time for busy parents, parents felt assured that the application followed the school curriculum and provided appropriate educational activities of high quality.

Chapter 1: Introduction

This chapter provides background information, formulates the research objectives, explains the rationale and discusses its significance and potential value. The structure of the thesis is outlined with a brief description of each chapter provided.

1.1 Homework and learning

School students are usually given work by their teachers to complete at home.

Homework is essential to children's learning. It enables learners to develop positive study routines, improves their thinking skills and empowers them to manage their study time wisely. Homework also teaches children to become independent and responsible learners. In addition, homework can also be beneficial to parents since it allows them to be aware of the content that their children are learning at school (Corno & Xu, 2004). Prior research shows that students who develop good homework habits and do more academic learning activities at home are more successful at school (Cooper, 1989). Homework is also expected to enhance the material learned in class, and to improve student understanding of topics.

In most New Zealand schools students are given some weekly tasks to do at home as their homework. The homework tasks are normally the material children have learnt at school and give them the opportunity to practice and master the subject they are taught at school. Homework activities vary however; activities that are given to young students include mathematics (maths) and English exercises.

Homework activities fall in four different categories: practice exercises, preparatory homework, assignment extension, and creative homework (Matton, 2010). Practice exercises are the most common type of homework given in both maths and English language, e.g., activities such as time tables memorisation in maths or word spelling in English. Preparatory homework helps students to obtain prior background information and prepare for future lessons and includes library or Internet research, or gathering items to bring to class the next day. Extension homework requires students to go beyond the skills that they have learned at school. This type of homework includes activities such as writing (e.g., a book review) or designing a handcraft. Creative homework normally is a research project and requires more time than the other three types. Practice exercises and preparatory homework are the types of homework that are more commonly given to early age primary school students with the two other types normally assigned to older students (Matton, 2010).

1.2 The role of handwriting in children's learning processes

Most of the activities assigned to early age students are based on pencil and paper, meaning that students are given homework sheets that need to be filled in using a pencil, for instance for practicing basic skills such as addition in maths and the spelling of words in English; both activities need to be handwritten.

Handwriting is considered an important factor in improving student learning. Studies show that learning by handwriting produces better and longer lasting results (Klauser, 2001). Handwriting practices especially in the first couple of years at school have a direct relationship with student reading and spelling achievement. Attention to this relationship can help strengthen student reading and spelling in early school ages (Spear-Swerling, 2006). Therefore homework activities that use handwriting may significantly improve child learning.

1.3 Parental involvement issues

Most parents are aware of the importance of homework with respect to academic success thus they endeavour to effectively contribute to their children's homework. However, homework may become a hard and time-consuming mission as many families, especially single parents and those with both parents working, may find it difficult to allocate enough time, if any, to assist children with their homework. On the other hand, parents' over-involvement in children's homework may lead to frustration, arguments and fighting with their children (Dudley-Marling, 2003). Silbert (2009), also states that homework has become one of the biggest issues for parents and children as it may bring anger, frustration, tears, fear and family disharmony. The latter creates impatient parents who choose to spend less or no time on their children's homework.

Conversely, some parents spend many hours helping their children with homework and this may result in issues for parents, such as less pleasurable time spent with the family. Dudley-Marling (2003) also notes that "the demands of supporting their children's homework left many parents—especially mothers—with little time for themselves or for other family members" (hours and hours [of homework], para. 4). Furthermore, families who have struggling children and spend a lot of time assisting them have less time to spend with other children in the family. Whether parents choose not to get involved or to get fully involved in their children's homework they are likely to struggle with some type of issue (Dudley-Marling, 2003).

1.4 Homework and educational computer games

Another problem with completing homework is that, despite its importance, many children do not find homework interesting or engaging. According to Corno (2000) children consider homework a chore and thus are less likely to engage with or complete it without assistance or encouragement. Hence, to make homework more appealing to children it could be designed as a 'game to play' rather than 'work to do' i.e., as something children love and desire to complete (Corno, 2000). Since most children are already engaged in playing computer games in their leisure time computer games have been widely used in education to make learning more pleasant. Therefore using computer games as a replacement for paper homework could be more interesting and more engaging for the student rather than paper based homework.

1.4.1 Relevancy to school curriculum

Computer games have been proven to have a positive effect on child learning. For example McFarlane, Sparrowhawk, and Heald (2002) stated that computer games are useful in developing children's thinking and problem solving skills. However, the authors also found that the activities in these computer games are not always relevant to the school curriculum. Therefore, it is difficult for teachers to use computer games at school as these games either do not cover the material that needs to be taught or use approaches different from the ones prescribed in the school curriculum framework (McFarlane, Sparrowhawk, & Heald, 2002). Hence, educational computer games need to follow school curriculum and cover the material taught in the classroom if they are going to be used as homework; homework is a mean for mastering the material that children learn at school. The necessity of the curriculum relevancy of educational computer games has been also pointed out by teachers in studies by Gros (2004) and Sanger (1997) (as cited in Gros, 2007, p. 31).

1.4.2 Use of handwriting in computer educational games

Another issue with the use of educational computer games in place of paper homework is that most of them are based on typing and clicking. Studies show that children learn more effectively by using handwriting rather than typing, and also the content learned using handwriting is better retained compared to the material learned using typing (Longcompa, Zerbato-Poudoub, & Velay, 2005; Richards, et al., 2009). Since one of the important factors of learning (handwriting) is seemingly missing in most existing educational computer games, these games may not effectively improve children's language art skills (i.e., reading, writing, spelling, and composition), which are a requirement for academic success. Although recent technologies have developed handwriting capabilities such as the stylus or finger-touch screens, there is little evidence of applying these new technologies to incorporate meaningful handwriting into educational games. Some examples of using handwriting in computer games can be seen in applications such as "Tracing ABC" or "123s ABCs", however, these only focus on teaching the alphabet using handwriting and tracing, and therefore these cannot replace homework.

1.4.3 Differentiated instruction

One important issue with existing educational computer games is that they do not cater for individual differences in students in the way homework assigned by teachers does. The purpose of education is to empower each individual learner to develop knowledge based on his/her personal skills and learning ability. In order to attain this, school teachers observe each individual student closely in order to identify the level of abilities and skills and vary the learning activities to match. Proper differentiation is very important in student learning as it increases the possibility of academic success (Heacox, 2002). Vygotsky (1978) placed a great emphasis on the importance of differentiated instruction and introduced a model known as the Zone of Proximal Development (ZPD). According to Vygotsky, each individual child has a particular

developmental point of ability; when the child reaches this point he or she is able to accomplish tasks without any help from the teacher (the actual level of development). Beyond that point (the potential level of development) he or she will need help to accomplish a certain task. The distance between these two points is known as ZPD. Gardner (1983) extended Vygotsky's work by developing a new differentiated instructional theory known as multiple intelligences (MI). According to Gardner, every student has numerous "distinct intelligences" each of which relate to a certain region in the brain. Teachers should identify these intelligences in their students in order to help them to succeed educationally (Gangi, 2001).

Since computer games cannot observe each student closely in order to find out about their personal abilities and skills or identify their distinct intelligences, educational game developers use other strategies to differentiate learning activities in their games. For instance, they use words such as "easy", "medium" and "hard" for categorising the activities or they group the activities by age, such as for 6 to 7-year-olds. Considering student differentiation these strategies are not an efficient way to customise learning activities according to skill level since the words "easy" or "hard" may be interpreted differently by different students. For example, an activity which is categorised as easy might be easy to solve for one student and hard for the other. Or similarly, an activity that suits the level of understanding of a five-year-old child may not be suitable for another five-year-old child.

Even though computer games may help children engagement with education they cannot effectively replace paper homework for the abovementioned reasons. This study aims to address some of the issues identified above and proposes improvements in order to design an educational game that could replace the paper homework given to early age students in New Zealand schools. The next section formulates the objective of the research.

1.5 Research objective

The objective of the research is to develop the means to facilitate the work of parents of Year 1 and 2 children who are interested in their children's academic success and are willing to help them with their homework but do not have the time. To achieve the objective the study first investigated the factors that contributed to the design of high quality homework relevant to the New Zealand school curriculum that suit each individual student's learning needs. Second, the study describes the design and evaluates the implementation of the Android-based tablet application which was designed by the researcher that helps children to improve their language art skills. The application simulates paper-based homework for primary school children by using a stylus (a pen-shaped device used to write on the touch screen of a tablet).

1.6 Motivation and rationale

There has been limited research into some aspects of homework: "Many areas of homework research are still open to debate. Much of the investigation has taken place

in America and there are no large-scale studies on the topic that have been conducted in New Zealand” (Inglis, 2005, p. 112).

The motivation and rationale behind this research can be categorised as three different factors. The first factor is the use of computers for doing primary school student homework. Plowman & Stephen (2005) have studied the benefits of introducing children to ICT (Information Communications Technology) at an early school age. Also some educational computer games have been designed for primary school students, which can be used in conjunction with homework assigned by teachers (e.g., ‘Reading Eggs’ is used widely in New Zealand classrooms). However, there is no evidence available of the use of educational computer games that focus on homework and replace paper-based homework.

The second factor is the idea of incorporating handwriting in educational computer games. Considering the importance of handwriting in learning there is little evidence available for the use of handwriting in such games and no evidence of computer educational games replacing paper homework and incorporating activities that need to be done using handwriting.

The third factor is the need to explore what helps to design educational computer games for primary school students that focus on student differentiation and cater for individual student learning needs. Since the New Zealand education system focuses on teaching primary school students based on their individual learning needs and skills, the homework assigned to each student by the teacher is designed for that specific student.(e.g., teachers do not assign the same homework to all students in a classroom. Each student has different homework specifically designed for him/her). Hence this research intends to design an application that addresses individual’s learning needs and skills and also is relevant to New Zealand’s educational curriculum.

Additionally it attempts to incorporate in the application the factors that positively affect the process of learning, such as handwriting, in order to create a useful application that could effectively replace paper homework. Furthermore, the application may be a help to busy parents by integrating easy-to-follow instructions so that the students would not need their parents to help guide them through each activity.

1.7 Significance and potential value of the research

The outcome and results of this study may be of potential value to the developers of the educational computer applications and other researchers in this area. Based on the factors found to influence children’s learning processes, this research may provide recommendations about the design and development of educational applications relevant to today’s society. This study may also provide support to parents in their effort to improve their children’s academic success by making it easier to supervise their children’s homework and reducing the time required to do so. Furthermore this

study can make learning enjoyable as well as improve their language arts and motor skills.

1.8 Outline of the thesis

This thesis is comprised of six chapters. The introduction outlines the research objectives and emphasises the importance of the study. Chapter 2 presents findings from a literature review with a focus on the issues and problems addressed in the research, presents a research model derived from the literature review, and briefly reviews the research approach of this study. In Chapter 3, a design science approach is applied and discussed in order to develop the research model. Furthermore, it outlines the research process, data collection method and questionnaire. Chapter 4 presents the findings and analysis of the data collected from interviews with teachers. Chapter 5 describes the design and development of the application in details. Due to the high volume of codes used for programming the application they could not fit in this paper, however they are accessible as softcopy on request. Chapter 6 presents the evaluation of the Android application. Chapter 7 discusses the results from the chapter 6 and concludes with a summary of the research findings and their implications with suggestions for future work.

Chapter 2: Literature Review

This chapter reviews the existing literature on the importance of homework and its impacts on children's academic success as well as the literature on the role of handwriting in the development of children's learning processes and its effects on the brain in comparison with typing. Furthermore, the issues involved in completing homework are discussed with regards to the existing literature. Finally, the literature on the role of educational computer games in children's academic education is reviewed and issues around it are discussed.

2.1 Homework

Homework is essential to children's learning processes. It improves children's thinking and memory and helps them develop positive study skills and habits that will serve them well throughout life. Additionally, it helps the growth and development of student initiative, independence, and responsibility. Finally, it serves as an intersection between home and school as it gives parents a way to observe and become involved with their children's education (Cooper, 1989).

Various studies have focused on the importance of homework in children's academic success and development of their learning processes. For example, Cooper (2001) and Cosden, Morrison, Gutierrez and Brown (2004) have studied the effects of homework on student's achievement in school. These and other studies conducted in the last decade have significantly strengthened the case for homework and its importance, with most researchers coming to the conclusion that doing more homework results in greater academic achievement. The study conducted by Leone and Richards (1989) revealed that increased homework time was associated with better academic achievement, and Tymms and Fitz-Gibbon (1992) found a positive relationship between the quantity of homework completed and A-level examination results.

Apart from contributing to academic success, homework can help children prepare for their future work environments. Corno and Xu (2004) suggest that viewing homework metaphorically "as the job of childhood" reveals its potential to help develop work ethic and job management skills that are highly valued in the workplace. Furthermore, Bempechat (2004) stated that homework teaches children to develop applicable life skills such as how to cope with difficult problems and setbacks and find solutions for them.

Studies generally have found homework assignments to be most helpful if they are carefully planned by teachers and have direct meaning to students. According to Vatterott (2009) meaningful homework should be purposeful, efficient, personalised, doable, and inviting. Paulu (1995) also states that homework assignments will be more successful if they are wisely designed in order to be relevant to students. Most of these studies have emphasised the quality of homework rather than quantity. For example, Zwaagstra (2009) suggests that "instead of measuring homework by the number of minutes it takes to complete it, let's focus instead on making sure that it is properly

designed and helps reinforce concepts learned in school” (para. 10). The following section discusses how handwriting, as one of the most important factors influencing children’s learning processes, may be used to enhance the quality of homework exercises as well.

2.2 Development of the children’s learning process by handwriting

Handwriting practices improve children’s learning processes. Studies show that writing by hand is more than just a way to communicate since it helps clarify one’s thoughts to focus on the current activity and enhances the memory by engaging the brain (Mangen, 2011).

With the introduction of computers, the use of handwriting has decreased. People use digital devices to communicate and pen and paper are less common. Most teachers and educators seem to have moved away from handwriting education to keyboard skills. Therefore the art of handwriting is threatened by technology. (Yancey, 2009)

Although teaching keyboard skills to children is essential in the 21st century, teaching this skill instead of handwriting is a major disadvantage for students: studies have shown that while both keyboarding and handwriting are skills needed in today’s world, handwriting has the added advantage of encouraging literacy and developing thinking skills.

2.2.1 Handwriting vs. keyboarding

Recent studies (Longcompa, Zerbato-Poudoub, and Velay (2005); Anthony, Yang, and Koedinger (2007); Berninger (2012)) have considered the effectiveness of handwriting on learning processes in comparison with keyboarding. Handwriting has been found to be more beneficial to learning and brain development than keyboarding since writing by hand has been proven to build up the learning process while typing on a keyboard may in fact impair the process. Handwriting fully engages the hand during letter formation whereas in keyboarding one can tap with just one finger on a specific key to form the desired letter. Researchers (Thomas & Dieter, 1987) have examined the effectiveness of typing and handwriting for people learning foreign languages. For example, Longcompa, Zerbato-Poudoub, and Velay (2005) concluded that practicing by handwriting allowed children to improve their performance in letter recognition significantly more than when practicing by typing . The results of a study done by Berninger (2012) of more than 200 children also indicated that children's writing ability improved when they used a pen rather than a keyboard and that they were able to write more and faster (As cited in Handwriting in the 21st century). Anthony, Yang, and Koedinger (2007) extended prior work by finding the benefits of using handwriting maths versus typing. The outcomes of their study show that students were able to solve maths problems twice as fast using handwriting compared to keyboarding. Since handwriting has been shown to be a better method for learning compared to keyboarding some researchers have investigated the question of what happens to the brain when using handwriting versus keyboarding.

2.2.2 Handwriting and the brain

Especially for children, learning via handwriting has been proven to produce better and longer-lasting results as it engages the brain more than typing. Klauser (2001) in his book explains the biological reasons behind handwriting's effect on human achievements. According to him handwriting stimulates a group of cells in the brain called the reticular activating system (RAS). The RAS acts as a filter for everything one's brain needs to process, giving priority to the actively that the brain is currently involved with. Therefore, handwriting, as it activates and stimulates the RAS, can help "train" the brain to act more efficiently when focusing on a particular task. In other research, Richards, Berninger, Stock, Altemeier, Trivedi, and Maravilla (2009) focused on the effects of handwriting on brain development. They showed that the consecutive finger movements when writing by hand activate many parts of the brain including the thinking, language, and short-term memory regions. Consequently writing by hand allows the brain to think, to understand and to remember more efficiently. In addition, writing by pen and paper seems to imprint information in the brain in a more superior way than using a keyboard and a computer screen, indicating the existence of a unique connection between handwriting and the brain when it comes to learning and memorising. In James' (2012) study on children's brains for example some children were given letters to learn by visualising and some by handwriting while their neural brain activity was measured using an MRI machine. The result of her study indicated that the neural activity of children who used handwriting to learn letters was much more enhanced compared to children who visualised the letters. (As cited in Handwriting in the 21st century)

2.3 Issues revolving around completion of homework

Despite the importance of homework there have been some significant issues hindering the successful accomplishment of homework assignments especially with early school age children. Children at this age are too young to be aware of the importance of homework. So it is up to the parents to help them understand the importance and value of homework by participating in their homework. However, parents may not be always able to get involved or may find it difficult to interest children in doing homework, as discussed below.

2.3.1 Parental involvement issues

Parents' involvement in their children's homework is an important factor in children's learning processes especially during the early school years as it motivates children to learn (Seginer, 2006). Studies show that children do their homework much better and faster and they are more likely to succeed in learning when they are well assisted and guided by a parent or another adult. The study conducted by Patall, Cooper and Robinson (2008) showed that parental involvement in children's homework results in a higher rate of homework completion, less homework problems, and improved academic performance. Tymms and Fitz-Gibbon (1992), Bogenschneider (1997), and

Callahan, Rademacher, and Hildreth (1998) have also found positive links between parental involvement and student achievement.

Even though parental guidance is important there are always problems regarding parents' involvement. A major problem related to today's busy lifestyle is people having a lack of free time. Most parents cannot allocate enough time to their children's homework especially if they have more than one child. In addition, the constantly increasing percentage of women in the workplace has had an impact on the family time allocation since mothers have less time to spend on parenting, including their children's education (Bianchi, Robinson, & Milkie, 2006). Bulanda and Lippmann (2009) who believed that parents should spend more time with their children, have also investigated the factors that influence the quality and quantity of the time parents spend with their children. According to them, parents' working hours are the main factor, especially for families where both parents are working or single parent families: they have less time to spend with their children than families with only one parent working. Therefore despite the importance of parental involvement in children's education, most parents may not be able to find enough time to participate in their children's education.

Although the allocation of time and involvement in children's homework by parents is essential to children's learning processes, solely spending time with them does not ensure quality homework is completed. For example, some parents might have the time to participate in their children's homework but they may not be well educated or know the correct way to assist their children. In their study Patall, Cooper, and Robinson (2008) concluded that parents must be trained for being involved in children's education and their skills in the subject areas are important mediators ensuring the effectiveness of parents' involvement in children's homework. In addition, parents' background and education may negatively affect their children's learning: "Parents can confuse children if the instructional techniques they use differ from those used by teachers" (Cooper & Valentine, 2001; p. 146).

Finally, parental involvement with children's homework may sometimes result in arguments and disagreements between parents and children. For example, a child being distracted while doing homework or his or her resentment of having to do homework can be the start of a parent-child conflict. This may create a tedious and stressful environment, which makes both the parent and child dislike the whole homework process (Dobkin, 2007).

2.3.2 Children issues

Generally, children do not find doing homework on a piece of paper interesting or engaging; as a result they easily get distracted and begin feeling bored. For example, most children do not consider homework as interesting as watching television or playing on a computer; they mostly think of it as a chore (Corno, 2000).

Children need to be motivated in order to willingly engage in an activity that they otherwise find tedious such as homework. As computer games have become an essential part of children's contemporary culture—more than any other media, one way to motivate them is to incorporate computer games within homework (Kafai, 1995). Educational computer games have been designed to motivate and engage children in learning. Rosas, et al. (2003) investigated the effects of learning through computer games on Year 1 and 2 primary school students and they discovered an improvement in motivation to learn.

2.4 Educational computer games as replacement for paper homework

As mentioned computer games are popular among children and playing games has become one of the main reasons children use computers (Dormann, et al., 2005). In a study, Phillips, Rolls, Rouse, and Griffiths (1995) found that 72% of children played video games and that 72.8% of children reported "enjoyment" as the main reason for playing. The attractiveness of computer games to children has led game developers to create educational games in order to engage students and enhance their learning. Recent research has shown that this approach has been successful: for example Tüzüna, Yılmaz-Soylua, Karakuş, İnal, and Kızılkaya (2009) found that computer games can be used to significantly motivate children in learning. Olsen (2011) also states that: "computer games are an excellent way to motivate students academically by making learning fun."

Studies report on a number of academic benefits that can be gained from playing computer games such as improving literacy skills, learning math and science concepts, and acquiring business and social skills (Jackson, Eye, Biocca, Barbatsis, Zhao, & Fitzgerald, 2006; Olsen, 2011). Some researchers also have questioned the relationship between computers and the cognitive, social, and developmental needs of young children (Cordes & Miller, 2000; Healy, 1998), while others have examined the benefits of introducing children to ICT (Information Communications Technology) specifically by using computer games for learning at an early school age (Plowman & Stephen, 2005). ICT can be used as a means for learning by incorporating high-quality learning applications and the benefits of technology in all areas of learning. As highlighted by Olsen, the computer game industry can help people succeed at school, work, and in life by designing educational games as learning tools.

Despite being motivating and engaging, educational games are not necessarily as effective as paper-based homework for learning. Grose writes, "engagement and motivation are interesting benefits of the use of games but they are not enough for educational purposes" (2007, p. 23). Most educational computer games lack an emphasis on the two main learning factors on which paper homework focuses: handwriting and catering for individual learner's needs. Most educational games are

designed to use keyboards instead of handwriting, as mentioned earlier and therefore do not have the same benefits as paper homework. Second, existing educational games do not use a differentiated approach in their activities in a way that could cater for individuals' learning needs.

2.4.1 Educational games with keyboarding

Most existing educational computer applications allow only for the use of keyboarding, however this leads to neglecting handwriting—one of the main components of the learning process. As stated earlier (section 2.2.1), handwriting is more advantageous to both the learning process and development of the brain than keyboarding. Therefore these educational applications cannot effectively replace good quality pen and paper homework.

New technology has recently introduced tablet computers that offer a user-friendly interface that allows users to interact by touching areas on the screen—either using their fingers or stylus pens especially designed for the use with tablets. Consequently, educational applications that use handwriting on tablets have been designed. For example “The Write Connection” is an educational application to be used at home or school, and it provides some handwriting practice along with concept recognition for early learners (*Best Educational Software*, 2013). The “Little Writer” is another educational application that incorporates this new technology in order to create a fun learning environment for children. However, these applications focus only on the use of handwriting for forming letters and numbers with no maths or language arts activities included that could replace pen and paper homework.

2.4.2 Catering for individual differences

One of the most fundamental issues of education is finding a way to tailor instruction to accommodate for student differences (instructional differentiation) (Knight & Knight, 1995). Tomlinson (2000), placed a great emphasis on instructional differentiation and on the effort by teachers to respond to student differences in the classroom. As every child has a different learning ability and skills it is essential for teachers to identify these differences and teach each student based on his or her level of ability and skills. Also it means that the level of difficulty of the material taught by teachers should be slightly more advanced than a student's current level. According to Vygotsky (1978) there is a point of learning for each student where she or he can solve a certain problem on their own (actual development level) and a point where the student requires help in order to solve a particular problem (potential development level). Vygotsky refers to the difference between these two points as the “zone of proximal development” (ZPD). Many studies, including Fisher et al. (1980), strongly support Vygotsky's ZPD model. Fisher et al. also found that there was a relationship between student achievement and teachers' capabilities to identify students' abilities and skill levels and to assign them suitable tasks (Fisher, 1980 as cited in Tomlinson, 2000). According to Veresov (2004) the ZPD of each student can be detected by school teachers.

The most important factor in differentiated instruction is to teach students within their ZPD in order to help them reach their highest level of potential. New Zealand's Ministry of Education also has emphasised teaching students based on their ZPD. Therefore New Zealand teachers normally identify their students' ZPD and assign them with learning tasks and homework activities that are within their ZPD. Teaching a student outside of their ZPD can sometimes be harmful as any learning task that is not in the student's ZPD will not provide valuable knowledge to the student (Vygotsky, 1978). For instance, if the level of homework activities assigned to the student is lower than the student's actual understanding level, they will not bring new knowledge to the student and they may feel bored and reluctant to do the homework. On the other hand, if the activities assigned are at a higher level than the student's actual understanding level, the student may feel like they are not smart and may be unwilling to complete the activity (Table 2. 1). Hence it is vital to allocate homework activities that match students' ZPD.

Table 2. 1: Tapping the Zone of Proximal Development

Level of Activities			
Student's Reaction	Too challenging	Appropriate challenge	Not challenging enough
	Low Academic Grow	Optimal Learning	Low Academic Growth
	<ul style="list-style-type: none"> • Fight or flight • Out of control • Quick burnout • Anxiety • Distress • Chaos 	<ul style="list-style-type: none"> • Problem solving • In control • Achievement • "Relaxed alertness" 	<ul style="list-style-type: none"> • Sleepy • Relaxed • Apathetic • "Off-duty" • Depressed
	Student's thought	Student's thought	Student's thought
	<ul style="list-style-type: none"> • I feel dumb • I wish I were smart 	<ul style="list-style-type: none"> • I need to pay attention • I need to work hard 	<ul style="list-style-type: none"> • This is a cinch • I am so bored

Adopted from (Strickland, 2007, p. 19)

Similarly it is essential to use the ZPD concept in development of educational computer games. In his study Rieber (1996) argued that in order to have a game that is challenging enough it should be within the player's ZPD. Likewise Kafai (1995) states that to make learning meaningful and useful to students, the methods and techniques used should be motivating and exclusively relevant to the student.

2.4.3 Curriculum relevancy

In addition to the importance of applying the concept of ZPD, homework assigned to students needs to be relevant to the school curriculum. Zwaagstra (2009) also suggests that "homework should be meaningful and provide students with the opportunity to

practice skills and concepts they have recently learned in school. Ensuring that homework is properly designed and relevant to what students are learning is the best way to alleviate concerns about its effectiveness” (para. 9).

Hence in order to design an educational computer application that could play the role of homework it should also be relevant to school curriculum. The necessity of curriculum relevancy for educational computer games has been pointed out by teachers in Gros’ (2004) and Sangers’ (1997) (as cited in Gros, 2007, p. 31) studies. McFarlane, Sparrowhawk and Heald (2002) examined many educational games, and they found a lack of curriculum relevancy in most of the games. They evaluated educational games that had apparent curriculum relevance, used a relevant learning approach, or built up certain skills. The researchers concluded that the amount of content relevant to school curriculum in these games was generally low, and if there were any relevancy, the potential contribution made to the child’s learning was peripheral. As stated by them:

There were many comments from teachers, parents and pupils about the valuable ways in which games made them think. However, within the school curriculum teachers found it hard to justify using resources whose value lay in thinking alone, however effective that resource might be at developing thinking skills. (McFarlane, Sparrowhawk, & Heald, 2002, p. 32)

Furthermore, teachers thought that spending time on activities not building on the subject knowledge was worthless.

2.5 Summary

This chapter reviewed the prior work on children education with respect to several key concepts. First, it reviewed the importance of homework and its effect on students’ education and their academic success. Main factors that could enhance the quality of homework such as parental involvement and the use of handwriting in homework activities were identified. The issues around completion of homework were argued. The role of educational computer games in educating students and the factors that need to be considered when designing such games for students were also discussed. Based on the findings from the literature review, it can be concluded that a key factor that has a positive influence on learning (literacy and mathematics) is the use of handwriting. Furthermore, it can be concluded that the most important factors influencing the design of quality homework activities are catering for individual student’s learning needs and relevancy to the school curriculum. Further the study will design an educational computer application that considers all the factors which have been proven to have a positive effect on student learning. The initial research model and a detailed research approach are discussed in the next chapter.

Chapter 3: Research Method

3.1 Chapter overview

This chapter includes a description of the adopted research approach and design and reflects on the stated research objectives in that respect. This chapter presents the methodology and the methodology instruments and techniques used for data collection and data analysis. This chapter is organised along the steps of the research design development process as shown in Figure 3. 1.

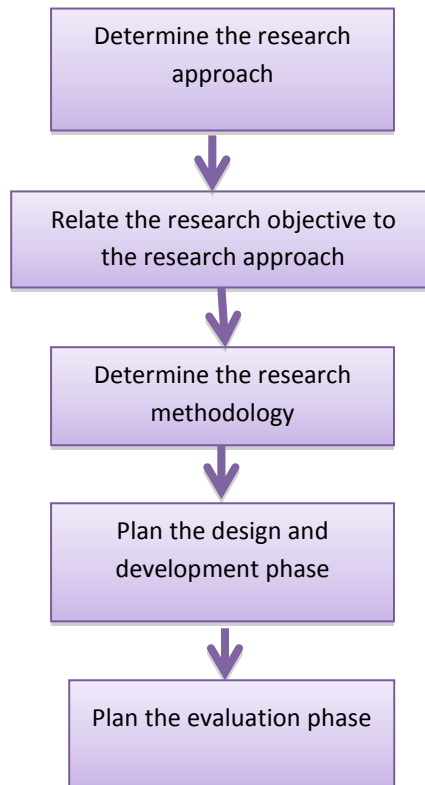


Figure 3. 1: Developing the research design

3.2 Research approach

There have been prominent studies conducted in the past two decades aiming to discover a suitable approach for Information Systems or Information Technology (IS/IT) discipline research by questioning the legitimacy of the research approaches currently used in IS/IT research. One of these studies was carried out by Nunamaker, Chen, and Purdin (1991). Nunamaker et al. introduced the 'system development' approach for Information Systems (IS) research. This was a multimethodological approach and was initially based on two fundamental processes: building and evaluating.

Later Hevner, March, Park, and Ram (2004) presented another approach that was derived from the Nunamaker et al. study among other studies. According to Hevner et al., research in the IS discipline is predominantly based on two paradigms: behavioural science and design science. Behavioural science investigates human and organisation behaviour through natural observations. Design science addresses the

limitations of human and organisational abilities by producing new artifacts. The authors mention these two paradigms as the foundation of the IS discipline; therefore their approach is a combination of these two methods. Furthermore, Hevner et al. introduce guiding principles for conducting design science research in the IS discipline that describe characteristics of well carried out research. They propose three closely related cycles of activities known as the “design science cycles”. An essential part of the design science cycle is obtaining feedback from stakeholders and potential participants. The feedback helps design an application that meets their needs and expectations.

More recently Peffers, Tuunanen, Rothenberger, and Chatterjee (2007) presented a design science research approach which comprises six steps that should be taken in order to conduct and evaluate quality design science research. The steps, which are derived from Hevner et al.’s 2004 study, are “problem identification and motivation, definition of the objective for a solution, design and development, demonstration evaluation and communication” (p. 46).

The design science approach is a problem-solving paradigm that aims at creating and evaluating original artifacts that address important problems in society (Adikari, McDonald, & Campbell, 2009). The introductory chapter of this thesis has indicated the design science nature of the research upon which this paper focuses. Therefore the research methodology is chosen based on a design science approach as discussed above.

The research follows a design science cycle and specifically adopts Hevner, March, Park, and Ram’s (2004) approach and follows their guidelines throughout the study. Considering that there is no need to follow their guidelines precisely, Hevner et al. have advised researchers to make their own decisions in applying the guidelines in their approach. A further explanation on how the research applies and follows this approach and these guidelines is discussed below.

3.3 Research objective revisited

The first chapter introduced a concise description of the problems that need to be addressed, presented several aspects of the motivation behind this research, and formulated the research objectives. This section relates the research objectives to the adopted research approach.

The research is concerned with designing a mobile application to help parents of Year 1 and Year 2 primary school students who have problems participating in their children’s homework. The research involves the design of a mobile application and is motivated by the needs of parents, especially busy parents.

In the previous chapters it was pointed out that in order to design an Android application for tablet that could replace the paper homework given to students in NZ schools, first there was a need to understand the factors that help create good quality

homework activities relevant to NZ school curriculum. Second, as the use of handwriting in children's learning development is very important, the application would need to utilise a pen in its activities. The following section will discuss the steps undertaken to cover these requirements.

3.3.1 Interviews with teachers

Interviewing primary school teachers helped identify the factors that help create high quality homework activities that are suitable for New Zealand primary school students.

In order to satisfy the second requirement, which was the use of handwriting in the activities, a touch screen tablet with a stylus was used as it allows for the simulation of a pen and paper environment and can be used to create high-quality homework activities.

This study contained three sets of interviews: the first set of interviews were designed in order to identify appropriate activities for Year 1 and Year 2 primary school students, the second set of interviews gathered information for further improvement and development of the application, and the third set of interviews occurred after the application was tested and evaluated by parents.

Qualitative interviews were considered the most suitable data gathering method as they can be used to explore the views, experiences, beliefs and motivations of individual research participants whereas quantitative interview questions are limited to predefined answers (Newton, 2010). According to Myersa and Newmanb (2007), qualitative interviews are the one of the leading data gathering tools in qualitative research. Consequently, as this study consisted of qualitative research, qualitative data collection and analysis were chosen as methods to identify the factors.

There are three major interview types: structured, semi-structured and unstructured. Structured interviews contain predetermined questions with no scope for follow-up and consequently do not allow further elaboration. Therefore they are not useful for in-depth interviews. Unstructured interviews are performed with little or no organisation hence they are usually very time consuming. Conversely semi-structured interviews contain several key questions that help to determine the areas to be explored and guide both the interviewer and interviewee on what to talk about, thus allowing for the discussion of an idea or response in more detail. This approach is flexible and allows for follow-up questions and further elaboration on issues raised by participants that may not have been set up as an interview question at the beginning (Gill, Stewart, Treasure & Chadwick, 2008).

Semi-structured interviews were chosen for the data collection in order to obtain an insight and understanding of the opinions of participants by probing for more details and clarification of answers. Following Boeije (2010), the interview questions were prepared in advance; this effectively directed the interview.

3.3.2 Ethical approval

The Auckland University of Technology requires that any research involving human participants is conducted in accordance with the highest ethical standards. An application was submitted to Auckland University of Technology Ethics Committee (AUTEC) for approval before commencing the interviews. Approval was granted on 23 August 2012, with the reference number of 12/177. (See Appendix A for the AUTEC approval).

3.3.3 Selecting and recruiting participants (teachers/educators)

Participants consisted of experienced primary school teachers across the decile range. The decile ranking from 1 to 10 signifies the socioeconomic status of a school's area. A decile of 1 means that the school is located in a poor area; a decile of 10 means the school located in a wealthy area (Decile Ratings, 2012). The reason for selecting the participants from various decile schools was to find out if there were any differences in the teaching systems in different decile schools. Permission to contact teachers was obtained from school principals. Prospective participants were sent an invitation and an information sheet. Four participants were sufficient for the purpose of the study. The following section describes the data gathering process.

3.3.4 Data gathering (teachers/educators)

The interview questions were designed to gauge the factors that help create good quality homework activities relevant to New Zealand primary school homework assignments. Each interview took about 20 minutes. The interviews were recorded using an audio recorder and were transcribed by the author and made ready for analysis.

3.3.5 Data analysis (teachers/educators)

The interview data were analysed after all the interviews were finished and the recorded data transcribed. In accordance with the qualitative data gathering method selected, the data was analysed using a qualitative content analysis approach. Content analysis is a qualitative research method that has been used widely in qualitative research and consists of analysing written, spoken or optical communications, which can be done in an inductive or deductive way. In situations where there have been no prior related studies, an inductive method will be useful for analysis, but in cases where the aim is to test an existing theory, a deductive method is used (Elo & Kyngäs, 2008). As the research objective was to create something new inductive method was used for data analysis.

3.4 Application design

The findings from analysing the data gathered in the first interview were used to inform the design of homework activities for the mobile application. All activities for Year 1 and Year 2 students were first designed as a draft (on paper) to be integrated later in the actual design software. To design the mobile application some knowledge about how to design a Graphical User Interface (GUI) was required. Thus, relevant

literature needed to be investigated. More details on the design of the activities are provided in chapter 4.

3.4.1 Platform

As previously stated, the use of handwriting is critical in children's learning development. Therefore one of the applications' requirements was to utilise a pen to provide handwriting practice. After investigating the technologies available, an Android-based touch screen tablet with a stylus was determined to be appropriate as it allows for simulation of a pen and paper environment. iPads also could be used as they have similar abilities. The reason of choosing tablets over iPads was that the device was available and also the researcher was more familiar with android application development than apple application development.

3.4.2 Programming language

Java was used as the programming language because all Android applications are developed in Java.

3.4.3 Software development

Once the homework activities were determined and the application layout and interface were formed and also the suitable platform and the programming language were selected, the mobile application would be coded and built to run on the tablet.

In order to start writing the code an IDE (integrated development environment) and Android SDK (Software Developers/Development Kit) (which is open source and freely available for download) were required. Since the programming language is Java, a JDK (Java Development Kit) and JER (Java Runtime Environment) were required. More details on designing the mobile application, from the preparation of the programming environment to the writing of the code will be given in chapter 5.

3.4.4 Obtaining teacher feedback

After the initial design of the application feedback from the teachers was required to assure the suitability and usefulness of the application. Obtaining feedback from stakeholders and potential participants is an important component of the "design science cycles" approach chosen for this study (Hevner, March, Park & Ram, 2004). Therefore, the teachers from the first interview were interviewed again to obtain their feedback about the application. This feedback assisted further development of the application and helped make it ready for the evaluation phase.

3.4.5 Second ethical application

The development and evaluation phases of the research involve human participant so two separate sets of interviews were required. For the development phase the teachers who had been interviewed previously were interviewed once more in order to confirm the activities or suggest any changes. More details on the development phase will be given further in chapter 5. For the evaluation of the application, a group of parents of Year 1 and Year 2 primary school students were invited to participate.

The parents were given the application to evaluate and assess at their convenience and then were interviewed about their experiences, impressions and recommendations. A second ethical application was submitted to AUTECH for approval before commencing the data collection for the development and evaluation phases (reference number 12/177) (Appendix G).

The second round of interviews used the same approach as the first round (i.e. semi-structured interviews) (see section 3.3.1). The next section discusses the approach that was used to carry out the evaluation component of the study and explains how data were gathered and analysed.

3.5 Application evaluation

This section describes how evaluation data will be gathered from participants (parents) and how the data will be analysed.

3.5.1 Data gathering

In order to evaluate the final design of the mobile application, it was tested by parents of Year 1 and Year 2 students as the intention is to help parents participate in their children's homework.

As mentioned earlier, the data collection process used semi-structured face-to-face interviews. The interview questionnaire was planned in advance and developed with the aim to find out how useful the mobile application was in terms of time saving, ease of use, information density, information relevance, and enjoyability (parent's perception of their children's level of enjoyment) (Petrova & Li, 2009; Parsons, Petrova, & Ryu, 2011).

The duration of each interview was approximately 20 minutes. The questions were posed in the same order as in the pre-written questionnaire, however follow-up questions and further elaboration of information was carried out when possible. A digital recorder was used to record the conversation and the data collected was analysed and categorised by critical success factors.

3.5.2 Participant selection

Participants were selected from the parents of Year 1 and Year 2 primary school students in Auckland. The parent participants constituted a convenience sample selected from among personal acquaintances of the researcher from different regions of Auckland. It was important to select the participants from different regions of Auckland in order to investigate whether the mobile application is suitable for schools across geographical locations. It might have been useful to have participants from different cities in New Zealand, but this was not possible because of time and travel limitations. Hence, inductive reasoning was utilised in the data analysis. Inductive reasoning is a way of reasoning that moves "from specific observations to broader generalizations and theories" (Crossman, 2013). Participants were only asked to participate if they considered homework important for their children's development and were prepared to spend time with their children assisting them doing homework.

Invitations to parents were sent in sequence, so once the number of recruited participants reached nine no further invitations were sent. Since the study was part of a Master's thesis there was limited time for each phase of the study, with a time limit of six weeks for completion of the evaluation. Additionally, only three tablets were available and the application required testing for at least two weeks by each participant.

3.5.3 Data analysis

The data were analysed using a qualitative content analysis approach (as used before for the data analysis of the first set of interviews). The data gathered were interpreted and categorised based on their meaning and also referring to the framework used to develop the research instrument as explained previously.

As the interview questions were open ended, other categories emerged from the data and were added as appropriate. The final set of categories was analysed in order to establish their dimensions and interrelationships. In line with the design science approach the results informed the design and content of the mobile application. Chapter 6 will describe the evaluation and the data analysis of the evaluation phase in more detail.

3.5 Chapter summary

This chapter presents a description of the adopted research approach and justifies its selection. It revisits the research objectives and explains how the objectives relate to the adopted approach, and describes the process of data gathering and analysis. Figure 3. 2 illustrates the methodology as presented in the chapter. The next chapter outlines the findings from the first set of interviews and the first steps taken to design quality homework activities that could be used in the mobile application.

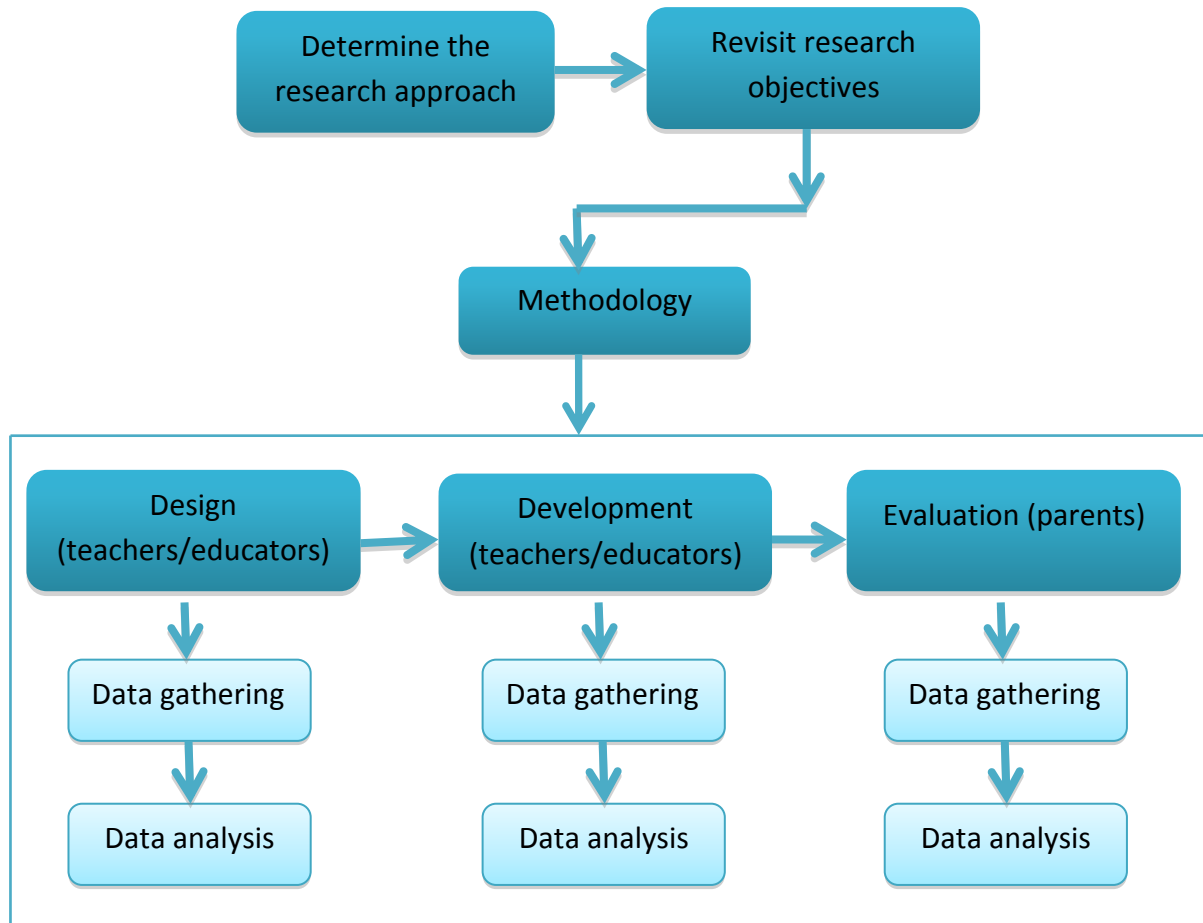


Figure 3. 2: Research methodology as outlined in chapter 3

Chapter 4: Informing the Application Design

This chapter presents the outcomes of interviews with the teachers who assisted in the design of the mobile application. First, the background of the interview participants is discussed. Second the design of the interview questions is presented. Finally, findings from the interviews are analysed.

4.1 Participants

The participants for the first set of interviews were selected from primary school teachers at schools across the decile range. Choosing schools from different decile ranges helped to ensure that the homework activities in the application would suit all primary school students across New Zealand. Figure 4. 1 illustrates the location of the schools from which the participants were selected. In addition identified expert primary school teachers were selected. For instance, as illustrated in Table 4. 1, teacher interviewee 1 was from Randwick Park School, a Decile 3 school. According to the school principal she was one of the best teachers in the school. She had eight years teaching experience: five years with Year 1 students and three years with Year 2 students. Teacher interviewee 2 was from Reremoana, a Decile 9 school. She had taught Year 1 and 2 students for 10 years. Teacher interviewee 3 was a very experienced retired teacher who had taught Year 1 to Year 7 students for 18 years. She now runs an after school program that helps kids with homework and provides them with additional educational activities. Teacher interviewee 4 was a skilled teacher from a Kumon Centre who had had experience teaching students of all ages using methods developed by Kumon whose techniques are apparently very successful. However, the interview with this teacher has been omitted as the information provided was not relevant to New Zealand curriculum and could not be used for the design of the mobile application. Therefore only data from the first three interviews were analysed and used for this study. As the information provided by the teacher interviewees were similar and all the teachers taught in accordance with New Zealand curriculum, the decision was made that no further interviews were required. Table 4. 1 summarises the schools at which the teacher interviewees have been employed and gives their decile numbers. As implies, teacher interviewee 3 (the retired teacher) has had experience teaching at three different schools. This is also the reason why six different school locations can be seen in Figure 4. 1 despite that there are only four teacher interviewees.

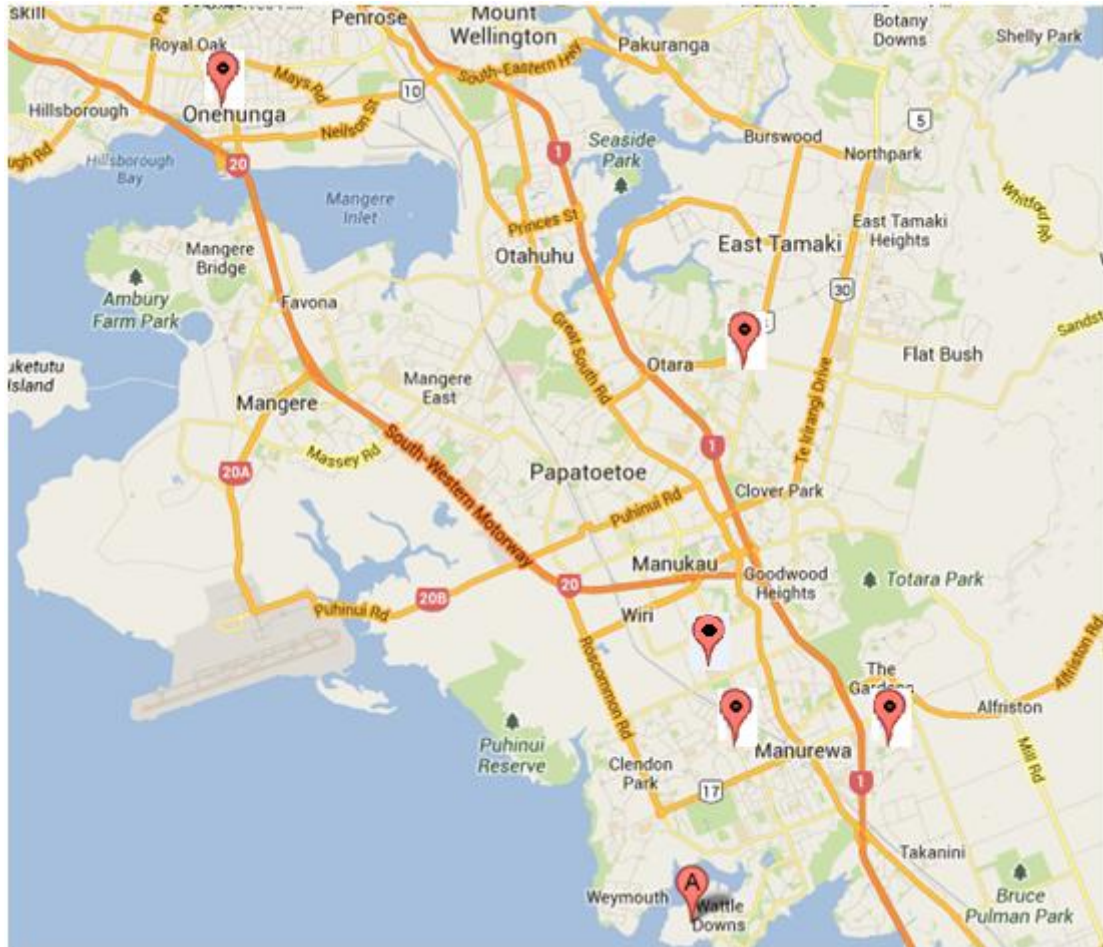


Figure 4. 1: Participants' school locations in Auckland, NZ (Source: Google maps)

Table 4. 1: Schools at which participants for the first round of interviews have taught

Teacher interviewee	School name	Decile
Teacher interviewee 1	Randwick Park School	3
Teacher interviewee 2	Reremoana School	9
Teacher interviewee 3	Manurewa Intermediate	1
	Onehunga Primary School	3
	East Tamaki School	1
Teacher interviewee 4	Kumon Centre	N/A (as this is not a school)

4.2 Interview questionnaire

As stated in chapter 3, qualitative interviews were considered suitable as the data gathering method. Semi-structured interviews were used as this allowed the inclusion of several key questions that helped determine the areas to be explored and provided guidance for both the interviewer and interviewee on what to talk about and allowed for the exploration of an idea or response in more detail.

The interview questions were designed to investigate the factors that help create good quality homework activities relevant to New Zealand primary school students. The primary objective was to find out what criteria are used in different schools in New Zealand for categorising children in different learning groups and to find the common points between the schools that could be used in the application. An additional objective was to identify principles that could be applied in order to design activities that suited and motivated each individual child in the classroom. Since this application was designed to serve all schools, finding the common points (in both categorising the children and also designing the activities) between the different schools was an important part of each interview. Therefore it was considered appropriate to use open-ended interview questions. “The more open the interview is, the more the interviewee can determine the contents and flow” (Boeije, 2010, p. 62).

The interview questionnaire is available in Appendix F. The interview questionnaire consisted of questions that were related to Year 1 and Year 2 students. There were eight main questions which focused on determining maths and English levels in each year and also the main sources that are used for designing activities. The participants were expected to help in identifying suitable mathematics and English exercises for children and share their experiences on how to design an exercise to be more effective.

The data collected from the in-depth interviews were analysed and categorised into factors that help design activities that cater for individual children. The next section describes the data analysis process.

4.3 Data analysis

According to Boeije (2010, p. 72-73) there are four aspects to data preparation before beginning the analysis: “organization of the storage of the data files”, “transcription of the audio and visual sources”, “taking out all information that can identify participants and violate the promise of confidentiality” and “manipulation of data that might be necessary for processing qualitative data analysis with the computer”. The data were prepared with regards to these four aspects. The original data contained some recorded audio clips and some notes. The next step involved transcribing the audio clips, since working with text is much easier. Every recorded interview was transcribed and saved in a file with the same name as the audio file name and stored in the folder under ‘transcribed Interviews’. Any information that could identify the participants

(such as their names) was removed and replaced with a code number. Since the data gathered from these interviews were manageable no specific software was used for analysis. Only “pencil-and-paper strategies” were used for segmenting and coding the data (Bazeley, 2013, p. 132).

The two main components of qualitative data analysis are segmentation and reassembling. Segmentation involves dividing the data into relevant and meaningful parts and is followed by reassembling which consists of structuring the data (Boeije, 2010). After the segmentation of the interviews, the related segments were put into the same category and given a name or summary label. This process is known as coding. Following segmentation the data required reassembling. “Reassembling refers to looking for patterns, searching for relationships between distinguished parts, and finding explanations for what is observed. The aim of reassembling is to make sense of the data from a theoretical perspective” (Boeije, 2010, p. 76). Upon examining the data segmentation, a close relationship can be seen between the interviewee responses. The responses from interviewees that were relevant to each question were studied and analysed. The following is a summary of the data analysis after reassembling the data.

Q1: Let us discuss the different levels of Mathematics you teach and the requirements for each.

Q2: Let us discuss the different levels of English you teach and the requirements for each.

All the interviewees had the same response to the first two interview questions. According to them all New Zealand public schools are required to follow the New Zealand curriculum, which was designed by the New Zealand Ministry of Education, hence all teachers must use the levels and stages that have been designed for both English and mathematics in New Zealand curriculum and they also should categorise and teach students based on these levels and stages. For instance, one of the interviewees answered that “we do an assessment to see what level the kids are at. The assessment is based on New Zealand curriculum.” Consequently as all public schools must follow New Zealand curriculum therefore all teachers use the same method for categorising the activities, this method can be applied in order to categorise the activities in the mobile application.

Q3: What sorts of activities do you use for handwriting practice for Year 1 and Year 2 students?

Most handwriting practice included tracing alphabet letters or numbers for Year 1 students, and tracing or writing words for Year 2 or high-level Year 1 students. For instance, one of the interviewees said: “I would recommend exercises that have following or tracing shapes on them so they have letters or shapes with either dot on them or point so that they know where to start. And as they improve they get to words

and sentences.” Therefore for higher levels writing sentences was used frequently as handwriting or writing practice.

Q4: What subjects are you teaching to Year 1 and Year 2 students other than Mathematics and English?

A variety of activities were indicated by the interviewees that students do at school such as science, art, sports and dance. Art (e.g. drawing) may suit this application quite well, for instance having a page that students can draw on and they could save their drawing as images.

Q5: What sorts of activities do children respond to?

According to the interviews children respond well to hands-on activities as one of the interviewees said, “If I tell them write from 1 to 20 on a piece of paper they are not as motivated as they are on the computer or on a laptop or on the white board—just on anything different than a pen and a paper.” Interviewees also mentioned that activities with competition produce better responses from the children.

Q6: What resources do you use to design the activities that you give to the children?

Teachers refer to New Zealand curriculum for activities: “We follow New Zealand curriculum, which you can find it on the New Zealand curriculum website.” They also referred to “nzmaths planning sheets” for their resources. The nzmaths planning sheets are basically what all New Zealand schools use for either classroom or homework mathematics activities, which can be found online. For the reading and writing they have suggested books, and one of the most common was a book series called *Ready to Read*, which is the main instructional reading series for New Zealand students in Years 1-3.

Q7: Are there any specific learning areas that require more practice than others?

All teacher interviewees mentioned mathematical fractions as an area that students have difficulty understanding and need more practice. Handwriting was noted as an area that children need much more practice at home: “Handwriting they struggle with the most.”

Q8: Would you have any suggestions for exercises that I could use in my application?

For the mobile application, the teachers recommended exercises that have tracing shapes for students who have problems with pencil grip (as one of the interviewees mentioned “they are quite stuck with handwriting at that age”) or alphabet letters for the beginner student, and also they recommended to have beginning points for these shapes and letters because “they don’t know where to start the letter from.” As they improve, they move to writing words and sentences, so they would no longer need the beginning point at that stage.

The interviewees recommended some books and websites as resources for the application design. Most of these resources are provided by the Ministry of Education.

Overall the findings from the first round of interviews indicated two main points:

1. All activities in New Zealand schools (public schools) are guided by New Zealand curriculum, which is a framework designed by the New Zealand Ministry of Education that gives schools direction for teaching and learning.
2. New Zealand schools (public schools) use standards for reading, writing and Mathematics that establish the level of literacy and mathematics knowledge that can be reasonably expected of students by the end of each period. Each individual child is assigned to these standards based on their own skill levels.

The next section will explain these two points in more detail.

4.4 Alignment of activities with New Zealand curriculum

In New Zealand public schools all activities assigned to students align with the New Zealand curriculum, which is a framework designed by the Ministry of Education that gives schools direction for teaching and learning. Therefore all teachers are required to teach and design activities based on this curriculum. The curriculum indicates what must be taught to students at school and specifies eight learning areas: mathematics, English, science, social sciences, arts, health and physical education, learning languages, and technology. Knowledge related to each of these areas is the foundation for future specialisation and it opens a gateway to further learning (New Zealand Curriculum, 2007).

Amongst these eight learning areas, mathematics and English are considered most important because they provide the base for learning in the other areas. According to the Ministry of Education, mathematics is one of the most essential areas of learning and every person should develop knowledge of mathematical concepts and skills in order for them to become a responsible member of society. Literacy in English is also very important because language is the key prerequisite to learning and English is the medium of learning in most learning areas as defined in the New Zealand curriculum. In addition, learning English provides students with the skills that they need to play a part in social, political, and economic life in New Zealand society and the broader world (Ministry of Education, 1992). Therefore, as stated by the teacher interviewees mathematics and English activities are widely used by teachers as the main focus of students' homework. An outline of New Zealand's mathematics and English curriculum are provided below.

4.4.1 New Zealand Mathematics Curriculum

The Ministry of Education has designed a mathematics curriculum that includes six main "strands" that each represents a specific objective of the curriculum. These strands include mathematical processes, numbers, measurements, geometry, algebra,

and statistics. The division is intended to simplify the classification of the outcomes of mathematics education in schools. It does not mean that teachers should teach the strands separately but it is intended to inspire teachers and students to adhere to these strands as much as possible (Ministry of Education, 1992). Each strand (except numbers) is divided into eight levels. The levels are designed to describe the development of mathematics from Year 1 to Year 13 by setting objectives that students need to achieve each year. At each level the objectives are quite broad; therefore the curriculum splits each level into two standards known as “National Standards”. Consequently Mathematics Level 1 aligns directly with Year 1 and Year 2 standards. Since the mobile application will be designed for Year 1 and Year 2 students, the focus here will be only on Level 1 of the mathematics curriculum. Table 4. 2 illustrates the Level 1 standards for Year 1 and Year 2 students based on the mathematics curriculum.

Table 4. 2: New Zealand Curriculum Level 1 aligned with National Standards

New Zealand Curriculum Level 1	National Standards	
In a range of meaningful contexts, students will be engaged in thinking mathematically and statistically. They will solve problems and model situations that require them to:	In contexts that require them to solve problems or model situations, students will be able to:	
	Year 1	Year 2
Number strategies use a range of counting, grouping, and equal-sharing strategies with whole numbers and fractions Number knowledge know the forward and backward counting sequences of whole numbers to 100 know groupings with five, within ten, and with ten	Apply counting-all strategies continue sequential patterns and number patterns based on ones.	Apply counting-on, counting-back, skip-counting, and simple grouping strategies to combine or partition whole numbers using equal sharing and symmetry to find fractions of sets, shapes, and quantities Create and continue sequential patterns by identifying the unit of repeat continue number patterns based on ones, twos, fives, and tens.
Equations and expressions communicate and explain counting, grouping, and equal-sharing strategies, using words, numbers, and pictures Patterns and relationships generalise that the next counting number gives the result of adding one object to a set and that counting the number of objects in a set tells how many create and continue sequential patterns.		

Source: (Ministry of Education, 2010)

4.4.2 New Zealand English Curriculum

The Ministry of Education has also designed a curriculum for teaching English and defined three standards that include oral language (listening and speaking); written language (reading and writing); and visual language (viewing and presenting). Each standard focuses on a specific area of the English language and is designed with the aim of developing that specific area (Ministry of Education, 1994, p. 19).

The oral language standard is designed to develop effective listening and speaking skills. It is essential for students to improve their listening abilities in order to acquire adequate literacy skills, and similarly it is critical for them to improve their speaking abilities in order to be able to communicate effectively and increase their fluency of speech. The written language standard is designed to develop students' academic reading and writing skills. Being able to read will help students to communicate through writing and also it develops a sense for the structure of the English language so students can speak properly and with correct grammar; reading skills improve vocabulary and thus their writing ability. Writing also develops phonic knowledge and improves reading fluency (Kurniasih, 2011). The visual language standard refers to viewing and interpreting what students have seen; for instance young children will recognise MacDonald's by seeing the big "M" logo. According to the Ministry of Education (1996) "Young students' skills at interpreting visual language play an important part in their learning about their world in general. English and language programmes in school need to build on their prior experiences and learning in order to develop their visual language skills" (para. 2).

Although these three standards are taught and practiced in the classroom, some activities are given to students as homework for further practice at home. For instance, every day a book from the *Ready to Read* book series will be given to primary school students in Year one and Year two to take home and read for reading practice. Also some spelling and writing activities will be given to them as homework. All classroom and homework activities are designed based on the English curriculum. The English curriculum has set objectives for the different levels of the three standards. Table 4. 3 illustrates achievement objectives of the written language for Year 1 and Year 2 primary school students.

Table 4. 3: Ministry of Education Written Language Achievement Objectives

Reading Functions		
	Personal Reading <i>Students should:</i>	Close Reading <i>Students should:</i>
Level 1	select and read for enjoyment and information a range of written texts, beginning to use semantic, syntactic, visual, and grapho-phonic cues to gain meaning	respond to language and meanings in texts
Level 2	select and read for enjoyment and information a range of written texts, making confident use of semantic, syntactic, visual, and grapho-phonic cues and the conventions of print, and predicting and self-correcting while clarifying ideas	respond to language, meanings, and ideas in different texts, relating them to personal experiences
Level 3	listen to and interact with others to clarify	listen to texts and recall and respond to the main ideas in an organised way, relating them to personal and wider experience

Source: (Ministry of Education, 1994)

While the standards designed for mathematics and English address the overall purpose they do not differentiate both the skills and knowledge needs that each student may have. In addition to the curriculum objectives, levels and stages that may suit individual students are also provided in the curriculum. The next section will explain these levels and stages and how they help differentiate between individual students.

4.5 Instructional differentiation in New Zealand public schools

As stated earlier the New Zealand curriculum framework emphasises catering for individual needs and believes that “all students should be enabled to achieve personal standards of excellence and that all students have a right to the opportunity to achieve to the maximum of their potential” (Ministry of Education, 1992, p. 12).

4.5.1 Catering for individual learning needs

Empowering each student to achieve their individual potential is a principle of the New Zealand curriculum framework. According to this curriculum all students with special abilities should be given the opportunity to experience a range of activities higher than their age level and equal to their capabilities and interests, and students with lower abilities also should be given a chance to experience activities suitable for their capabilities and interests. These new experiences will improve their abilities and knowledge and opens a door for new ideas, whereas repeating the works that they have previously mastered will not add to their knowledge (Ministry of Education, 1992).

This curriculum also points out that each student has a different rate of development, thus it is not likely that all students of the same age will reach the same level at the same time, also it is not expected that an individual student will reach the same level in all strands at the same time. Hence it is the teacher’s responsibility to carefully evaluate the student’s capability and experience before moving them to the next level. Consequently, the extent to which teachers are able to facilitate this process significantly affects how well students learn. Therefore the Ministry of Education has provided some assessment rules under the New Zealand curriculum to improve students’ learning and at the same time teacher’s teaching (Ministry of Education, 1992). The next section describes these assessment rules for student differentiation in English and mathematics.

4.5.2 Assessment rules for student differentiation

In New Zealand schools, teachers assess students by making a general judgment with regards to the New Zealand national standards. They draw conclusions based on the close observation and interaction of individual students in regards to their progress and achievement over a period of time. Teachers do not rely on a single assessment; which means that teachers should use different ways to collect enough evidence for their judgments, for instance, interviews and results from assessment tools (Ministry of Education, 2010). The Ministry of Education also confirms that a single assessment is insufficient and encourages teachers to use different types of assessment: “different

types of assessment provide different information; assessments should be chosen for their suitability for purpose and viewed together to arrive at an overall teacher judgment. Assessments need to be meaningful for students. For this reason, teachers need to choose a range of assessments that give their students the best opportunity to demonstrate achievement” (Ministry of Education, 2009b, p. 12).

There are assessment tools developed by experts, including teachers and subject specialists, which are available in the New Zealand curriculum for both English and mathematics. All New Zealand teachers are required to evaluate their students in all learning areas using these assessment tools and assign them to an exact level that suits their individual ability and knowledge based on New Zealand curriculum. As mentioned in the previous section New Zealand curriculum divides English and mathematics into different levels and stages and predefines objectives for each. Each individual student can be assigned to one of the levels in English and one of the stages in mathematics only if they are able to achieve the objectives of that specific level or stage. These predefined objectives are known as “standards”. The next section outlines the Mathematics and English standards.

4.5.3 Mathematics standards

The New Zealand mathematics standards provide examples of what mathematic problems student should be able to solve and also descriptions of how students should solve the problems in each stage. According to the Ministry of Education, since each student may have a different response to the same mathematics problem, it is critical for students to follow the expected way described in the mathematics standards when solving a specific problem. The standards have been derived from a combination of the recent research and also the judgment of experienced teachers as to what students can do at various ages (Ministry of Education, 2009a). The following are the standards defined for the first four stages (aligned with Year 1 and Year 2) of the Number Framework in New Zealand Mathematics curriculum.

Stage Zero: Emergent

At this stage students lack knowledge of counting and they are not able to count a given number of objects consistently. Therefore teachers are working on their counting knowledge and start with number counting from 1 to 5 by giving them different objects to count.

Stage One: One-to-One Counting

Students who are at this stage are able to count and form a set of objects up to 10 although they cannot solve simple addition problems like $3+3$. Hence teachers are working to improve their basic facts knowledge.

Stage Two: Counting from One on Materials

At this stage students still depend on physical material for solving an addition or separating problem. For instance in addition problems they count all the objects in both sets to find the answer, as in “Four beans and two more beans. How many beans are all together?”, so they will be given four beans first and then two more beans to count to find the answer.

Stage Three: Counting from One by Imaging

Students who are at this stage will be able to count all of the objects in their mind for solving simple addition and separation problems by imaging the visual patterns of the objects in their mind so they no longer rely on physical material to solve simple addition and separation problems.

Stage Four: Advanced Counting (Counting On)

Students at this stage realise that the last number in a counting sequence measures the whole set and can relate the addition or subtraction of objects to the forward and backward number sequences by ones, tens, etc. In this stage they will be given addition problems as “ $23 + 4$ ”. To solve this problem they hold the large number, 23, in their minds and start counting four numbers after 23, as “24, 25, 26, 27” so they get the answer 27.

There are eight stages defined in the curriculum for mathematics but for this mobile application the focus will be only on the first four stages as it will be designed for Year 1 and Year 2 students, and also since the evaluation phase of the research took place at the beginning of the new school year, at this point students usually do not reach higher than the fourth stage. The following section includes a description of the English standards.

4.5.4 English standards

The English curriculum attempts to develop students’ critical thinking skills by providing the chance for them to explore and engage with language. As mentioned before, the English curriculum contains three standards: oral language, written language, and visual language. The mobile application will be designed to mainly focus on the written language, as this is the part that needs more practice and repetition and is the main focus of the activities that teachers assign for students’ homework, particularly for Year 1 and 2 students. The written language includes reading and writing. The following sections will outline the levels for reading and writing in the New Zealand English curriculum and their standards.

Reading

During the early school age teachers focus on developing reading and writing skills and many activities in these years concentrate on literacy. In the first three years at New Zealand schools, the reading standards, which are referred to as the “colour wheel”, is used to classify different reading levels. The colour wheel levels are mainly used in a series of books called *Ready to Read*, which is the main instructional reading series for New Zealand students in Years 1-3 (Ministry of Education, n.d). At the back of each book a colour wheel is printed and is divided into nine sections with each colour indicating a reading level. The colour wheel starts with Magenta and moves clockwise through the early reading levels: Red, Yellow, Blue, Green, Orange, Turquoise, Purple and Golden. Figure 4. 2 shows the colour wheel.



Figure 4. 2: Colour wheel used in *Ready to Read* book series designating skill levels.

In the *Ready to Read* book series texts are designed to be short and quite easy and sentences have a very simple structure for Year 1, and they gradually become more difficult for Year 2 and Year 3 students. The level of challenges increase in such aspects as sentence structure, vocabulary, and text length.

In order to assign a student to one of these levels teachers mainly focus on the level of student comprehension in preference to how well a student can read through the sentences in the book. Students should be able to understand a written passage of text and interact with the texts of a specific level in a meaningful way in order for the teacher to be able to assign them to that specific level. According to the Ministry of Education, developing students’ reading comprehension skills is essential for a rich academic, professional, and personal life. Therefore these levels are designed in some ways to help student build their critical thinking and comprehension skills as they progress through the levels. Since the texts in these book series gradually become longer and more complex, accordingly students need to deal with longer and more complex texts that holding a bigger amount of information to process (Ministry of Education, 2009b).

In New Zealand schools, each student is assessed and assigned to one of the colour wheel levels, and students are required to read books which correspond to their assigned colour. For instance, students at the red level should pick a book that has been marked as red to read and practice. In addition, students take a book at their level home every day to read. When a student is able to read fluently and more importantly understand what they are reading and is able to retell the story, the teacher can decide to move the student one level up.

Spelling

According to the teacher interviewees in conjunction with the colour wheel levels in the *Ready to Read* book series there are spelling word lists associated with each level; these words are known as “Basic Vocabulary” or “High-frequency words”. These words are used most often in the colour wheel book series. The first Basic Vocabulary list in the Red Level of the colour wheel books contains 27 words and is shown in Table 4. 4.

Table 4. 4: Basic Vocabulary list in Red colour wheel level

a	is	I	am	come	and	we	up	this
father	mother	for	said	go	see	in	it	you
my	went	at	the	here	to	me	look	little

The second Basic Vocabulary list in the Yellow Level contains 25 words as shown in Table 4. 5. There are also Basic Vocabulary word lists for Blue, Green, Orange and Turquoise levels.

Table 4. 5: Basic Vocabulary list in Yellow colour wheel level

are	all	after	be	come
do	down	was	they	get
got	he	her	if	where
saw	then	of	if	like
she	can	are	away	us

Depending on which level a student on, a Basic Vocabulary list will be given by the teacher as part of their homework every week. Students are required to practice the spelling of these words at home by writing them down. Being able to spell these words will help students to recognise the words when encountering them in the reading books and also help them to learn new vocabularies. Consequently they will improve their writing by using new vocabularies.

4.6 Summary

This chapter presented an analysis of the data gathered from the first set of interviews which aimed to determine how to design quality activities for students’ homework for the software application. The results of the findings highlighted two main points. Firstly, all activities in New Zealand public schools are guided by the New Zealand

curriculum. Therefore, all the activities should be designed following the curriculum guide lines by the teachers. The second point is that the Ministry of Education emphasises catering for individual needs, and it has provided assessment guidelines for teachers to identify students' levels of knowledge and capabilities. This should lead teachers to assign activities to suit each individual student. Considering the importance of these two points for students' learning and development, the mobile application is designed to follow similar paths as the New Zealand curriculum by using its assessment rules to assign students to their exact level and stage, and uses the mathematics and English standards for designing its activities. The next chapter will describe how the activities for the mobile application have been designed to follow the New Zealand curriculum.

Chapter 5: Design

This chapter presents the details of the design and development of the mobile application, which is a major component of this research and intends to demonstrate the feasibility of using the mobile application as a replacement for paper homework.

5.1 Design of the activities

As stated in chapter 1, the objective of this research is to find a way to facilitate the work of New Zealand parents of Year 1 and 2 students who are interested in their children's academic success and willing to help them with their homework but do not have the time. For this purpose a mobile application was designed to replace paper homework. The mobile application was designed to consider the following requirements:

- First, as the application is to replace the paper homework it should contain the exact material that teachers in New Zealand schools give to students each week for homework.
- Second, it should cater for each individual student's learning needs.
- Finally, the activities must be designed so that the students can use a pen most of the time in order to give them the opportunity to practice handwriting.

In order to achieve the first requirement (replacing the paper homework), the activities of the application have been designed following the Exemplars, which "are samples of authentic student work, often annotated, to illustrate levels of achievement." (Ministry of Education, n.d) According to interviews with teachers, these Exemplars can be found on the Ministry of Education website, and they are some of the main resources used by New Zealand teachers to design activities for students' homework. The design of the activities was also inspired by the sample activities provided by teachers during the first set of interviews.

The second requirement which is catering for each individual student's learning needs can be achieved by making use of the New Zealand curriculum assessment rules (explained in chapter 4) in the mobile application. However, using these assessment rules in the application is not feasible as they contain different assessment tools and also requires a close observation of each individual child over a period of time.

As mentioned in chapter 4, New Zealand teachers conduct a precise assessment on each student using New Zealand curriculum assessment rules and tools and assign them to a specific level in English or a specific stage in mathematics (explained in chapter 4). Therefore, for this application, the same system of levels and stages has been applied for categorising the activities rather than using age group or difficulty levels (easy, medium or hard). This system of levels and stages used in this application, which is exactly the same as the levelling system used in schools, enables each student to choose their own stage or level that has been assigned to them by their teacher at

school. In addition, within the stages and levels the activities will match what the student is already working on at their level or stage.

Finally, the activities were designed so that a stylus is required to be used at all times. This will provide students with the opportunity to practice handwriting.

The results from the data analysis of the first set of interviews (discussed in chapter 4) were helpful for designing the mobile application so it could cater for each individual student's learning needs and at the same time making it work for all public schools across New Zealand. Additionally, the results of findings helped to design the homework activities for the mobile application. All activities were designed first on paper to be followed later in the actual design in the software. The next two sections will outline the platform and programming language used for coding the mobile application.

5.1.1 Platform

As stated in the first two chapters, the use of handwriting is critical to children's learning development; thus one of the application requirements is to utilise a pen in its activities. In order to satisfy this requirement, a touch screen tablet with a stylus was chosen as it allows for the simulation of a pen and paper environment. Android tablets provided by Auckland University of Technology were used for the study. The tablet provided was a Samsung Galaxy 10.1, however, the application is designed to work with any touch screen tablets powered by Android. It would be possible to change the application to work with other tablets, such as MS Windows-based ones, but this is not the focus of the study.

5.1.2 Programming language and coding

Java was used as the programming language as all Android applications are developed in Java.

Once all homework activities were designed and the suitable platform and the programming language were selected, the mobile application needed to be coded and built to run on the tablet.

In order to start writing the code a computer was required to install Java, an integrated development environment (IDE), and also the Android software development kit (SDK). This software is open source and can be downloaded for free. The Java development kit (JDK) accompanied by the Java Runtime Environment (JRE) was required. JDKs are generally available for a variety of platforms, and for the platform chosen here the latest update of JDK SE 7 was downloaded from the Oracle website:

<http://www.oracle.com/technetwork/java/javase/downloads>. After installing Java, Eclipse was chosen as the IDE, which is the most recommended IDE for developing Android applications. Eclipse can be downloaded from the Eclipse website:

<http://www.eclipse.org/downloads>. Finally, the Android SDK was downloaded, which has two parts: the starter package that can be downloaded from the web and the SDK component, which could be installed later.

After the coding environment was set up, the application layout and Graphical User Interface (GUI) needed to be designed and coded. The next section will describe the design of the application layout and GUI.

5.1.3 Graphical User Interface

For designing the mobile application some understanding about the design of an educational mobile application for children in terms of layout and GUI was required. The relevant literature was identified and explored; the findings of the investigation are explained below.

One of the most important aspects in mobile applications is designing a winning GUI. According to Helander, Landauer, and Prabhu (1997), in order to design winning GUIs, they should “accurately and efficiently be related to the task, workflow, objective, education, personality and culture of the user” (p. 424). Additionally, in designing a winning GUI, children’s comprehension of a novel interface should also be considered, which is directly related to four factors: age, technology experience, complexity of the GUI and familiarity of player with the GUI (Gilutz & Black, 2010). Gilutz and Black (2010), in their study on children aged between 3-12 discovered that the older the child is, the better their comprehension of the layout and GUIs of applications. In addition, children who had previous experience with technology were more comfortable with interfaces. Moreover, if the interface was less complex or if the children were familiar with the shapes or images used in the GUIs it was easier for them to work with the application. Therefore, considering these four factors will have a positive impact on the effectiveness of GUIs designed to be used by young children (Gilutz & Black, 2010).

By considering what has been found in the literature, the mobile application’s layout and GUI thus should be designed to be suitable for young children ages five and six and also in a way that children who have no experience with technology can understand and use the application easily. In addition, to make the GUI simpler, each page will be designed with only a few buttons. Since five and six-year-olds will not be able to read very well, each button will have text accompanied with an image indicating the function of the buttons. Moreover, there will be a voice guiding the child on what to do next and which button to click. Furthermore, to avoid confusion the application should present the activities the same way as the paper homework since children are familiar with these activities. Additionally, the GUI will be colourful and will include some cartoon images that are appealing for children. The next section will describe the design of the activities and the design of the application in more detail.

5.2 Application design

The application is designed to feature Year 1 and Year 2 activities and covers two learning areas that are the most important amongst the eight learning areas as stated by the Ministry of Education (2007) and also mentioned in interviews as the main focus of assigned homework: mathematics and English. The activities for Year 1 and Year 2

are placed in two separate applications respectively named Home Fun 1 and Home Fun 2.

5.2.1 Home Fun 1 application

On running the Home Fun 1 application, as it can be seen in Figure 5. 1, the GUI is very simple. It consists of a yellow page with two red buttons labelled: English and Maths. This will enable students to choose either English or Mathematics to complete their homework. Obviously the Maths option contains activities related to mathematics and the English option contains English activities. The following sections will describe the activities designed for each area in more detail.



Figure 5. 1 : Running the application this is the first window that will appear to choose to do Math or English activities

5.2.1.1 Maths

Upon clicking on the Maths button, three different buttons will appear representing three different stages of maths; Stage 0, Stage 1, and Stage 2. These stages are designed to be in line with the New Zealand Mathematic curriculum stages, and they attempt to achieve the curriculum objectives described for each stage. These stages (which were described in more detail in chapter 4) are used in all New Zealand schools to differentiate between each individual child's learning needs, and teachers can work within student's ZPD (Zone of Proximal Development) by assigning them to the appropriate stage. As mentioned in chapter 4, teachers identify the stage suitable for a student by close observation of the student in the classroom and also by applying the New Zealand assessment rules. Therefore, the mobile application uses the same method to categorise the activities in a way that students can choose the mathematics stage that has been assigned by their teacher and start working on the activities designed for that stage. For instance, if a student is at stage 1 at school, they should choose the Stage 1 button in order to do the activities related to them on the Home Fun 1 application. Using this approach links the application to the school material. In addition, since the Home Fun 1 and Home Fun 2 applications must contain the exact activities that teachers give to student there will be a possibility of accepting the application by teachers as well as parents to replace the paper homework. As can be

seen in Figure 5. 2, this page is designed to have a very simple layout and there is also a voice to guide the student through the activities, so that confusion will be avoided.

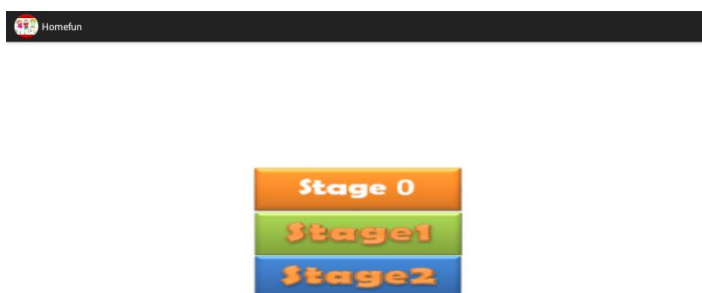


Figure 5. 2 :On clicking Maths in the Home Fun 1 application, three stages will appear for students to choose from.

The section that follows will explain the different activities that have been designed for the different stages of Maths. Figure 5. 3 illustrates the configuration of the application for Maths in detail.

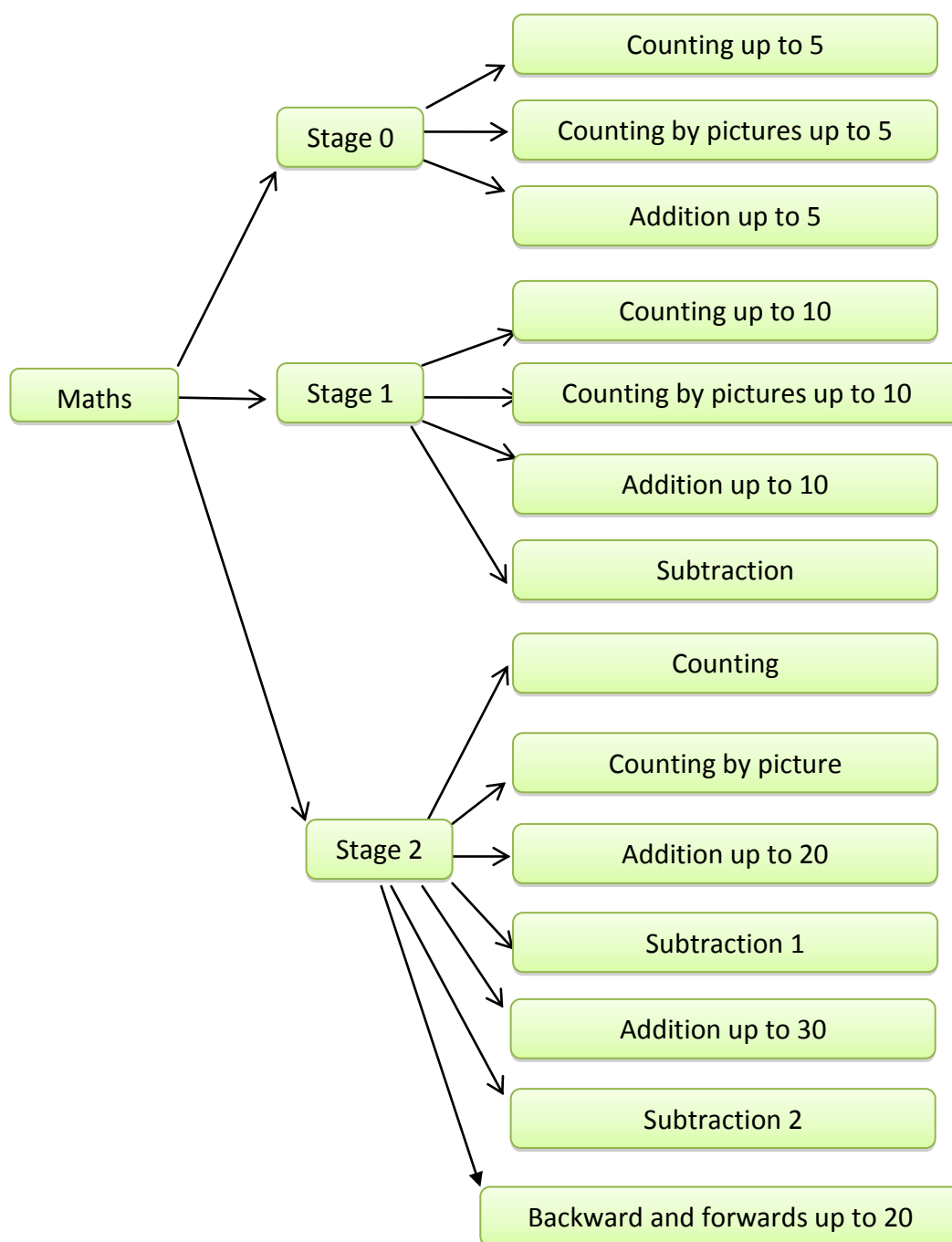


Figure 5. 3 : Maths configuration for “Home Fun 1” application

Stage 0

As stated in Chapter 4, students at Stage 0 lack counting understanding and teachers try to build this by giving them different objects to count starting from 1 to 5. As illustrated in Figure 5. 4, Stage 0 contains three different activities that are suitable for

students who are assigned to stage 0 at school: counting (up to 5), counting by pictures (up to 5), and addition (up to 5).



Figure 5. 4 : Stage 0 of the Maths

Counting (up to 5)

The Stage 0 “Counting” activity helps the student to learn the number sequence up to 5 and also become familiar with the shape of each number by handwriting practice. When starting this activity, a set of numbers from 1 to 5 will appear, and a guide voice that says “count with me” will be heard; then the voice will start counting from 1 to 5 and the student should count along, and then the student will be asked to trace the numbers that they see on a red background (Figure 5. 5). As stated by teacher interviewees since most of the students at this stage cannot recognise the numbers, and are unable to distinguish between numbers 2 or 5 or writing them back to front especially 2’s 3’s and 5’s (For instance writing the number 3 to look similar to the letter E), this exercise will assist students by filling the stated learning gaps. In the next step of the activity, all the numbers will appear again except number 5 and the voice will start counting up to 4 and ask the student to write down the missing number and check the answer by clicking the “Check” button. Again the student is guided to count up to 5 and trace the numbers. In the third step, two numbers will be missing; at the fourth step three numbers, and so on, until all the numbers are missing and the student is asked to count and write down the five numbers on their own. These steps should encourage the students to remember the number sequence and also the shape of the numbers. Figure 5. 5 illustrate a sample of the counting activity done by a student.

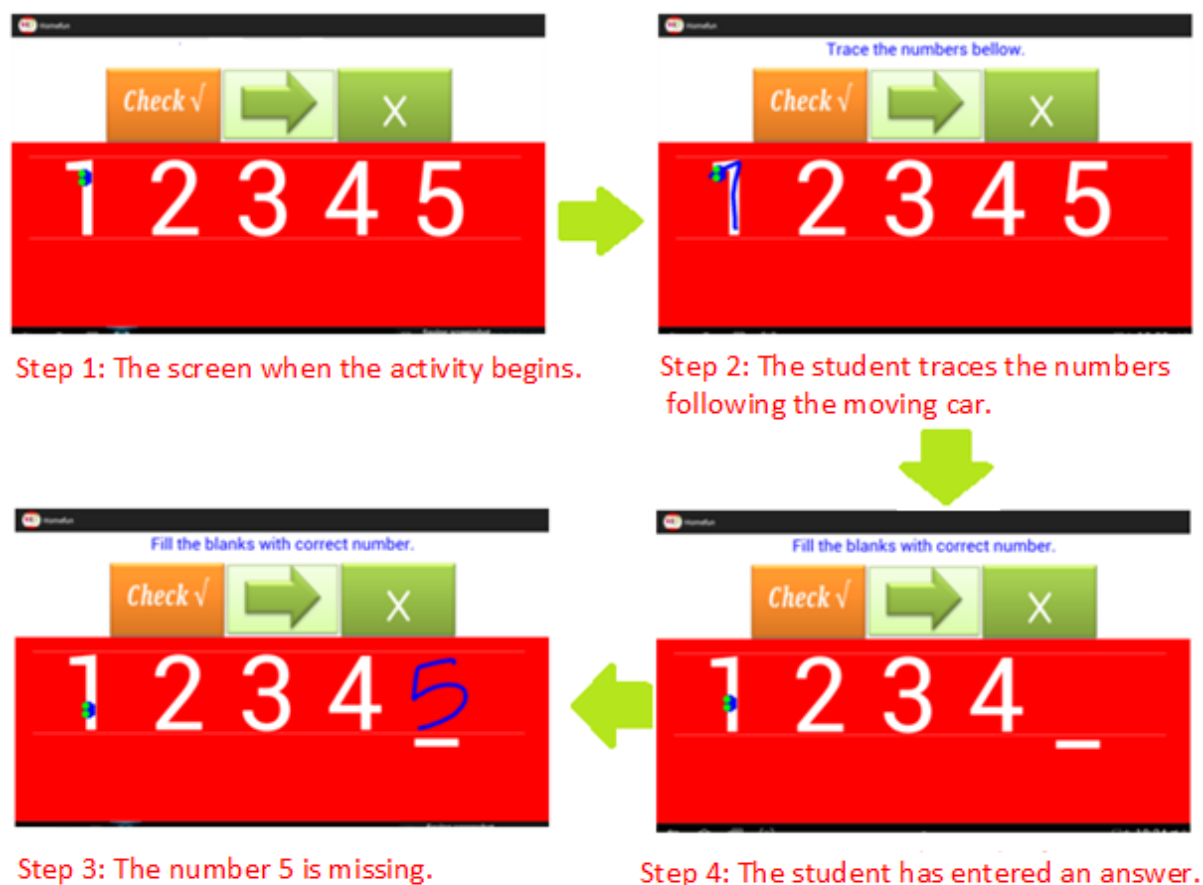


Figure 5. 5 : Counting (up to 5) activities for Stage 0

Counting by picture (up to 5)

This activity is designed to help students practice counting up to five objects while the previous activity helped the student to become familiar with the numbers. This activity will assist students in understanding how these numbers are applied in the real world by counting objects. When starting this activity, a random number of objects (not more than five) will appear and the guiding voice will ask the student to count the objects and type in the relevant number and check the answer by clicking the “Check” button. If the answer is correct, a cheering voice can be heard saying “Nice work! Now trace the number in the red area.” However, if the answer were incorrect, the student would be asked to try again. This activity enables the student to build on their “counting object” knowledge, while at the same time they learn the numbers and their shapes. Also, practicing this activity enables students to master this stage and progress to the next stage, which is counting up to ten. Figure 5. 6 illustrates a part of this activity.



Figure 5. 6 : Counting by picture activities for Stage 0

Addition (up to 5)

This activity is designed to help students practice adding two sets of objects. The objects should not add up to more than five at this stage. At the beginning of this activity, two random numbers that add up to five will appear and accordingly, images will appear that illustrate the numbers. The student can use these images to solve the addition problem by counting them all. For instance “ $1+3=$ ” will be shown as well as “image of one sea creature + images of three sea creatures =” (Figure 5. 7), so the student can count all the sea creatures in order to solve the addition problem. This is a similar approach in solving addition problems for this stage as defined in the New Zealand Mathematics curriculum. Students are also given the opportunity to use the stylus to mark the objects as they count. This will help them keep track of their counting. Then they should enter their answer by clicking on the number on the small keyboard (shown in Figure 5. 7) designed for the activity. If the answer is correct, a cheering voice can be heard saying “Well done! Now trace the number”, and the number that has been entered as the answer will appear for the student to trace. The student will then gain points, as mentioned by the teacher interviewee this encourages the students and creates interest in working on more activities. If the answer were incorrect, the student would be asked to try again.



Figure 5. 7 : Addition (up to five) activity in the Stage 0 Maths section of the Home Fun 1 application.

Stage 1

As mentioned in chapter 4, according to the New Zealand Mathematics curriculum, students at Stage 1 should be able to count a set of objects up to ten even though students might not be able to solve simple addition problems like $3+3$ yet in their heads. As it is shown in Figure 5. 3, “Stage 1” of the Home Fun 1 application contains four different activities that are suitable for students who are at Stage 1 at school: counting (up to 10), counting by pictures (up to 10), addition (up to 10), and subtraction.

Counting (up to 10)

This activity is similar to the “counting (up to 5)” activity, however the numbers go up to 10. Therefore, when starting this activity, a set of numbers from one to 10 will appear, and a guide voice that says “Count with me” will be heard, the voice will start counting from 1 to 10, and the student should count along. Afterwards the student will be asked to trace the numbers. Students at this stage have mastered counting up to 5 and they are able to recognise the numbers up to 5 and write them correctly. Although at this stage the focus will be on numbers from 6 to 10, and students need to know that this set of number comes after 5 and that this is a continuance, not a set of new numbers that start with 6. For that reason, in this activity the 1 to 5 set will be available again for the students to practice. This activity will help the student to practice counting up to 10 and also to recognise the shape of the numbers and learn how to write them. The next step of the activity is similar to the Stage 0 “counting” activity. There will be missing numbers for the student to fill in. This activity helps the students to build on their object counting knowledge and simultaneously learn the numbers and their shapes. Figure 5. 8 illustrates images of a sample of counting activity done by a student.



Figure 5. 8 : A student working on counting up to 10 activities.

Counting by picture (up to 10)

According to the New Zealand Mathematics curriculum, students at Stage 1 still rely on images to help them count; therefore this activity is designed to help students practice counting up to 10 using objects. This activity is quite similar to the Stage 0 “counting by picture” activity. However, in this activity there are up to 10 objects to count each

time. When starting this activity, a random number of objects (not more than 10) will appear and the guiding voice will ask the student to count the objects. Students can use the stylus to mark the objects as they count to help them keep track of their counting. Then the student should type in the relevant number and check the answer by clicking the “Check” button. If the answer is correct, a cheering voice can be heard saying “Nice work! Now trace the number in the red area” and the student should trace the number in the red area. Additionally, after each right answer the student gains some points. However, if the answer were incorrect, the student would be asked to try again. This activity helps the student to build on their counting knowledge using objects while at the same time learning the numbers and their shapes. Moreover, practicing this activity should help them master counting up to 10 and prepare to move to Stage 2. Figure 5. 9 illustrates a sample of this activity that has been done by a student.

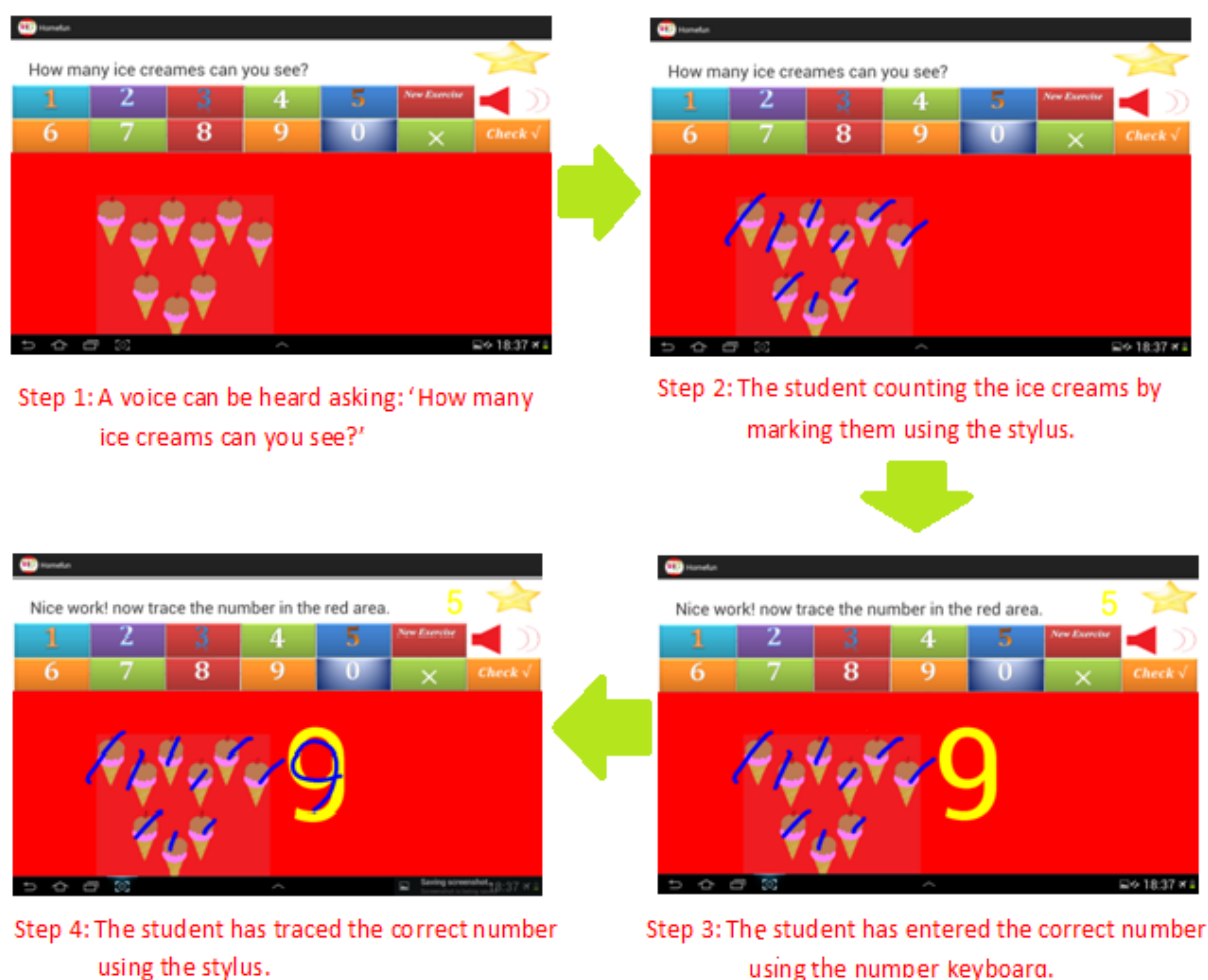


Figure 5. 9 : A sample work of a Stage 1 student on the “counting by pictures” activity

Addition (up to 10)

This activity has the same approach as the Stage 0 “Addition” activity and similarly helps the students to practice adding up two sets of objects. However, this time the objects should not add up to more than 10. At the beginning of this activity, two random numbers that add up to 10 will appear and accordingly, some images will appear that illustrate the numbers. The student can use these images to solve the addition problem by counting them. For instance “ $4+3=$ ” will be shown as well as “images of four sea creatures + images of three sea creatures =”, so the student can count all the sea creatures in order to solve the addition problem. Students are also given the opportunity to use the stylus to mark the objects as they count. This will help them keep track of their counting. Then they should enter their answer by clicking on the number on the small keyboard designed for this activity. If the answer is correct, a cheering voice can be heard saying “Well done! Now trace the number”, and the number that has been entered as the answer will appear for the student to trace. Additionally, the student will then gain some points. If the answer were incorrect, the student would be asked to try again. This activity will help students to master the basic maths facts at this stage and move to the next stage. Figure 5. 10 demonstrates the steps of solving an addition problem in this activity that have been done by a Stage 1 student.

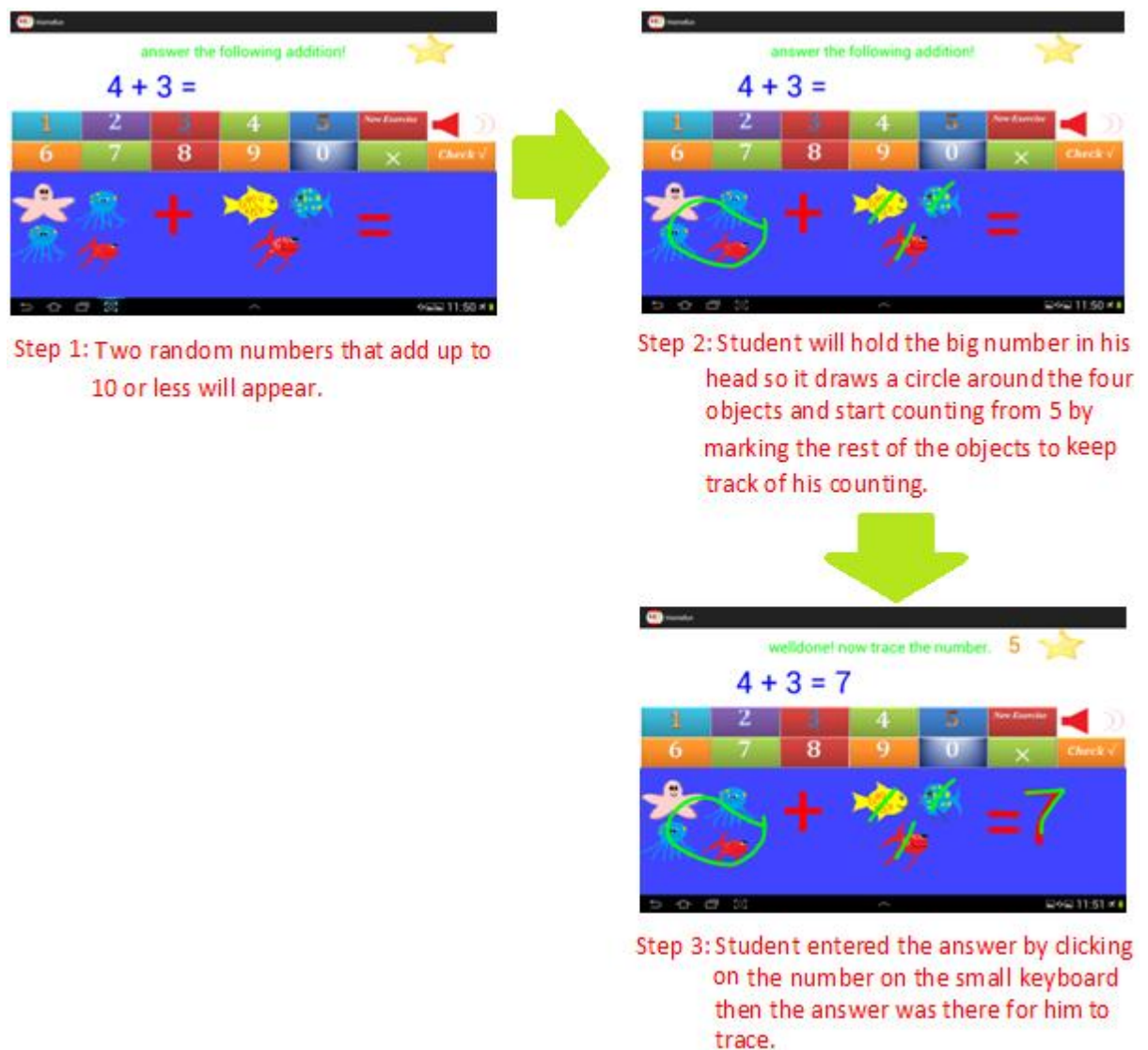


Figure 5. 10 : sample work of a Stage 1 student on “addition” activities

Subtraction (up to 10)

This activity is designed to help students to practice subtraction using a set of objects. There should not be more than 10 objects in the set for this stage. When starting the activity, two random numbers will be generated between 1 and 10, and accordingly images of sea creatures will appear that illustrate a set of objects representing the biggest number in the subtraction equation. The students can use the images to solve the subtraction problem by crossing out the number of images that should be subtracted. For instance “9-3 =” will be shown as well as images of nine sea creatures. The students cross three of the images out and count the images remaining in order to get the answer. This is the approach that New Zealand teachers use to teach students to solve subtraction problem as per the New Zealand Mathematics curriculum. This activity should help students build on their basic maths fact knowledge. When they have mastered this stage they can move to the next one. Figure 5. 11 illustrates different steps in which a student has completed this activity.



Step 1: Two random numbers have been generated. The numbers are less than 10.



Step 2: The student has crossed out three of the sea creatures.



Step 3: The student has counted the remaining objects using the stylus.



Step 4: The student has entered the correct answer using the number pad. A cheering voice can be heard and five stars have been added to his score.



Step 5: The student has traced the number using the stylus.

Figure 5. 11 : Subtraction (up to 10)

According to the New Zealand Mathematics curriculum students at Stage 2 still rely on the use of counting objects to solve basic mathematics facts problems. However, they can recognise numbers up to 20, and consequently they increase up to 30 in this stage. At this stage, teachers focus more on basic mathematics facts and backwards counting as students should have mastered counting up to 10 at this point. After 10, the numbers become a combination of numbers up to 10, so the students move on quickly from counting. Therefore teachers use the basic facts for teaching larger numbers and counting.

Addition (up to 20)

The structure of this activity is quite similar to the Stage 1 “Addition” activity; however the numbers will add up to 20 or less. Students must master this activity to be able to move to “Addition (up to 30)” in the same stage. Figure 5. 12 illustrates one activity in this stage that has been completed by a student.

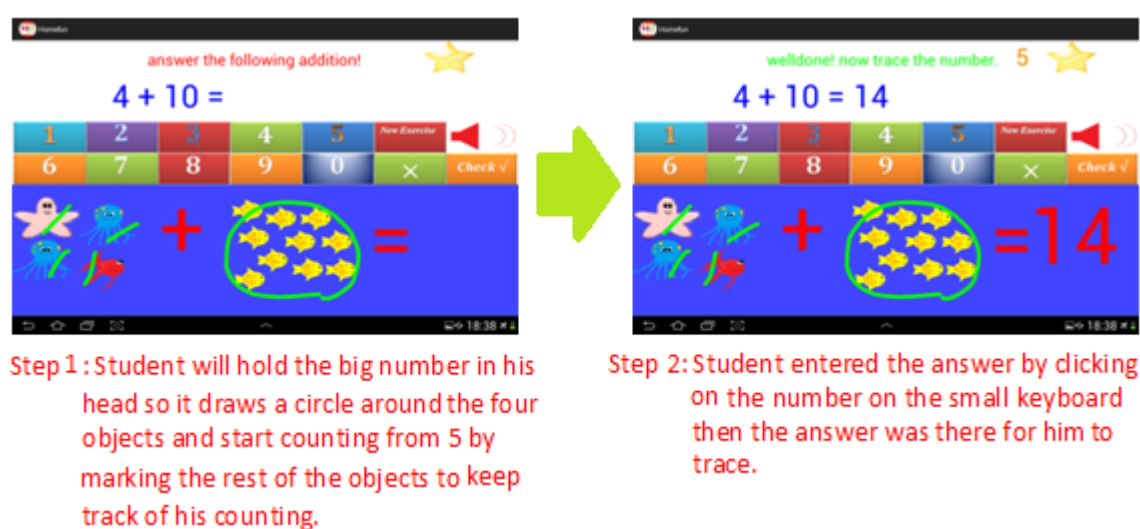


Figure 5. 12 : Addition up to 20 activities

Backwards and forwards (up to 20)

Wherever students are able to count forwards to, they should learn to count backwards from. Counting backwards helps students prepare for solving subtraction problems without using objects. Mastering backwards counting can also be very helpful for teachers when teaching subtraction to students, because now students will understand that “20-3” (twenty minus three) means counting three numbers backwards from 20, and the answer will be the last number in the backwards counting—17. Counting backwards is very hard for most students at this stage; thus they need a lot of practice.

At Stage 2 students should learn how to count backwards from 20. In this activity students will practice counting backwards from a number between 1-20. When

starting this activity, a number between 1-20 will appear along with two blank spaces, which are to be filled by the student. For instance, “_ , _ , 20” will appear on the screen and the guide voice will ask the student to fill the blanks by counting backwards. Students should write down the answer using the stylus and check their answer. Clicking the “Check” button will fill the blank with the correct numbers and the student will be able to see the correct answer. Figure 5. 13 illustrates some examples from a sample of the backwards counting activity that has been completed by a student.

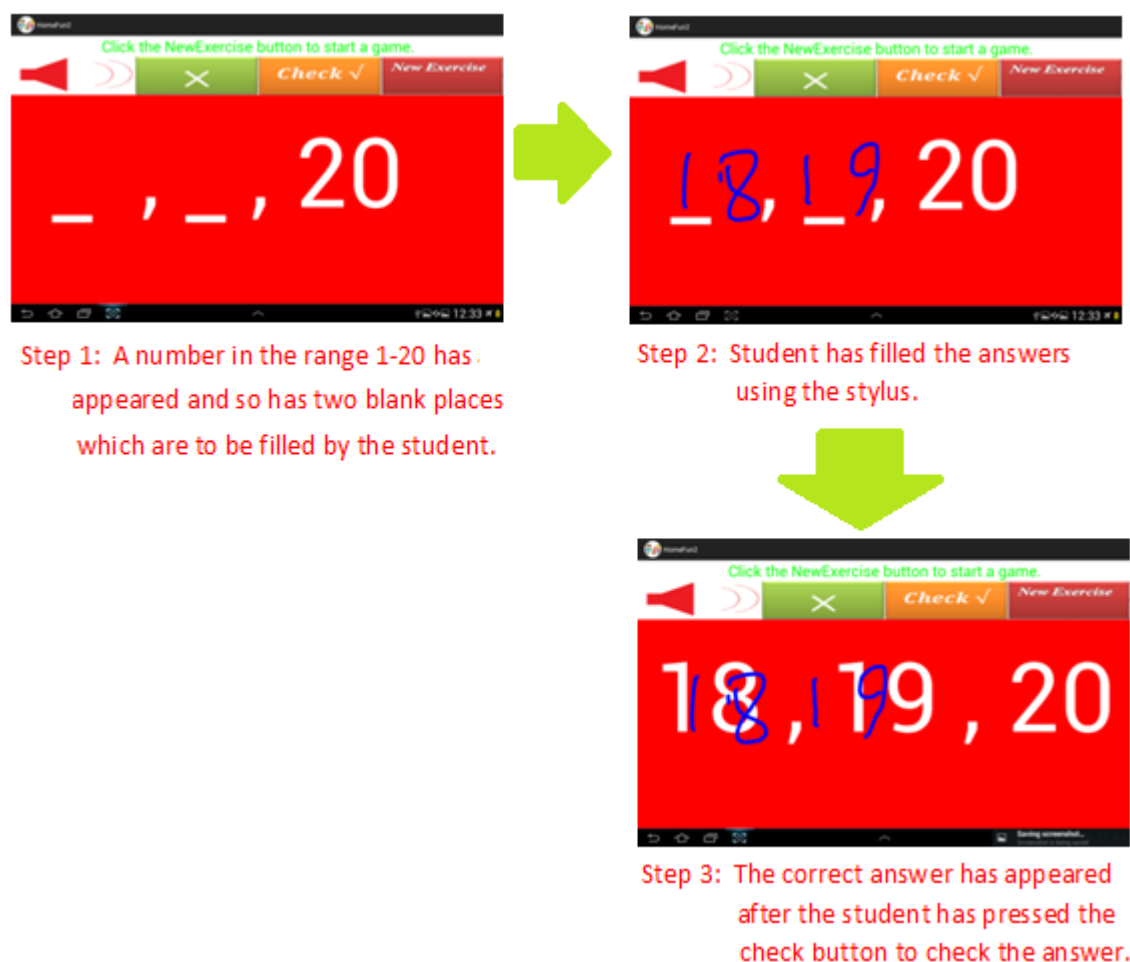


Figure 5. 13 : Sample student work of counting backwards (up to 20)

Subtraction (up to 20)

When starting this activity, two random numbers will be generated (the numbers will be 20 or less) and accordingly images will appear that illustrate the highest number in the subtraction equation. The students can use the images to solve the subtraction problem by crossing out the number of images that should be subtracted. For instance, “15-11=” will be shown as well as images of fifteen sea creatures. The students cross eleven of the images out and count the images remaining in order to get the answer. Then they enter their answers using the keyboard and check them using the “Check”

button. If the answer is correct, a cheering voice can be heard saying “Well done! Now trace the number below”, then the number that has been entered as the answer will appear for the student to trace. Additionally, the student will gain points. However, if the answer were incorrect the student would be asked to try again. This activity will help students to build on their basic mathematics fact knowledge. When they have mastered this stage they can move to the next one. Figure 5. 14 shows an example of this activity completed by a student.

Stage 2 is a standard that students should achieve at the end of Year 1. At the beginning of Year 2 students move to Stage 3 of mathematics. However, as stated in chapter 4, each child has different abilities, so some students in Year 2 may stay on Stage 2 of Mathematics. Therefore both Home Fun 1 and Home Fun 2 applications contain Stage 2 in their maths areas. In the Home Fun 1 application, Stage 2 is the last stage of the maths area (Stage 0, Stage 1, and Stage 2) and for the Home Fun 2 application, Stage 2 is the first stage of the maths area (Stage 2, Stage 3, and Stage 4).

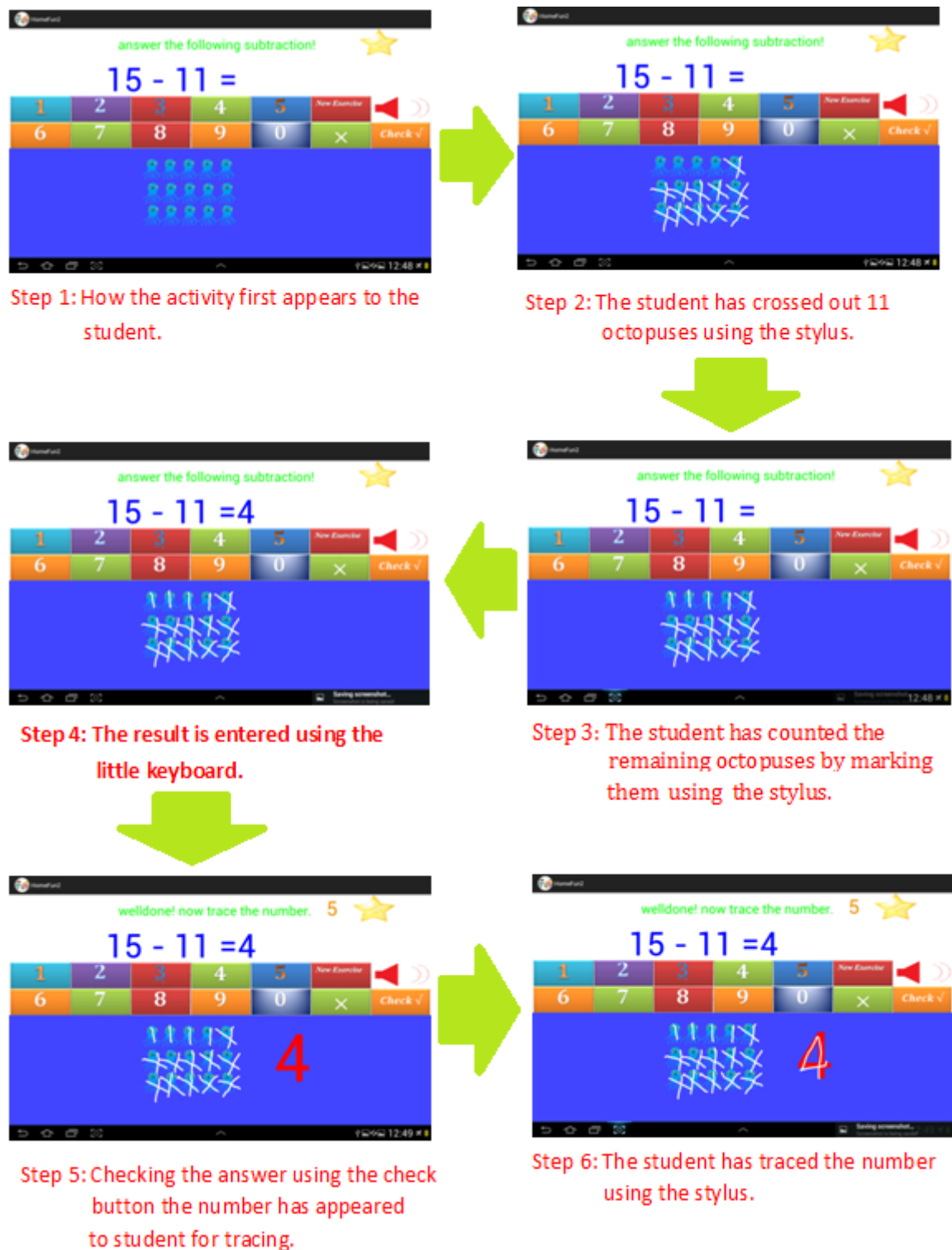


Figure 5. 14 : An example of student work on the subtraction (up to 20) activity.

5.2.1.2 English

Upon clicking on the English button, three different buttons will appear to choose from: "Tracing", "Letter of the Week", and "Essential Words". Figure 5. 15 outlines the

configuration of the application for English. The following section will explain the different activities that have been designed for different levels of English in detail.

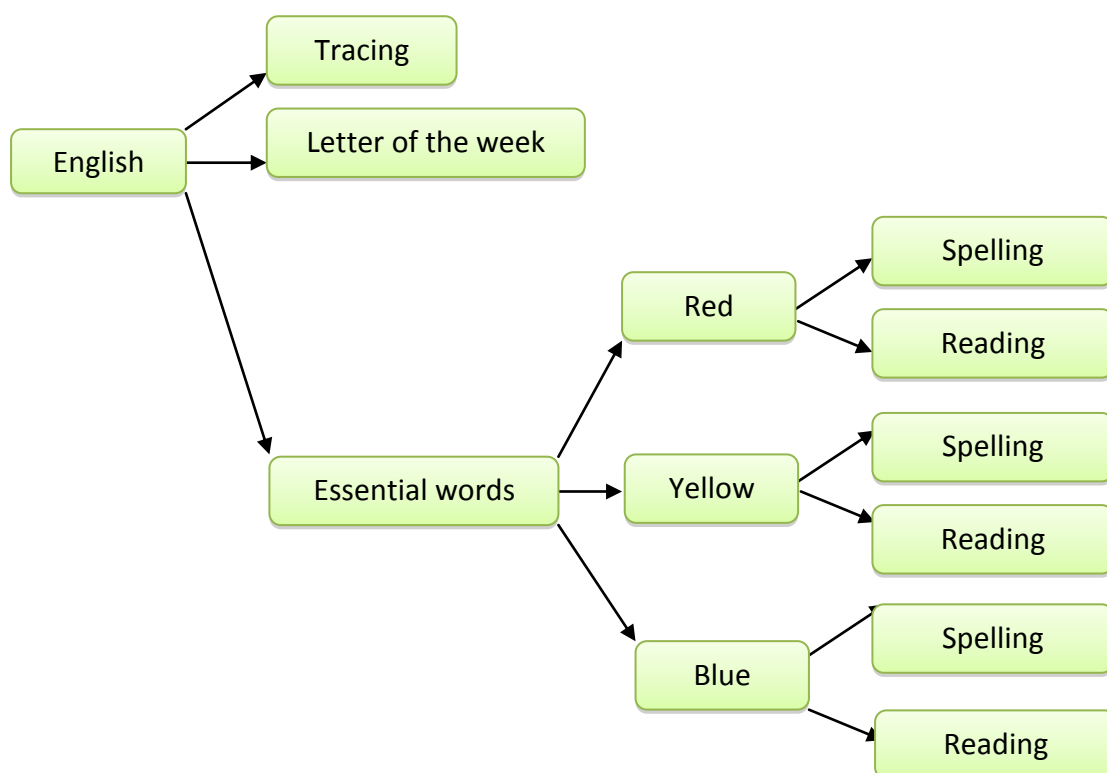


Figure 5. 15 : An example of student work on the subtraction (up to 20) activity.

Tracing

The “Tracing” activities include tracing straight lines, slanted directional lines and curvy lines. Figure 5. 16 illustrates one sample of the Home Fun 1 application’s tracing activities.



Figure 5. 16 : A sample of Home Fun 1 application’s tracing activities

Letter of the Week

If a Year 1 student has just started school, the “Letter of the Week” activities match what they are doing at school. From the beginning of the first school year, each week a new letter is introduced to students and teachers will focus on that letter for the entire week. The letter will be taught to them through stories, songs and words instead of only being memorised and practiced as an individual letter.

At the start of the “Letter of the Week” activity a pop-up window will appear with a guide voice asking students to “Enter the letter of the week.” Figure 5. 17 shows the pop-up window. When a letter is selected, activities related to that letter will begin. For instance, if the letter “C” was entered as the letter of the week, several letters will appear including “C” and the student must attempt to find the letter “C” in the group and click on it. If the student finds the correct letter and clicks on it, an image will appear that starts with the letter “C”, such as a cat with the word “cat” under it. Then, the student will be asked to trace the word “cat”. Figure 5. 18 illustrates a sample of this activity in the Home Fun 1 application. There are a few similar exercises for students to practice tracing different words that start with “C”, such as cow and camera. Then a page will appear with the letter “C” on it for tracing so the student can practice writing the letter.

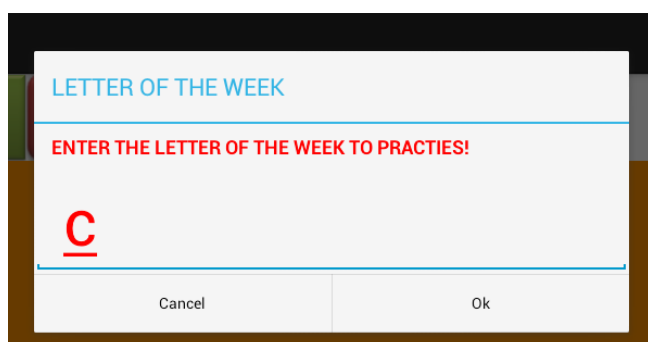


Figure 5. 17 : The pop-up window at the beginning of the "Letter of the Week".

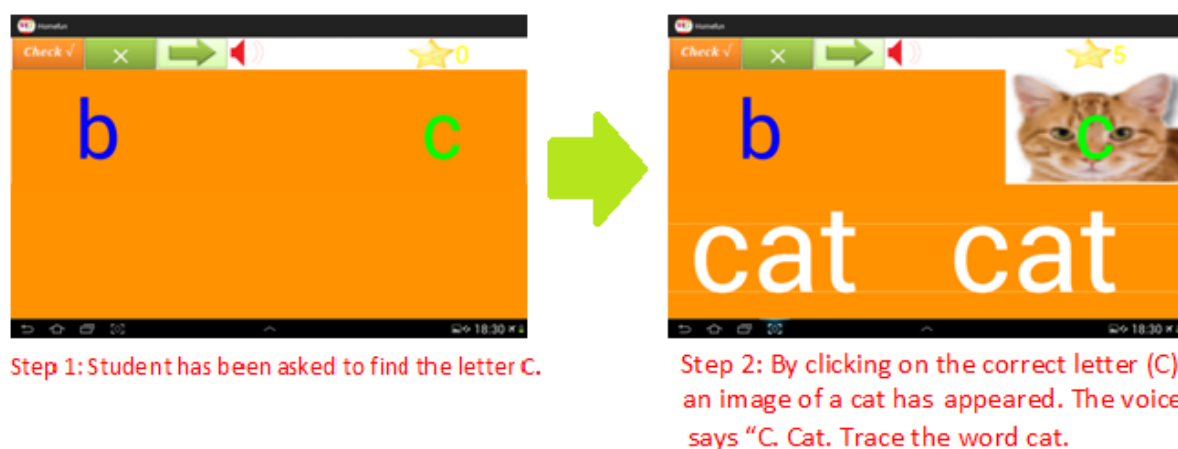


Figure 5. 18 : An example of the "Letter of the Week" activity.

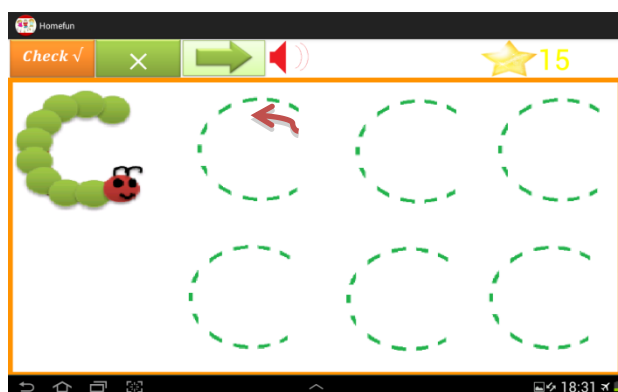


Figure 5. 19 : Letter tracing section of the “Letter of the Week” activity.

In this exercise there is a book and each page has an image of an object that starts with the letter “C”, and under each image is the name of the object with the first letter omitted. Student should recognise the missing letter and fill in the blank using the stylus. Then they can check their answer by clicking the “Check” button. Upon clicking the “Check” button, the correct answer will appear. Figure 5. 20 illustrates this activity in the Home Fun 1 application. The “Letter of the Week” activity is designed similarly for all 26 letters in the alphabet.

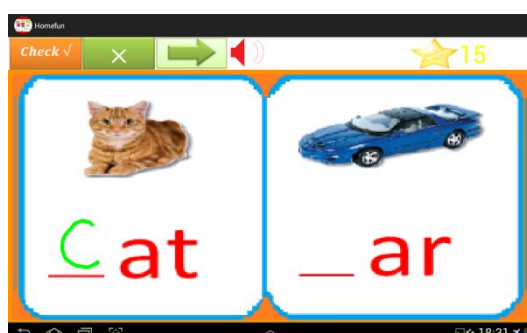


Figure 5. 20 : One page of the book in the “Letter of the Week” activity.

Essential words

By clicking on the “Essential words” button, three buttons labelled Red, Yellow, and Blue appear, which represent the colours on the reading colour wheel. Students should select the reading colour level assigned by their teacher so they can work on activities that are within their learning needs and are linked to the material taught in their schools. Figure 5. 21 shows the different colours designed for this activity that students can choose based on their levels.



Figure 5. 21 : Running the “Essential words” activity three different levels will be available to choose from.

Red level

By clicking on the red button two different buttons appear: one for spelling practice and the other for reading practice.

Spelling

The spelling activity is designed especially for learning the words in the *Ready to Read* book series. The spelling activity includes four different buttons: Check (which is shown by a tick sign and it is designed for self-checking), Delete (which is shown by an X sign), Next (which is shown by a → sign and will start a new activity), a repeating voice (which is shown by a speaker sign which will repeat the guide’s voice), and also an area to write on which simulates the pen and paper environment.

When starting the spelling activity the guide voice will ask the student to write down a word. Then, the guide voice calls out the word and reads it in a sentence. For instance, the guide will ask the student to write the word “down” by saying, “**down**” and “My little sister crawled **down** the stairs.” Then the student should try to write the word and then check the answer. By clicking the Check button the correct spelling will be displayed. By clicking on the Next button a new word will appear. The words used in this activity are words related to the Red level of the colour book series. Figure 5. 22 illustrates an example of this activity completed by a student.



Figure 5. 22 : A sample of student's work on the spelling activity.

Reading

The reading activity is designed to improve students' reading skills. According to Snow, Burns, and Griffin (1998), teaching young children to read helps them develop their speaking and listening skills. Speaking is an important requirement to success in society and it is highly valued in social development. Reading improves comprehension which helps children [and adults] understand and focus on what someone else is communicating. Therefore this activity is designed in a way to assist students to understand written words, learn to listen and focus on what someone else is communicating.

At the beginning of this activity two words will appear and the guide voice says one of the words and asks the student to click on it. The two words chosen for this activity deliberately look similar in their spelling so the student is required to pay closer attention to the spelling of the words. This will help the student to remember the spelling of the word as well as help them to be more focused on the correct spelling of words while reading. Figure 5. 23 shows an example of the reading activity. As shown in Figure 5. 23, two words "little" and "letter" look quite similar in their spelling. The student thus is required to focus and realise that the word "little" has a letter "i" after "l" and ends with "le" whereas the word "letter" has a letter "e" after "l" and ends with "er".

If the words chosen were very different in their appearance, for instance two words such as "little" and "must", the answer would be too obvious.

After clicking on the correct word, the word is available for tracing. Students can choose not to trace the word and use this only as a reading activity, however this part of the activity will be beneficial for writing and spelling at the same time. All the words used in this activity are the words related to the Red level of the *Ready to Read* book series.



Figure 5. 23 : Example of the reading activity.

Yellow level

This activity is similar to the Red level activities as it includes spelling and reading, however the words used in the activities are related to Yellow level of the *Ready to Read* book series.

Blue level

This activity is similar to the Red level activities as well and it includes spelling and reading however the words used in the activities will be related to Blue level of the colour book series.

The above sections describe all the activities that have been designed for the Home Fun 1 application for Year 1 students. Since the evaluation will take two weeks for each student, the test activities should include two weeks of homework. However, the complete application would require more activities. The next section will outline the activities designed for the Home Fun 2 application designed for Year 2 students.

5.2.2 Home Fun 2 application

The Home Fun 2 application is similar to the Home Fun 1 application. Two buttons appear: English and Math (Figure 5. 1), so the students will be able to choose whether they want to do English activities or Maths.

5.2.2.1 Maths

By selecting the Maths button three different stages will appear for the students to choose from: Stage 2, Stage 3, and Stage 4. Students choose the math stage that they have been assigned by their teacher. For instance if a student is in Stage 3 at school they can use the Stage 3 activities on the Home Fun 2 application. Figure 5. 24 illustrates the configuration of the application for maths. The following section will explain the different activities that have been designed for the various stages of the Maths in detail.

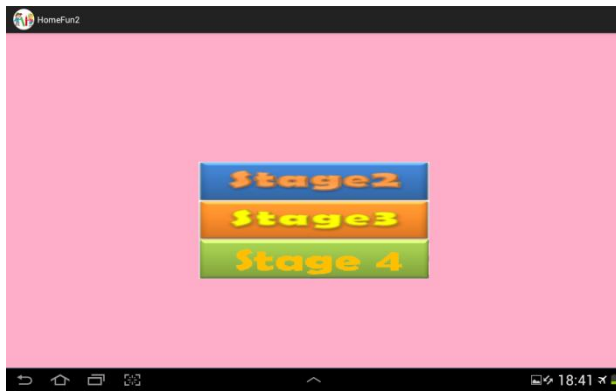


Figure 5. 24 : Maths stages in Home Fun 2 application.

Stage 2

As mentioned earlier in the chapter, Stage 2 is similar in both Home Fun 1 and Home Fun 2 applications. As this stage was described in the Home Fun 1 section of this paper, it will not be discussed further.

Stage 3

According to the NZ Mathematics curriculum, students at Stage 3 should be able to visualise sets of objects in order to solve simple addition and subtraction problems. Therefore, there are no images to count for this stage of the mathematics for the addition and subtraction problems.

Addition (up to 30)

The structure of this activity is somewhat different from the Stage 2 “Addition” activities. At the start of this activity a guide voice says: “Start a new activity by clicking The ‘New Exercise’ button.” Then two random numbers that add up to 30 or less appear. For instance, “ $21+4=$ ” is shown on the screen and the student then needs to compute the addition in their mind. The approach that they have learnt at school to use in this stage is to start counting from the big number. For instance, in this example the student will count four numbers from 21, which are 22, 23, 24, and 25. The student then enters the answer and checks if it was correct. The correct answer will appear with a blue background (as can be seen in Figure 5. 25) to be traced by the student. Students must master this stage to be able to move up to a higher stage. Figure 5. 25 illustrates one activity of the Stage 3 addition solved by a student.

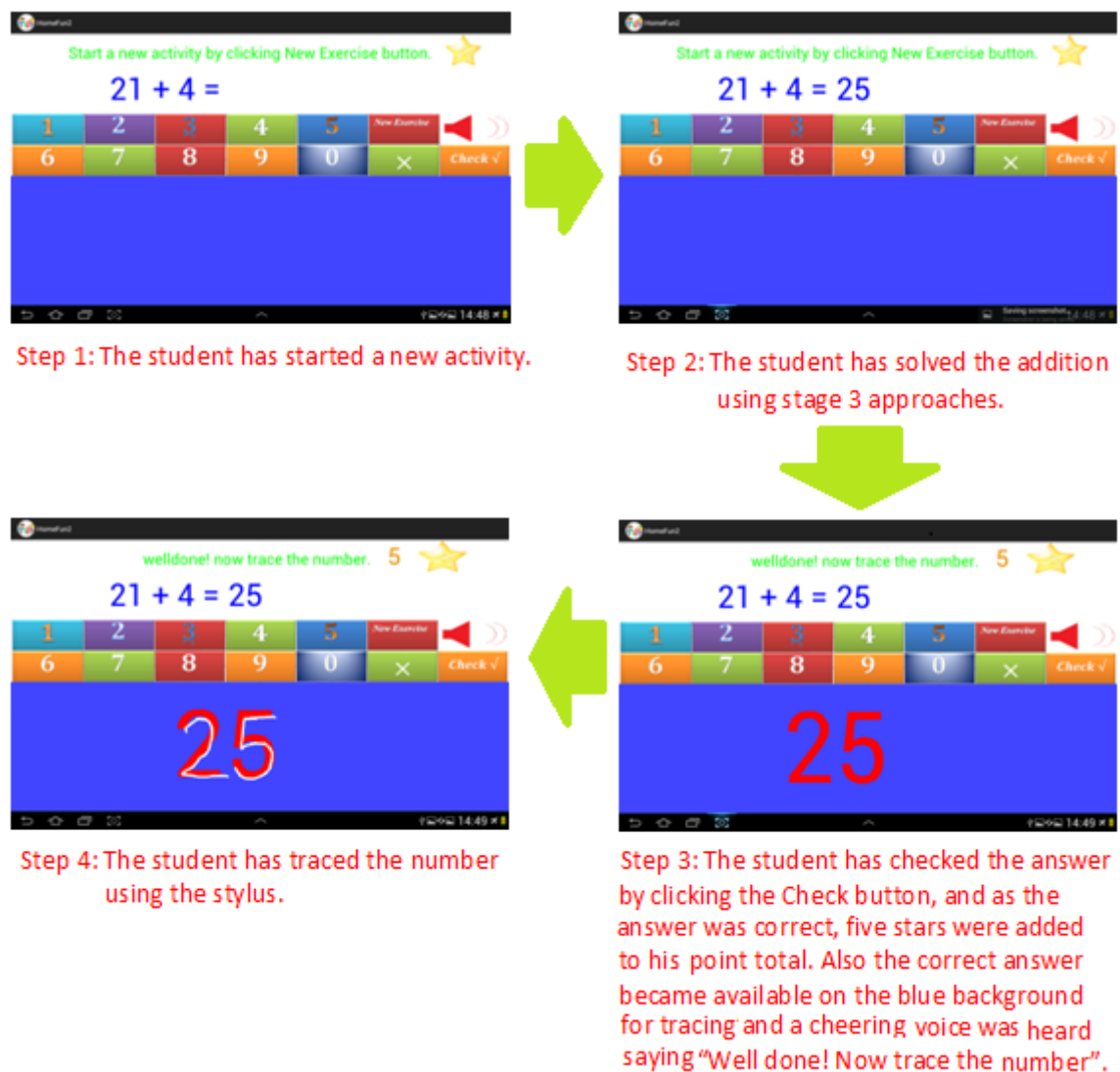


Figure 5. 25 : Student sample work from the Stage 3 addition activities using no images.

Counting backwards up to 30

Now that the students are able to count forwards to 30 and backwards from 20, they should now learn to count backwards from 30. Counting backwards fluently from 30 will help them prepare for solving subtraction problems up to 30 without using objects. In this activity students will practice counting backwards from a number between 1-30. When starting this activity a number between 1-30 appears with two adjacent blank spaces to be filled by the student. For instance, “ __, __, 29” will appear on the screen and the guide voice will ask the student to fill in the blanks by counting backwards; students need to write down the answer using the stylus and check their answers. Clicking the “Check” button will fill the blanks with the correct numbers and students will be able to see the correct answer (see Figure 5. 26).



Figure 5. 26 : Screenshots of counting backwards (from 30) activity completed by a student.

Subtraction (up to 30)

Students at this stage should be able to solve subtraction problems up to 30. Mastering backwards counting from 30 can also be very helpful for learning Stage 3 subtractions. The structure of this activity is somewhat different from Stage 2's "Subtraction" activities. As mentioned in the Addition section of Stage 3, students at this stage should be able to solve simple addition problems without relying on physical material. This should also be done for Stage 3's subtraction activity, however solving subtraction problems will be more challenging for students than addition at this stage since there will not be any images to work with. At the start of the activity, two random numbers are generated between 1 and 30. For instance, "25-7=" is shown, and the student is required to solve the subtraction in their mind by using backwards counting. The approach that they have learned at school to use in this stage is to start counting backwards from the large number as many as the smaller number. For instance, in this example, the student will count seven numbers backwards from 25— 24, 23, 22, 21, 20, 19, and 18. Then the student should enter the answer and check if it is correct. The correct answer will appear on a blue background for the student to

trace. The students must master this stage to be able to move up to a higher stage. Figure 5. 27 illustrates one component of this addition activity.

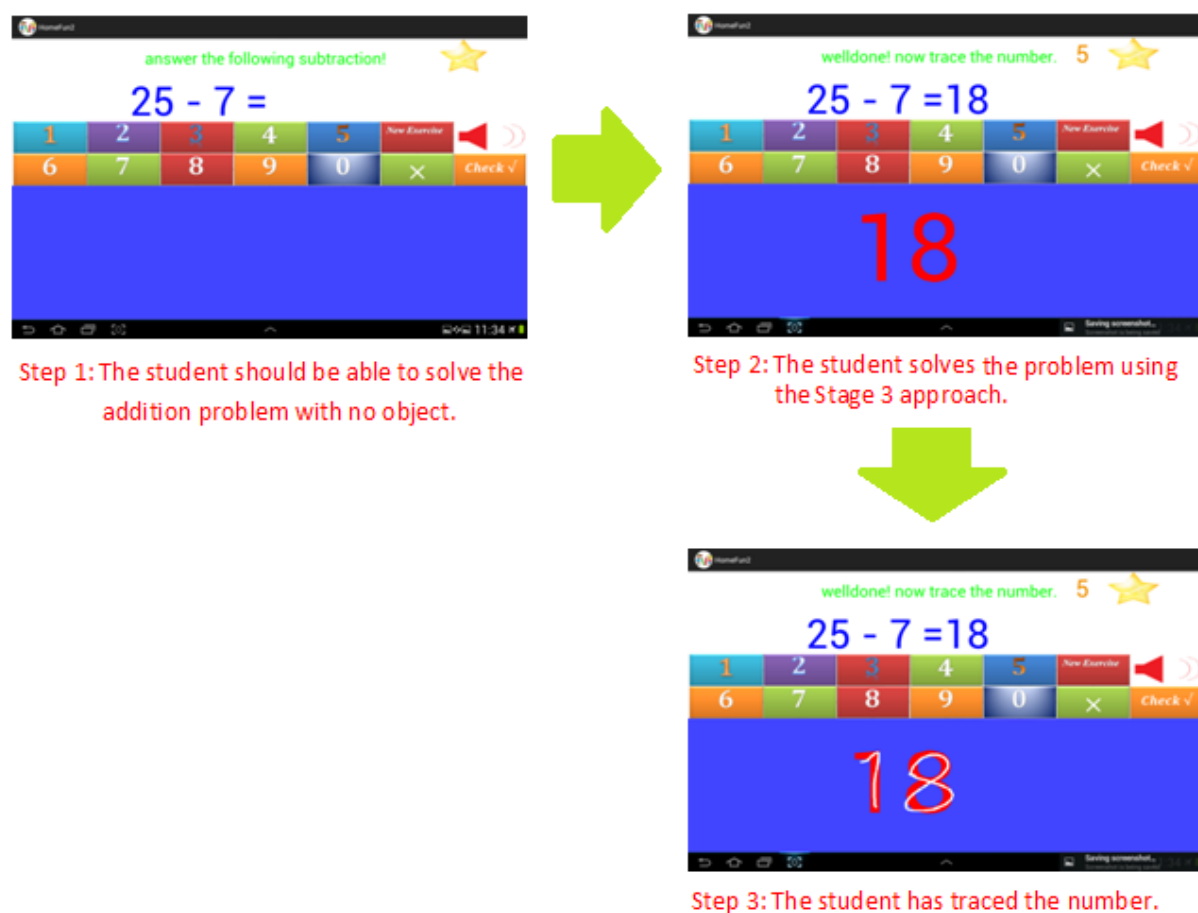


Figure 5. 27 : Screenshots of a sample subtraction (up to 30) activity solved by a student.

Skip count by 2

Skip counting is counting forward by skipping numbers. For instance, skip counting by 2 is: 2, 4, 6, and so on. Skip counting is a bridge for learning the concept of multiplication. For example, skip counting by 2s will make it easier for children to learn the 2's multiplication tables. At this stage students should be able to skip count by 2 from any number up to 100. Therefore, this activity has been designed to generate a number between 1 to 98 (99 and 100 were omitted because skip counting by 2s from 99 and 100 will exceed 100) and the student will be asked to skip count by 2s from that number. For instance, "92, __, __" will appear on the screen and the student is required to write down the answer using the stylus and check the answer by clicking the "Check" button. Figure 5. 28 illustrates a sample activity of skip counting.

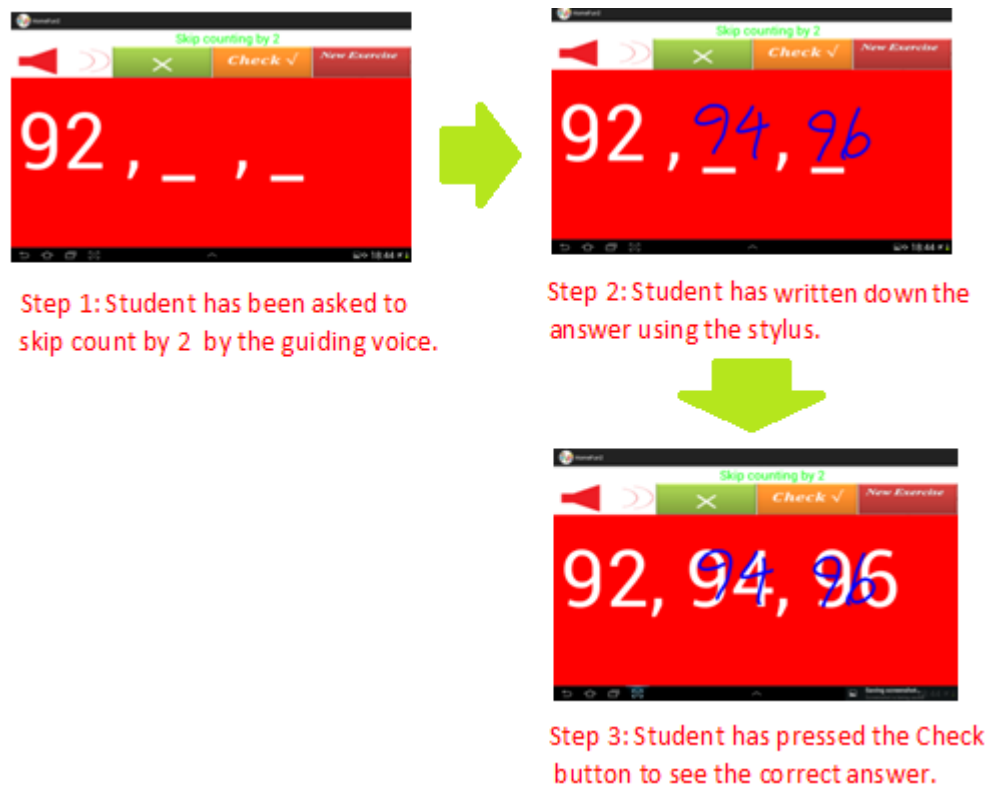


Figure 5. 28 : Student's sample work on the Skip count by 2 activity.

Skip count by 5

Skip counting by 5 enables children to learn the 5's multiplication tables much easier. At this stage students should be able to skip count by 5 from any number up to 100. Therefore, this activity has been designed to generate a number between 1 to 95 (96 and 100 were omitted because skip counting by 5 from 96 and 100 will exceed 100) and ask the student to skip count by 5 from that number. For instance "25, __, __" will appear on the screen and the student writes down the answer using the stylus and checks it by clicking the "Check" button. Figure 5. 29 illustrates a sample of the skip by 5 counting activity.



Figure 5. 29 : Skip count by 5 activity.

Skip count by 10

Skip counting by 10 will also enable children to learn the 10's multiplication tables. At this stage students should be able to skip count by 10 from any number up to 100. Therefore this activity has been designed to generate a number between 1 to 90 (numbers after 90 were omitted because skip counting by 10 from 91 will exceed 100) and ask the student to skip count by 10 from that number. For instance, “30, __, __” will appear on the screen and the student writes down the answer and checks it by clicking the “Check” button. Figure 5. 30 illustrates a sample of the skip by 10 counting activity.

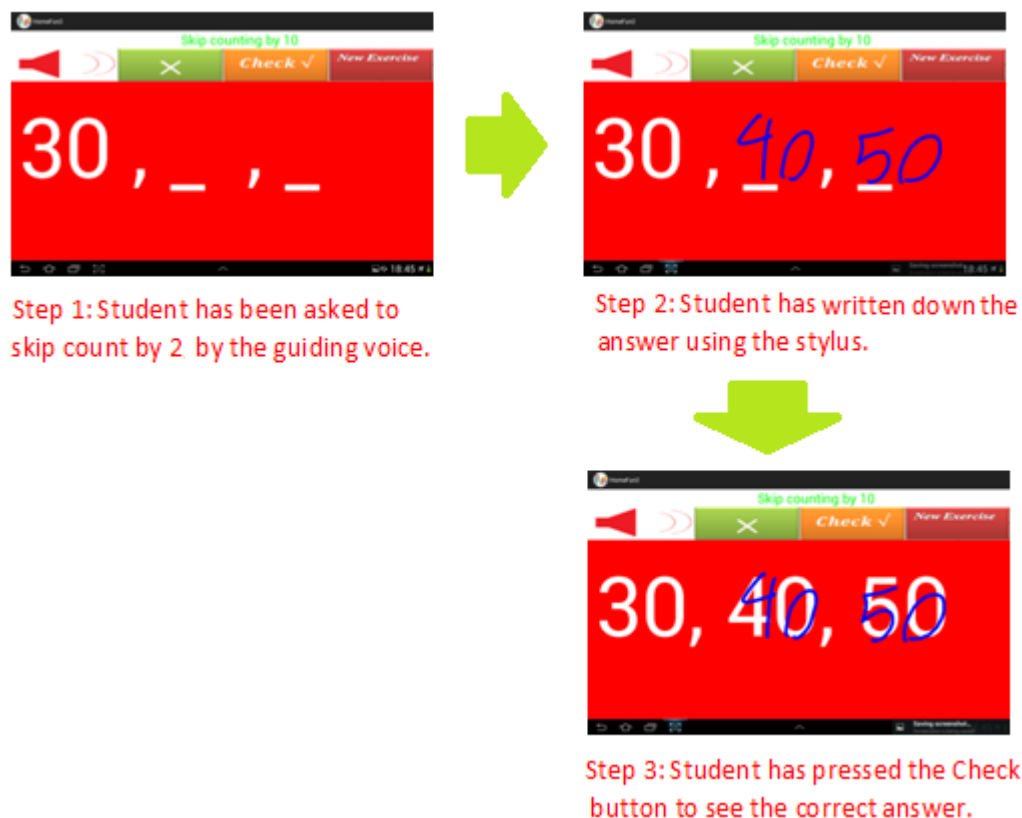


Figure 5. 30 : Skip count by 10 activity.

Fractions

Fractions seem complicated for most students and they need plenty of practice. Fractions are different because it is difficult for students to understand the concept of the proportion. According to the teacher interviewees since it is not easy for most students to comprehend the concept of fractions, teachers need to place activities into real life contexts such as using pictures of cakes and biscuits to represent fractions. Therefore, this activity has been similarly designed. When this activity starts, an image of a pizza, cake or biscuit appears, and the student is asked “what fraction of the pizza/cake/biscuit has been eaten?” The student counts the missing pieces as well as the overall number of pieces and writes down the answer as a fraction using the stylus. For instance, if the pizza was divided into eight pieces and three pieces had been eaten, the student should write the fraction $\frac{3}{8}$. The student then checks the answer by clicking the “Check” button. Figure 5. 31 illustrates a sample of the Fraction activity.

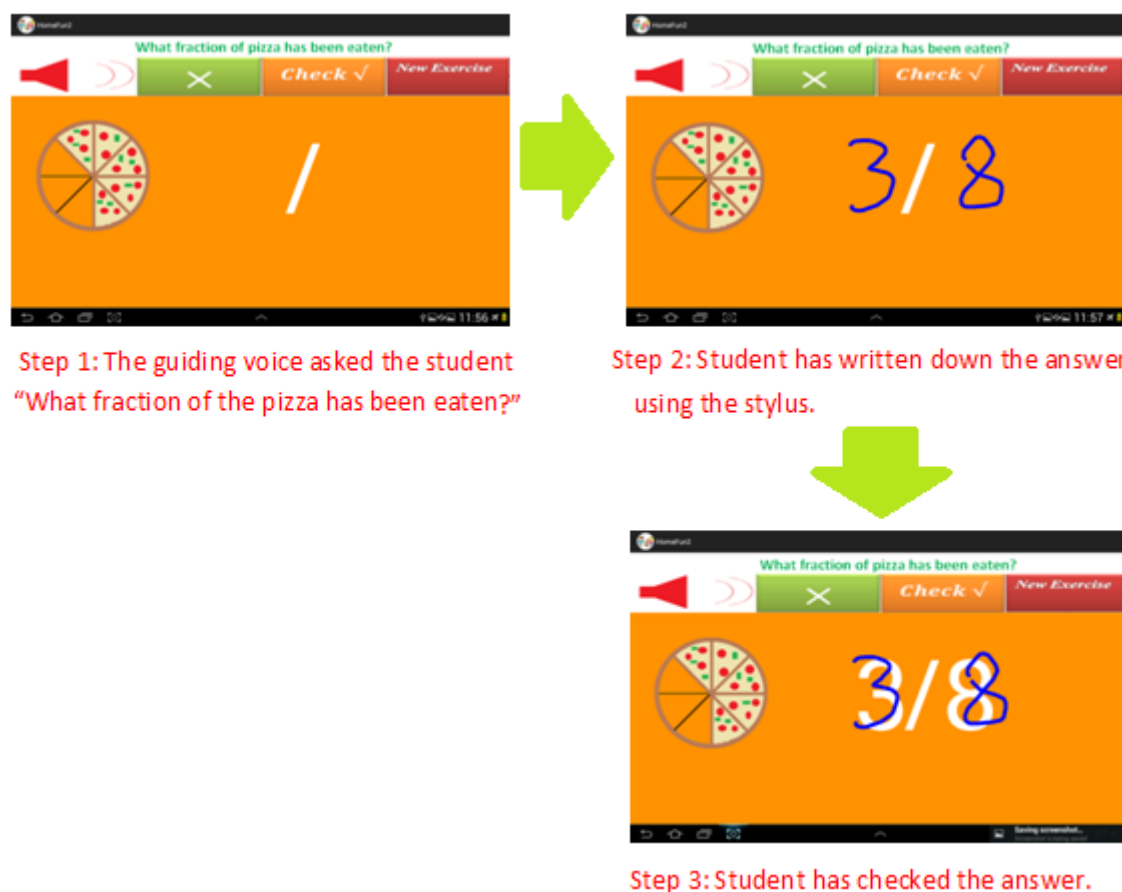


Figure 5. 31 : Fraction activity.

Stage Four: Advanced Counting (Counting On)

No activity has been designed for this stage since the evaluation took place at the beginning of the school year when all the students were at Stage 3 or lower. Year 2 students move to Stage 4 of Mathematics at the end of the school year.

5.2.2.2 English

Upon clicking on the English button, three buttons appear to choose from labelled green, orange, and turquoise representing the colours in the colour wheel. The GUI of the buttons with different colours can be seen in Figure 5. 32. Similar to the English activities in the Home Fun 1 application, students can choose the colour representing the level assigned to them by their teacher. Figure 5. 33 illustrates the configuration of the English activities in the Home Fun 2 application. The structure of the activities is quite similar to the Home Fun 1 English activities. Clicking on any of the three buttons mentioned above, two different buttons will appear: one for spelling practice and one for reading practice. Although the activities have been designed very similar to each other in each colour level, they contain different words that are suitable for a specific level (as explained in chapter 4). A sample activity of the orange level for reading has been illustrated in Figure 5. 34.



Figure 5. 32 : Different levels of the Essential Words activity.

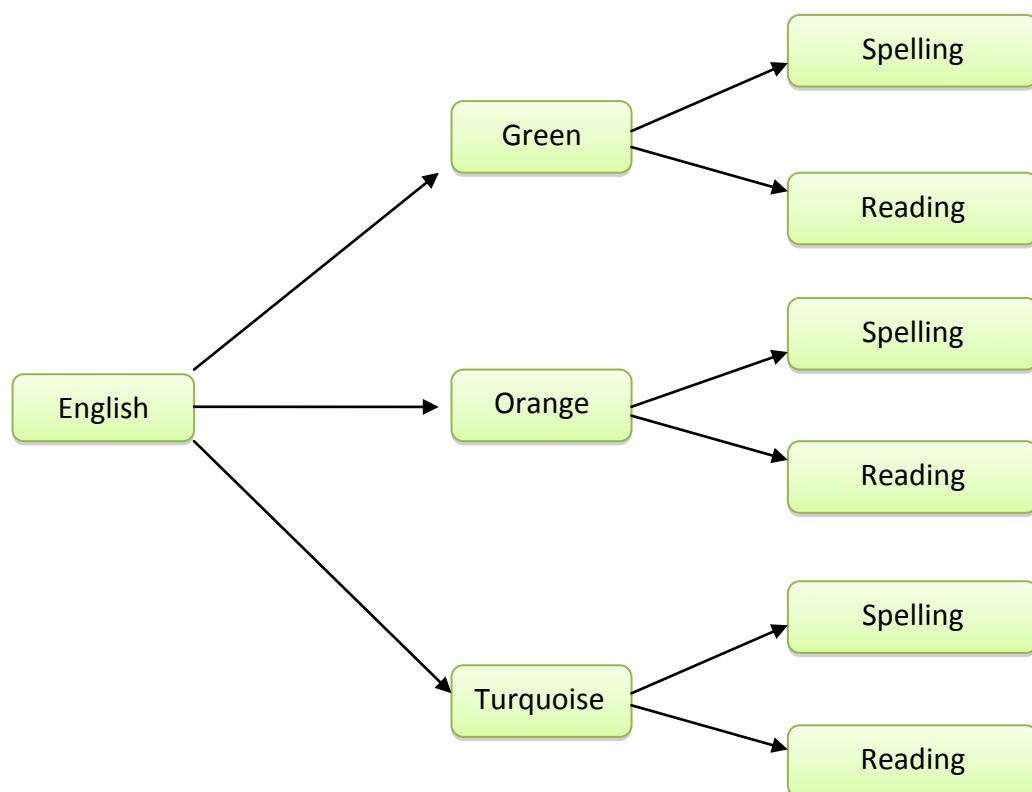


Figure 5. 33 : English activities configuration in the Home Fun 2 application

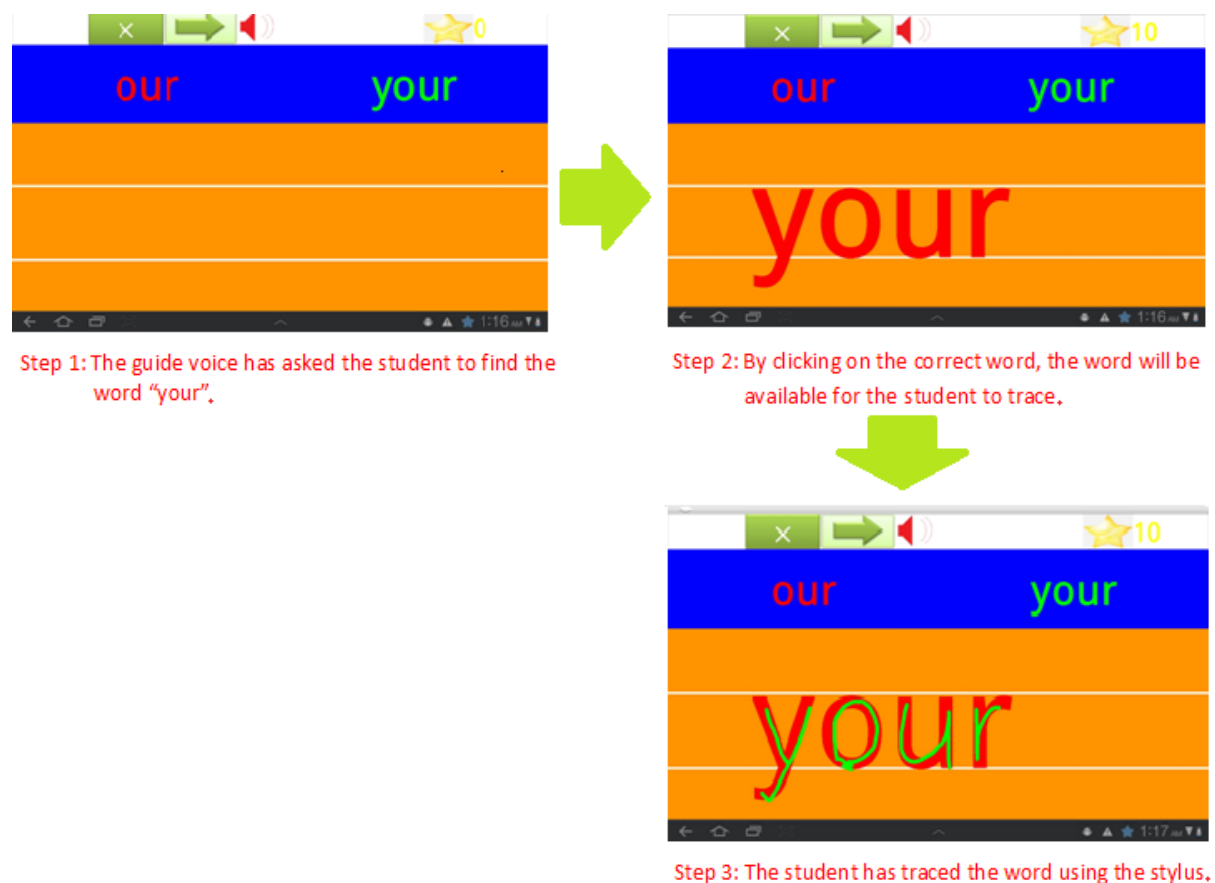


Figure 5. 34: A sample of Home Fun 2's reading activities completed by an orange level student

5.3 Issues regarding the design of the Home Fun applications

To attract children to a computer game, the application must contain animations with appealing graphics, so it is important to include animations designed by artists or those with understanding of graphic arts. In a 2-D application, artists draw images on paper and scan them into the computer. In a 3-D application, artists build images with software. Since the application is 2-D, the images were drawn on paper and scanned onto the computer to be used in the application.

Since having an artist to sketch the animations would have been costly, the other option was to buy and download images from the Internet. However, downloading images from the Internet raises a few issues. Firstly, finding the right images that could fit the application or match the design of the activities was rather difficult and sometimes impossible. Secondly, most websites did not give permission to use their images. Only one website gave permission to use a limited number of its images and only few of their images were suitable for the Home Fun applications. Therefore, in order to create all the other images Microsoft Paint was used. This was a very difficult and time consuming task.

Additionally, most of the images needed to be used on different buttons in the application. These images had to be transformed into nine patch images using nine

patch tools so they would be suitable for the use in the applications. One advantage of using nine patch images was that they required less memory. This was highly beneficial as the application required many images. Using .png or .mpg images would slow down the application. The nine patch images were also useful when designing the buttons. By drawing images without the use of the nine patch tools the buttons would look out of shape, especially where their borders were stretched more than the rest of the images. Since the nine patch images had defined stretchable areas, they could be stretched, so this was a good solution for the distorted buttons. Making a nine patch image was a straightforward process as it was simple to add black pixels to the top and left of the image borders to describe where the image could be stretched horizontally and vertically. However, the process was very time consuming as the border needed to be added to the images one at a time.

The other issue regarding the design of the Home Fun application was generating the guide voice. Every Home Fun activity required voices to guide the student throughout the activities. The voice needed to be clear and understandable by the student and with excellent English pronunciation. For this purpose it would have been ideal to record an actor's voice or someone with a sufficient English accent. Since hiring an actor for the voice guide was expensive and no one within the researcher's friend and family circle had the suitable characteristics for the voice guide, a computer-generated voice was used.

To create the guide voice, online text-to-speech software was used (available at: <http://text-to-speech.imtranslator.net/>). Therefore, all voice recording used in the applications were prepared using online text-to-speech software. The voices then were transferred to a computer to be used in the Home Fun applications.

However, there were a few issues with the text-to-speech software. Most importantly, the voices produced by this software did not sound authentic or friendly enough for software designed for children. Moreover, since the voice recording was done at a home setting on a computer and not in a studio, other voices could be heard in the background. For instance, a bird singing, car passing or the noise of the computer's hard drive could be heard in the background. These issues could have a negative impact on the quality of the voices used in the application and might not be very appealing to children.

The next section will explain the feedback loop that was followed in accordance with the design science approach in which feedback was obtained from participants to identify the design requirements.

5.4 Teacher feedback

As stated in chapter 3, an essential part of the design science cycle is obtaining feedback from stakeholders and potential participants. Therefore, a second interview was required for the development phase of the study in order to obtain feedback from

teachers. After the the applications were designed, testing was carried out by the same teachers in order to make sure that the activities were well designed and matched the requirements for good quality homework.

The second set of interviews lasted approximately 20 minutes each. The amount of data gathered in this set of interview was small since the teachers decided the applications were well designed and no major changes were required. By analysing the data gathered, the minor changes identified were:

- Letters should be both capitalised and lowercase (in the “Letter of the week” activities).
- Fractions need to be easier, for instance starting with simple problems like $\frac{1}{4}$ and $\frac{1}{2}$, and then gradually increase in difficulty.
- Letters should be displayed using simple fonts, for instance “a” and “g” need to be in simple formats like “α” and “g”.
- More images would be helpful.
- The vocabulary used for guide voice should match the vocabulary used in the classroom by the teacher.

Theses minor changes were applied to the application the application were ready for the next phase of the study which is the evaluation phase.

5.5 Summary

This chapter detailed the design of the Home Fun 1 and Home Fun 2 mobile applications. It outlined the configurations of both applications and also the levels and stages created for both the mathematics and English subject areas. In addition, the issues regarding the design of the applications were discussed. Finally, the main part of the design science cycle, which was obtaining feedback from teachers, was discussed and the development phase was detailed. The next chapter will describe the evaluation of the Home Fun applications.

Chapter 6: Evaluation

Validation of the designed application and assessment of its feasibility and capabilities to replace paper homework are evaluated and presented in this chapter. The background of the evaluation process such as selecting the participants and approaching them is first presented. Then the data gathering and analysis methods are discussed.

6.1 Background

The primary objective of this research aims to develop a mobile application for an Android based tablet computer that parents of Year 1 and Year 2 primary school students can use to help children complete their homework in an efficient and effective way. In order to achieve the objective some secondary objectives are also defined. First to provide high quality homework activities relevant to the New Zealand school curriculum that suit the student's individual learning needs. Second, to include handwriting in the activities in order to simulate paper-based homework. The strategy adopted for the evaluation process was to invite parents of Year 1 and Year 2 primary school students of schools across Auckland to participate in the testing of the application. Since the objective is to facilitate the work of parents the application is evaluated based on parents' point of view (in other words the participants are the parents who have observed their children use the application).

As the evaluation involves human participants, an approval from AUTC was sought and obtained before commencing the evaluation (Appendix A).

After the AUTC approval, the parent participants were selected from among personal acquaintances of the researcher from different regions of Auckland. Participants were invited to participate if they considered homework important for their children's development. Nine participants were selected. Selecting a large number and impartial participants for the evaluation is very important as the overall results will be more accurate (Hussey & Hussey, 1997) even if individual participants leave things out. The other reason is that data gathered from participants is influenced by their personalities and expertise: "data ... depend on the participants' ability to reflectively distinguish aspects of their own thoughts, ideas, observations and experiences and to effectively communicate what they perceive through language." (Polkinghorne, 2005; as cited in Boeije, 2010, p. 58).

In addition to selecting participants from different regions of Auckland, they were also selected from varying decile ranges. Table 6. 1 lists the schools that participants' children attend with the corresponding decile numbers. Figure 6. 1 shows the geographical distribution of the participants' children schools.

Table 6. 1: Schools where participants' children attend

Parent participant	School name	School Decile Ranking
1	St Joseph's School	6
2	Reremoana School	9
3	Onehunga Primary School	3
4	Pukekohe Hill School	5
5	Alfriston School	10
6	Pukekohe East School	6
7	Randwick Park School	2
8	St Dominic's School	6
9	Brookby	7

Upon agreeing to participate in the research, the participants were given an Android tablet with the application loaded and instructions. They were provided with an information sheet that contained details about the evaluation process and a consent form. In addition, a consent form was prepared for the children to give them an understanding about the research and obtain their consent for participation.

Testing the application involved a total of four hours and took place during a two-week period at times and locations convenient to the participants. However, there were some difficulties in meeting up with the participants. First, there was a distance problem; as it can be seen in Figure 6. 1, participants were located in different regions of Auckland ,which made travelling difficult for the researcher. Also, sometimes scheduled appointments were cancelled by the participants for various reasons and another appointment was needed to be scheduled. Furthermore, there were some delays in returning the tablets by the participants at the end of the evaluation. These issues interfered with the time planned for the evaluation and led to several weeks of delays in the evaluation process.

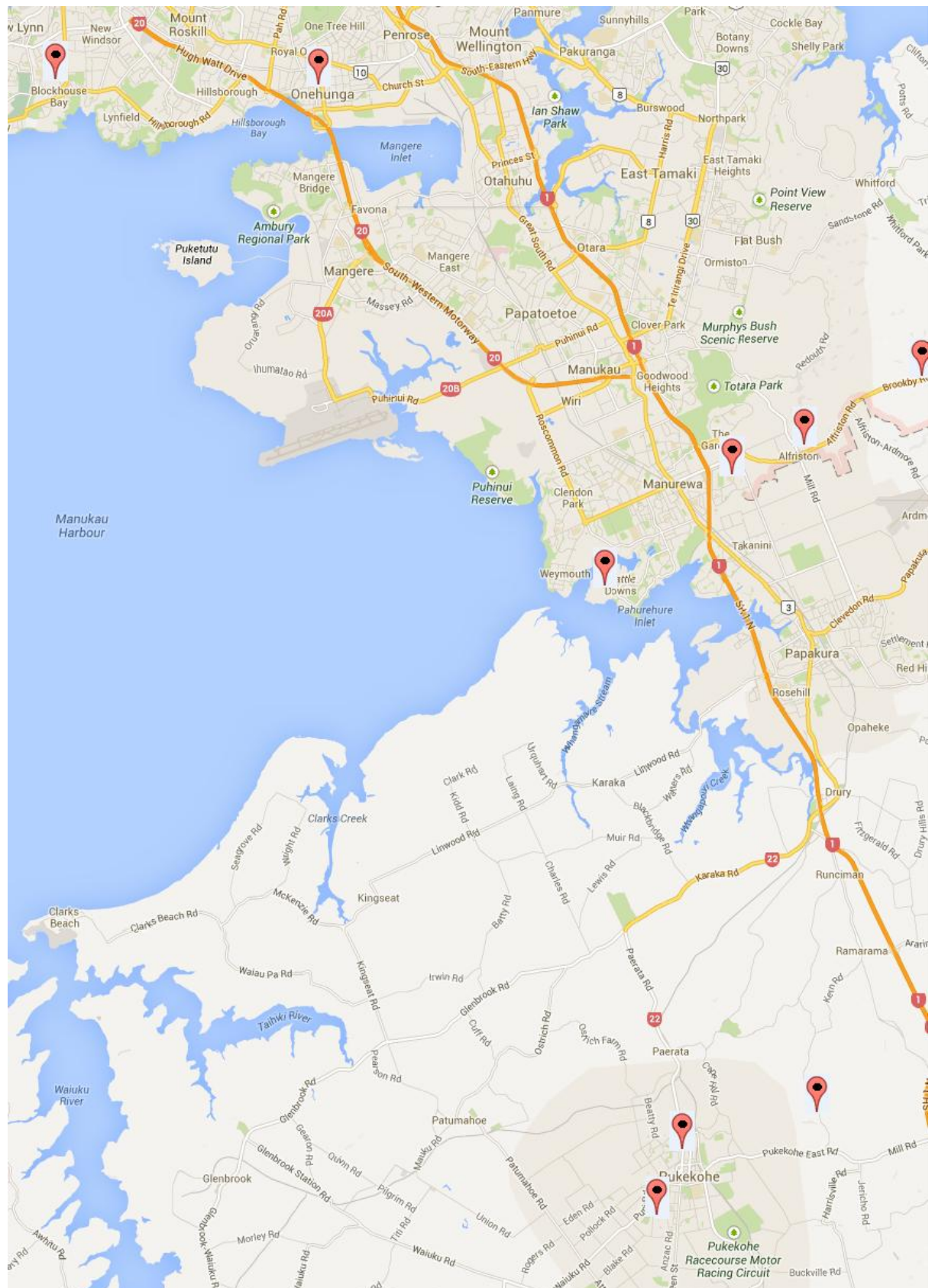


Figure 6. 1: Location of the schools where participants' children attend. (Source: Google maps)

After the testing period an interview was conducted for the participants to give their experiences, impressions and recommendations about the application.

The interview questionnaire involved nine main questions developed to determine how useful the mobile application was in terms of: time saving, ease of use, information density, information relevance, and children's enjoyability. In addition it contained questions related to the characteristics of the application and the experiences and impressions of the participants about it. The full set of interview questions can be found in appendix B.

The duration of each interview was approximately 20 minutes. The questions were posed in the same order as in the questionnaire, however since this was a semi-structured interview the follow-up questions and further elaboration of the information were carried out based on the interaction level of the participants.

A digital recorder was used to record the conversations. The data collected from the interviews were transcribed and analysed in order to identify critical success factors. The next sections will describe the data analysis process in more detail.

6.2 Data analysis method

In line with the qualitative nature of this study a qualitative analysis method was applied to the data gathered from the qualitative interviews. Analysing qualitative data is an extension to one's "inherited critical thinking" ability. It is a close engagement with the research data in order to break it down into manageable parts and gain a better insight and understanding, followed by assembling the data in a meaningful way (Bazeley, 2013, p. 4).

The four categories identified in Chapter 3 and based on related prior research (ease of use, information density, information relevance, and enjoyability), and the two factors proposed by Petrova and MacDonell (2010) (meeting participants' pre-existing expectations and specific requirements) were used to create an initial study framework. The data gathered from the interview responses was segmented and categorised applying the study framework capturing features and characteristics reflecting the overall usefulness of the application as a learning tool for children and as a tool to help parents.

More specifically the categories were used to bring together the descriptively coded data segments, as explained further in this chapter. As the interview questions were open ended, other categories had to be added as they emerged from the responses. The data within the set of categories were analysed further in order to establish their category dimensions and interrelationships. In line with the design science approach the results provided information, some of which was new, and may be used to inform the design of the mobile application interface and content in the future.

6.2.1 Preparing the data

The four steps involved in preparing the data for the analysis described in chapter 4 were as follows: organising the storage of the data files, transcribing the audio and visual sources, removing information that could violate participant confidentiality, and manipulating of the data in preparation for the qualitative data analysis.

All the audio files recorded during the interviews were transferred to a hard disk and saved in the folder 'EvaluationData'. Each file was given a name relevant to the interviewee for easier retrieval when needed. In the next step, each audio file was transcribed and saved in a file with the same name as the audio file and stored in the folder 'EvaluationInterviewsTranscript'. Then all the information that could identify the participant was removed; for instance, participants' names were replaced with randomly selected names. The randomly selected names 'Jacob' and 'Mia' were used for different children involved (for boys and girls respectively).

Additionally, since two interviewees spoke in foreign languages during the interviews one extra step was to translate these interview transcripts into English. The translation was done by the researcher, as the researcher was familiar with both of the foreign languages.

All prepared transcripts and notes were systematically read and interpreted to improve the initial understanding of the data. After reading the entire document the questions from the interviews were removed and the raw data were printed out in order to apply a pencil and paper analysis. Since the researcher was not familiar with any data analysis software, she used this approach in order to manipulate the data by creating segments that were later coded. The first modification of data after data preparation is segmenting (Boeije, 2010). Segmenting breaks up the data into relevant and meaningful parts. For this research, the data were segmented into relevant and meaningful parts by re-reading the transcripts line-by-line and determining the beginning and end of each segment. Then each segment was labelled with one or more codes as it may have included more than one sentence or meaning. The next section explains this process in detail.

6.3 Coding the data

Each segment was assigned a code following the open coding process described in Boeije (2010) (p. 96). Figure 6. 2 illustrates an excerpt of the data segmentation and open coding of an interview. The codes were written in the margin of the text, and all codes and relevant segments of each interview were organised in separate tables using Microsoft Word.

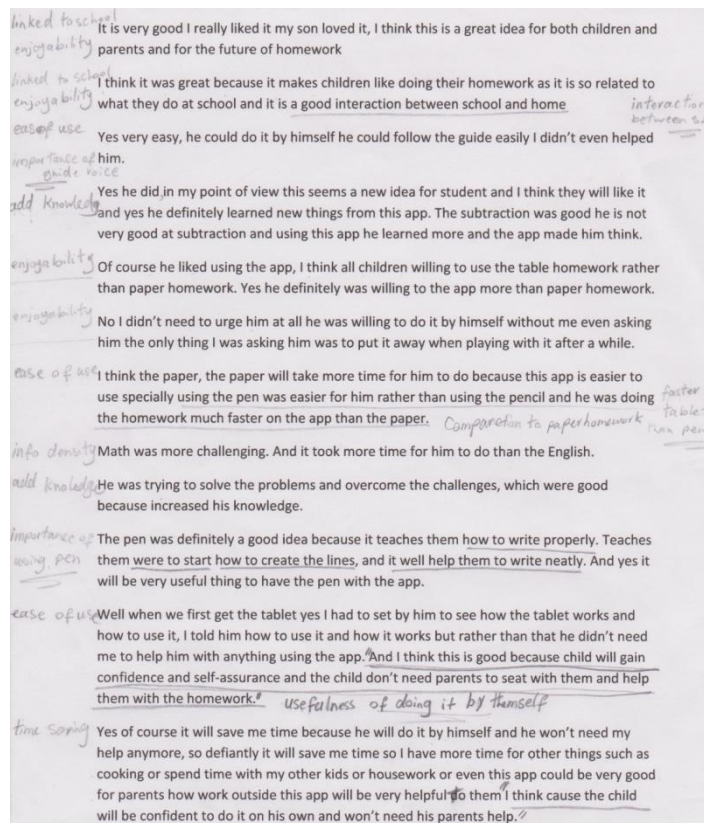


Figure 6. 2: Data segmentation of an interview transcript.

Since there is no rule for choosing the codes in open coding and the only thing that should be put in to consideration is to choose a meaningful code that clearly indicates the nature of the segment labelled by that particular code, (Lewins & Silver, 2007) the codes assigned to segments were rather descriptive. The researcher used some pre-existing notions based on her expectation about the mobile application and defined new codes where new meanings emerged—especially as at times interviewees would not provide a straightforward answer to a question or may have given answers in an order different from the order anticipated (Boeije, 2010). Table 6. 2 illustrates the open coding of the first interview. The segments that were seen as very important or relevant to the researcher's expectations were highlighted. Moreover, some of the segments could fit in two or more different codes, therefore they were labelled with multiple codes. Additionally, the codes in the tables (Table 6. 2-Table 6. 10) are shown in two different colours: the codes in black are the ones defined during the first reading of the interview. The codes in red are the codes that were assigned after coding an interview and returning to the previous interviews, as each time a new code was defined, there was a need to go back to the previous interviews and check if a segment related to the new code. If a segment that could be coded was found it was relabelled accordingly using the red colour to keep track of the new codes.

After the initial coding round the open coding of the first interview resulted in nine different codes (shown in black in Table 6. 2). As can be seen, the first segment of the interview transcript is coded as “Child interest in the application homework” as the participant mentioned that their child loved the application because the child was coming home and asking to do the homework on the application because it was fun, while homework never used to be fun. The second code was “Advantage of using pen in the activities” as the interviewee thought that the writing aspect of the activities was a good idea because it taught them to write in a proper way. The third code (“The skip counting activities”) was related to specific feedback about the skip counting activities. The fourth code was “Child willingness to do the application homework”, which was assigned to the segment: “She was asking for it as soon as she got home from school.” The fifth code was “Ease of use”. The sixth code was “Relevancy to school curriculum” as the interviewee mentioned that “the application was quite relevant because at the moment they are doing skip counting in maths and simple additions. The English as well...like the writing over the words. I think that’s very relevant.” The seventh, eighth and ninth codes were respectively “Parent participation in the application homework”, “Replacement for paper homework” and “Tracing exercises”, as there were segments that contained information relevant to each of these codes.

Table 6. 2 shows six more ‘red’ codes that had been assigned after several iterations of reviewing and coding the data. Thus the entire first interview ended up with 15 different codes.

Table 6. 2: Open coding of the first interview with a parent participant

Codes	Interview 1 transcript
Child interest in the application homework	It was good. Mia loved the game , even that one child meant to be doing it my other one was doing it as well, and both loved it
/Interest from other members of the family	
Advantage of using pen in the activities	It was more about writing skills actually It thought them to write in a proper way cause when they do it themselves (on paper) they tempt to go from everywhere and not from the right way, so it gives them a head start on that, I thought it was good for that.
Advantage of using pen in the activities	That is a good idea especially with the writing aspect of it.
The skip counting activity	The skip counting was good, the skip counting by 2 as well as the skip counting by 5 those were good.
child Willingness to do the application homework	Yes she was good. Yes she was asking for it as soon as she got home from school.
Time spent on the app	Well they both take the same amount of time but the application is more fun, well I have

/Reduction of argument between parent and child when doing homework	more complains (with paper homework), she is crying no I don't want it.
Ease of use	There wasn't any challenge it was easy to follow I think that what you want.
Relevancy to school curriculum	It was quite relevant cause at the moment they are doing skip counting in the maths and simple additions, the English as well like the writing over the words think that's very relevant.
Advantage of using pen in the activities/	The pen was good initially but the kids are a little bit rough so the top of it was falling off so I had to fix it so they used their fingers. They like drawing on it they were like: "oh look what I can draw!"... "No you meant to be writing."
Tracing exercises (girls responses)	
Parent participation in the application homework	The fact that I didn't have to monitor her, it was positive
Child interest in the application homework	-and the fact that she was coming home and saying mammy I want to do my homework because it was fun cause the homework are never fun.
/Reduction of argument between parent and child when doing homework	
/ Advantage of the application over paper homework	
child Willingness to do the application homework	-and the fact that she want it when she come home.
Advantage of the application over paper homework	Yes because normally getting her to set by me to do the homework it was a mission because she doesn't like doing homework, she always doing it with dad.
The amount of activities	Yes for what she normally gets in a week yes it was enough.
Replacement for paper homework	Yes, if all the kids in the class were doing it then yes. It will be a good idea and the teacher was able to see it like the normal weekly tasks
Tracing exercises (girls responses)/	Between those two line that you have for writing if you could have dotted line it was better so the kids know e.g. a shouldn't go over that line. The equations when they do them today and then want to do them the next day it will start again if you could do them in set of 10 questions and then the other set of 10 questions it will be good.
The content of the Maths activities	

The rules described above were applied for coding all the data. For subsequent interviews, the codes that had emerged from the previous interviews were used if applicable. As it can be seen in Table 6. 3, in the second interview the interviewee had given similar information but expressed in a slightly different way compared to the first interview thus pointing out some new aspects that resulted in new codes. One of these codes was the "Interaction between school and home" as the interviewee pointed out that the application created an interaction between school and home.

"Reduction of arguments between parent and child when doing homework", "Adding knowledge to students", "Advantage of doing it by themselves", "Time saving", "Advantage of the application over paper homework", "The content of the maths

activities”, “The content of the English activities” were the other codes that emerged from the second interview. After identifying these new codes the first interview was revisited to check whether segments related to the new codes could be found. As can be seen in Table 6. 2 segments that could be referred to by “Advantage of the application over paper homework”, “Time saving”, “Time spent on the app”, and “Reduction of arguments between parent and child when doing homework” were found. The open coding of the second interview resulted in 14 different codes. However, by reviewing the interview data after the open coding of the following interviews, four segments found relevant to the new codes emerged from the rest of interviews as shown in Table 6. 3.

Table 6. 3: Open coding of the second interview with a parent participant

Codes	Interview 2 transcript
Child interest in the application homework/	It is very good I really liked it my son loved it, I think this is a great idea for both children and parents and for the future of homework
Replacement for paper homework	
Child interest in the application homework	I think it was great because it makes children like doing their homework-
Relevancy to school curriculum	as it is so related to what they do at school-
Interaction between school and home	and it is a good interaction between school and home
Ease of use	Yes very easy, he could do it by himself he could follow the guide easily I didn’t even helped him.
Advantage of the guide voice	-he could follow the guide easily I didn’t even helped him.
Child interest in the application homework	Yes he did in my point of view this seems a new idea for student and I think they will like it
Adding knowledge to student	-and yes he definitely learned new things from this app. The subtraction was good he is not very good at subtraction and using this app he learned more
Engaging the brain	-and the app made him think.
Child interest to the app	Of course he liked using the app, I think all children willing to use the table homework rather than paper homework.
Child willingness to do the app homework	Yes he definitely was willing to do the app more than paper homework.
Reduction of arguments between parents and child when doing homework	No I didn’t need to urge him at all he was willing to do it by himself without me even asking him the only thing I was asking him was to put it away when playing with it after a while.
Time spent on the app/	I think the paper, the paper will take more time for him to do because this app is easier to use specially using the pen was easier for him rather than using the pencil and he was
Advantage of the application over paper homework	doing the homework much faster on the app than the paper.
The content of the maths activities/	Math was more challenging. And it took more time for him to do than the English.
Tracing exercises (boys responses)	He didn’t very like the tracing over the words, he was skipping it.

Adding knowledge to students	He was trying to solve the problems and overcome the challenges, which were good because increased his knowledge.
Advantage of using pen in the activities	The pen was definitely a good idea because it teaches them how to write properly. Teaches them were to start how to create the lines, and it will help them to write neatly. And yes it will be very useful thing to have the pen with the app.
Ease of use	Well when we first get the tablet yes I had to set by him to see how the tablet works and how to use it, I told him how to use it and how it works but rather than that he didn't need me to help him with anything using the app.
Advantage of doing it by themselves/	And I think this is good because child will gain confidence and self-assurance and the child don't need parents to seat with them and help them with the homework.
Parent participation in the application homework	
Time saving	Yes of course it will save me time because he will do it by himself and he won't need my help anymore, so defiantly it will save me time so I have more time for other things such as cooking or spend time with my other kids or housework or even this app could be very good for parents who work outside
Advantage of doing it by themselves/	this app will be very helpful do them I think cause the child will be confident to do it on his own and won't need his parents help
Parent participation in the application homework	
The content of the English activities	I think it needed more in English math was good but I like to see a little bit more on English side. I like to see more of spelling cause in their age they just start learning writing so I think more spelling will be helpful. Only one more page of spelling will do.
Replacement for paper homework	Yes definitely I support this idea. I support this app instead of these papers that kids bring home from school, because first of all you can find tablets or iPads in most houses now a day. Second it will be a great help to parents-
Introducing technology to children/	-and also children will be introduced to technology in early ages which is good. it is a good interaction between school and home as we learn about what they are doing at school.
Interaction between school and home	

The results of the open coding of the third interview included some codes already defined, however this defined, however this interviewee also highlighted some new factors, such as the uniqueness of the application uniqueness of the application and the relevancy to what her child was learning in school. Additionally, the school. Additionally, the interviewee mentioned how she gained some new knowledge from the application. from the application. Therefore new codes were identified: "Similar applications" and "Adding knowledge to "Adding knowledge to parents". Furthermore, the interviewee stated how the activities made her child think activities made her child think more to solve problems, therefore the "Engaging the brain" code emerged from brain" code emerged from this interview segment. After looking back at previously coded interviews some coded interviews some segments were found that could be labelled with the new codes.

codes.

Table 6. 4 illustrates the open coding of the third interview.

Table 6. 4: Open coding of the third interview with a parent participant

Codes	Interview 3 transcript
Similar applications	I really like the application because it was just what I wanted. I always looked for something in app-store that covers the material she is doing at school but I couldn't find any
Relevancy to school curriculum	-and I found your application quite relevant to what she is doing at school.
Adding knowledge to parents	Well, I loved the levels and stages that you had in the app. To be honest I didn't know much about these levels and stages it was good to know, it was something new for me.
Interaction between school and home	When you told me about the stages I had to go and ask her teacher.
Relevancy to school curriculum	So choosing her stage for math it was very relevant to the homework she is bringing home so the exercises were quite similar. For English the same.
Ease of use	Yes it was easy; she had no problem working with it.
Adding knowledge to parents	Well as I said I didn't know about the stages so I gained some knowledge myself😊.
Adding knowledge to students /	I liked the math activities it was challenging. English she learned how to spell some words that she had problem with before so yes definitely she gained knowledge. And her sister
Interest from other members of the family	learned a new alphabet letter she is only 4 she know some letters but she learned the letter "M".
Reduction of argument between parents and child when doing homework /Child willingness to do the app homework	Well she is not a big fan of homework. I have to ask her to do her school homework otherwise she won't do it but with the application she was asking me she wanted to play on it.
Time spend on the app/	Well we do 20min of homework together every day but with the application she didn't really need my help but she was spending more time playing on the application compare to paper homework.
Leading to practice more activities	
Adding knowledge to student/	Spelling in the English side was very good because she had to think how to write the words so that was challenging math were good addition was good, subtraction was more challenging for her.
The spelling activities/	
The content of maths activities	
Engaging the brain	It was challenging, not very easy but it made her think to come up with an answer so that was good. It made her brain works.
Similar application/	The pen is brilliant idea I haven't seen any application that use pen, well, there are some that do tracing I have downloaded for her before but it was just tracing the letters or colouring but using pen in your application the way you used it was brilliant. I liked the way that you had 2 lines and kids should write between the lines that were good that help them to write nicely. Yes the pen was good.
Advantage of using pen in the activities/	
Advantage of using pen in the activities	
Relevancy to school curriculum	Because the exercises were so relevant to what she is doing at school , so she could choose her level or stage
Parent participation in the application homework	I was sure that she is doing some homework and not wasting her time, so I could do my work or spend some time with my little ones while she is playing on the app.

Time saving	It will definitely save time because I don't have to seat by her and tell her what to do
Ease of use	- the application is very clear what to do.
The content of the maths activities/	Yes, Math was very good; English the spelling was very. It was good it was enough.
The content of the English activities	
Diversity of the activities (girls responses)	-and also I liked this "letter of the week" that you had in English side that was excellent it was practicing the letters in different ways. Like in few tasks kids should find the letter then it was tracing and filling the blanks so having different way for the same exercise was very good kids don't get bored.
Replacement for paper homework/	Yes, it will be a great help well I can choose to not to seat with her when I don't have the time and if I want to watch her I can so I don't lose anything but it could save me time. The exercises were good so yes if you market it I will buy it.
Time saving	

Table 6. 5 shows the codes assigned to different segments of the fourth interview. The interviewee pointed out new factors that resulted in new codes. For instance, the interviewee stated that doing the activity increased the learning progress of the student and also that the application led them to do more exercises than what they would normally do in paper homework. Thus the new codes "Student's progress" and "The time spent on the app" were defined. Also the interviewee mentioned how this application had interested her other child. Therefore a new code emerged: "Interest from other members of the family". Searching the previous interviews allowed finding new segments relevant to these new codes.

Table 6. 5: Open coding of the fourth interview with a parent participant

Codes	Interview 4 transcript
Relevancy to school curriculum	I felt the levels and stages suited Mia quite well.
Student's progress	-Because she got about %80 correct initially in the English section and doing more every time she was getting better and better. It would have been nice to see more challenging questions amongst the easier ones.
Quality of the guide voice	One thing that "I" didn't like, not her! Sounds of the words were not similar it was better to have nice voices which sound more real.
Relevancy to school curriculum /	The maths I felt was similar to what she is doing at school. Mia is very good at calculating addition and subtraction in her head and occasionally using fingers. So it was very good that you didn't have any images for her level because I looked at the lower stages and I noticed that you have images that children can use for counting but at her level you didn't have any.
The content of the maths activities	This was good.
Quality of the guide voice	Still I think it would be good to have cute voices☺.
Ease of use	The application was easy to use. It was also easy for the child to delete☺. Mia didn't need much guidance from me in using the program.

Adding knowledge to student /	I don't think Mia gained any new skills in playing the game however she did gain some knowledge.
The fraction activities /	Mia enjoyed the fractions the most as this is something she has never done before. Once I explained how they worked she soon mastered it by counting the squares etc. So yes she gained some knowledge.
Student's progress	
Child interest in the application homework	Initially Mia was on the tablet non-stop trying the different levels and tasks even the ones that wasn't her level. Once she had mastered them all, she preferred to only do the exercises in her level. She also let her 3 year old sister use it while she sat with her showing her what to do. Also, she has asked for it couple of times since it has gone.
Interest from other members of the family	
Leading to practicing more activities	This is a hard question as the home work she is getting at school is limited so it will be done when she finishes all the tasks but with your application she was starting all over again as she finishes each task. But I didn't really mind as long as she didn't need my help. I was even happy seeing her doing more exercises. But along with the homework tasks she gets at school she also has a reading book each day reflecting the level she is at.
The fraction activities/	Fraction! Hmmm, I very liked the fraction in the math section, well....math was design pretty well over all but fraction was the best.
The content of math activities/	And in English section I liked the spelling part that was very challenging.
The spelling activities	
The amount of activities	They were fair, they were fair.
Advantage of using pen in the activities	Using the pen itself was a brilliant idea because I very want my child to practice handwriting I want her to be able to write neatly.
The spelling activities	Spelling section was very good as she had to write the word herself and then check to see it she got it right rather than tracing the word.
The spelling activities / Child interest to the app	I liked the spelling section it was challenging and she enjoyed it too.
Parent participation in the application homework	I felt I didn't get to participate in Mia's homework, only when she got an error such as when incorrect words came up in the answer – if I remember correctly it was around the 'make' question_.
Time saving/	It was good that I didn't have to seat by her to know what she is doing I was able to hear the voice while I was busy doing my own work.
Advantage of guide voice	
The amount of the activities	For me I felt the app would be good if there were more activities, it was enough for two weeks but I want her to do more.
Time saving	The app didn't save us anytime as she played on the app and then had to do her school homework ☺ However if she could only use the app_ and that's what you really meant_ it will definitely save me time
Time spent on the app/	-but I'm not sure about her cause she love playing with it so she will probably spend more time on the app than she would on the school homework.
Leading to practicing more activities	
The amount of the activities	If you mean only for two weeks, it was fair. However I like to see more in English section.
recommendations	You could add a section that children could pick a topic and write about it. What they get at school for homework is some spelling word and a reading book and also a piece of writing and some basic facts. You have covered them all but the piece of writing that they get each

	week.
Replacement for paper based homework/	Yes I do, with a bit of improvement it will be a great app I think children would like to see more images. With some minor improvements yes I will definitely buy the application.
Images in the app	
Adding knowledge to parents	Thank you for allowing us to be part of your research. It has certainly opened my eyes to the world of technology and where things are heading.
Quality of the guide voice/	The voices need to be changed you could add more images. Also the tracing exercise she liked it but for me it was hard to monitor otherwise it would be a tool I would consider.
Tracing exercise (girls responses)	

Open coding of the data gathered from the fifth interview also resulted in a new code: “Diversity of the activities”. Additionally, there was a segment that was coded as “Gender difference” but no other segment found in the other interviews was relevant to this code, however pointing out the gender difference was an interesting observation that led to a closer look at all of the data gathered from the interviews to compare the data gathered from parents of female students and male students. There was evidence to indicate that the same gender students responded similarly to the activities and differently from the opposite gender. These different responses could be seen in the diversity of the activities and also the tracing activities. Therefore responses related to the “Diversity of the activities” and “Tracing activities” codes from the girls and boys were distinguished in the tables by labelling them as (girls’ responses) and (boys’ responses) in orange. These findings will be discussed in chapter 7 in more depth. Table 6. 6 illustrates the open coding of the fifth interview.

Table 6. 6: Open coding of the fifth interview with a parent participant

Codes	Interview 5 transcript
Diversity of the activities (boys responses)	First he very liked it but at the second week not so much I think it needs to be more diverse more activities more rewards most of the games have eggs or fishes or something like that to collect. I think that’s the reason he didn’t want to continue using it.
Relevancy to school curriculum/	That was fabulous, it was very good. But the game needs to be more interesting
Child interest in the application homework	
Ease of use	It was easy he could do it on his own he didn’t need help to do it, it was good.
Tracing exercises (boys responses)	No not really. For the tracing there was no way of monitoring if he wrote it in a right order. I don’t see how they have got to that letter? Like if they draw the letter “h” like they first go down and then make a tunnel and stick a stick to it because I know with my son he doesn’t form that in correct order.
Child willingness to do the application homework	Initially he was good he was asking to do it but then he got board of it but he possibly get board of his paper homework as well
Diversity of the activities (boys responses)	-unless it keeps changing to different tasks or keep doing the same thing but different

responses)	words.
Gender difference	I think with girls is different they could set down for hours draw a picture and hang on to that
Time spent on the app/	He normally does about 10 minute of written stuff and then we do reading separately which takes 10 minute as well with the application it is hard to say because there is no end to it but it took 30 minute at the first week but 10minute at the second week.
Child interest in the application homework	
The contents of maths activities	The maths was much more challenging.
Relevancy to school curriculum	Yes it was, they don't bring maths home so I can't comment on the maths I only see the English side but the English seemed quite relevant
Advantage of using pen in the activities	I loved it I will buy one too that's really good,
Parents participation in the application homework	Truly he did that on his own but with paper homework I had to seat down with him so with that one I could be at kitchen and he being in the room doing it on its own so I don't really need to support him in the same way it's nice that he could do homework without me but that will make me lazy I think 😊
Time saving	Yes for sure
The amount of the activities/	With the maths I can't compare cause he doesn't bring maths home but I suppose it is good so it will be in addition to what he do at school so that's really good with English I think it does need a bit more content but there is more challenges with the math, addition and fraction was challenging, but yes for two weeks it was enough.
The content of the English activities/	
The content of the Maths activities/	
The fraction activities	
Replacement for paper homework	Not instead of in conjunction with.
Recommendations	More reward like they have in reading eggs that's really cool it doesn't have to be as complicated as that just some rewards that they can do something with it or just the reward kind of works for them.

Table 6. 7 illustrates the open coding of the sixth interview. Most of the codes applied had already emerged from the open coding of the previous interviews—for instance the interviewee discussed the effect of the application on parent participation in homework. The next code referred to the introduction to the technology that had been mentioned before. The only new codes that emerged from this interview were “Advantage of the guide voice” and “Instant checking of the answers”. Here the interviewee had given some feedback about the voice used in the and about the instant checking of the answers, which had been considered as advantageous over paper homework by this interviewee.

Table 6. 7: Open coding of the sixth interview with a parent participant

Codes	Interview 6 transcript
Parents participation in the application homework	It was great that kids could go off and use it without parents, as a parent I always like to know what she is doing so I was walking in out to see what stage she is up to so it was great that she could do that
Introducing technology to children	-and it was great that she could use a bit of technology cause we are not a high tech family it was great for her to have go off it and they do specifically using them at school too.
Ease of use	Yes very easy, very easy.
Adding knowledge to students	The technology side of it like how to use it and backing out and things like that yes she did.
The contents of maths activities/	the math was very good very much in tune to what she was doing at school so that's great the English was a bit too easy the tracing was very easy. There was no repercussion for her if she didn't trace it nicely. But yes if you are capturing them as image or whatever and send them to the teacher or print them out and teacher is able to say like hay jess you haven't print it very nicely yes that would be good. Yes that would then work but if she was just playing with it that's very easy.
The contents of English activities	
Relevancy to school curriculum	the math was very good very much in tune to what she was doing at school so that's great
Child willingness to do the application homework	Pretty much the same because I don't have problem with Mia doing her homework.
Child willingness to do the app homework	She loves doing homework, but yes certainly because it was a novelty she wanted to use the tablet so there was a certain novelty about it but I don't have an issue with her doing homework. But after the novelty comparing with pen and paper I think for her will be pretty much the same.
Introducing technology to children	But because they have them at school I want her to be open to them, open to using them but weather she uses it for homework or uses them for other thinks during school time it doesn't matter as long as she is using it at some point the technology side of it. Certainly was a benefit using a tablet for homework!
Helping buys parents	For busy parent in the fact that you could send it straight to the teacher that would be great cause there won't be any homework bags, have you got it? Have you forgotten it? That sort of thing pack your bag... so yes that side of it was a bonus
Child willingness to do the application homework/	Because she was so willing to do it she was on it for 30 minutes going to different ones like adding subtracting so I would say 30 to 40 minutes at a time she was playing on it.
Time spent on the app	
Time spent on the app	Well paper homework is only what her teacher gives her so when she finished the requirement of the teacher it might be spelling or whatever may be 20 minutes to half an hour the homework might take but I think it was the certain novelty side of it that she wanted to keep playing with it. But I know with J... that she will spend as much time on the tablet as she would on pen and paper because she loves homework she is crazy! ☺
Relevancy to school curriculum	I loved the Maths the math was very on level to what she was doing at school so it was very challenging. It was quite challenging for her you could swap from addition to subtraction quite happily. But it didn't come up randomly for instance there will be adding and they might get a tricky one as subtract, so that would get her thinking: "am I adding? Or am I subtracting?" well that might come in the higher level.

Relevancy to school curriculum	The level was very good for the maths, and the fact that the levels were very good for her.
Instant checking of the answerswhich was different than what it would be for pen and paper where its gonna get back to the teacher and its gonna get marked and get a sticker on it or something like that. In the app instantly she got a score and got recognized by a clap, so that was good and the fact that the levels were very good for her.
Relevancy to school curriculum	The math was brilliant, for her at that level it was just the right amount of challenge,
Engaging the brain	- she had to think to subtraction. It made her think.
Diversity of the activities (girls responses)	It was great that you had a lot of different tasks to do so that whole separation of addition and subtraction for her was great but if you had that other side that was mixed
Advantage of using pen in the activities /	Yes! I like it, you still need to make sure that they holding their pen properly you never want them by technology to lose that skill of being able to write every one can use the maths and use the keyboard but they still need to learn how to write it is just another form that can give them enjoyment and the challenge in a different way of doing it, so it is good it's not just setting down with pen and paper.
Replacement for paper homework	
Replacement for paper homework	I probably say yes. But I am that sort of parent that likes watching their child while they do homework.
Time saving	Did it save me time? Yes it probably could have it was my choice not to
Advantage of the guide voice	-but one thing I could be in the kitchen and work in the kitchen and I could hear her getting it correct when she got an addition said correct you could hear if she get it right or if she get it wrong you could pop back in and say hey J.... where you having trouble lets work this through so that side of it you could hear things you are not just relying on pen and paper that you actually have to physically look at it you could actually be out of the room but you still will be able to hear things.
Time saving	I am sure that it could save me a lot more time but it is just that sort of parent I am. That's what I choose to be but I am sure it could have saved me time.
The content of the Maths activities/	Yes I think so, Maths brilliant maybe on English side you could do more spelling. The English I didn't think was as challenging as maths. I like to see more spelling than reading.
The content of the English activities	
Replacement for paper homework	Yes.
The content of the English activities	No I think it's brilliant just the English a bit more challenging and we covered that and just make sure the printing they are learning at school is what they are doing on the application.

Table 6. 8 and Table 6. 10 illustrate the open coding of the seventh, eighth and ninth interviews respectively. No new codes emerged from these interviews. All codes that were already defined were used to label the segments in these interviews.

Table 6. 8: Open coding of the seventh interview with a parent participant

Codes Interview 7 transcript

Student's progress	It was quite helpful actually we tried the level where my son was at that and also we tried the level below that and above that as well initially when we tried the level up he was happy but because he knew the level below that and every time he was going level up he was happy and he was really proud about himself
The amount of activities	I think it is initial but once it is gets going it will help parents a lot more.
Child interest in the application homework	It is great that the teachers know what is happening. I think it was a good idea because it is kind of "play for learning" I would say, and children would like technology rather than seating down and writing.
Child interest in the application homework	When I was watching him when doing the app he knew mostly at the level he was because he knew everything it was more like a fun for him rather than like you know... gaining one level up or down. It was like "oh I can do this I well do this", it is motivating.
Advantage of using pen in the activities	The main thing he didn't have to write it on a paper.
Easy to use	Obviously it was easy for him I guess as it is a finger touch and using a pen on screen
Child willingness to do the application homework	Yes he wanted to use it all the time
Time saving/ Advantage of the guide voice	Obviously pen and paper require more time because you have to physically write everything but here you got somebody asking you to do things like "add two numbers" or "write the words" and things like that. I think it is more time consuming when it is in the book
Easy to use	Uploading sometimes was slow; I didn't find anything that is challenging
Relevancy to school curriculum	It is what they are at the moment doing at school. I think it follows what teachers do at school
Replacement for paper homework/	I think they have to learn to write on the paper as well to improve their handwriting because it is much of a softer with the screen. It is kind of a... my son he gets board writing it was easy for him and I think because he didn't have to use eraser it was easier for him I guess. I think with writing (pen and paper) they get board faster and distracted faster.
Advantage of the application over paper homework	
Advantage of doing it by themselves/	I think he was much more independent doing it by himself rather than me seating by him and telling him what to do all the time, tell him don't get distracted don't do this don't do that..... Yes he was doing it independently. With normal homework you have to be there and as I said it's like a play time for them and at the same time learning
Parent participation in application homework	
The amount of the activities/ Diversity of the activities (boys responses)	It was a set think that one may be if you add more as you go probably but initially for that particular time it was good but then but probably after a week or two they don't want to go back and do the same thing so you need to update it all the time so they get more new stuff
Replacement for paper homework	I would not totally eradicate paper homework but I would want to encourage him to learn traditional way as well but of course these days everything are apps and programs for him like to get an idea what is addition subtraction he can do it easily it helps but then for me personally I think they need paper homework at some stage. So I think not replacing it but it is good for student who want some help at learning basic facts math and English writing and reading like sounds phonics and stuff the app helps like I mean in their own time they can do whatever in there but at the same time for me where I came from they need to do how much efforts it takes to do it on paper. That's how we learned right?
Diversity of the activities (boys point responses)	As I said you keep adding more stuff to it and make it much more complex as they go. I think it is on developing things as you keep developing things you get more ideas. But

overall my experience was good it was enough for that period of time.

Table 6. 9: Open coding of the eighth interview with a parent participant

Codes	Interview 8 transcript
Parent participation in the application homework	In my point of view it was very good for both parents and the kids because parents don't need to seat by the children and they can do it by them self
Adding knowledge to parents	-and parent will know about what level they are at school that's really good.
Relevancy to school curriculum	Yes it is good, it is linked very well.
Ease of use	It is very easy, quite easy; there was no problem for my son.
Adding knowledge to students	Yes definitely he did, in both English and Maths.
Reduction of argument between parent and child when doing homework	Well the paper home work he had to do it cause the teacher set this homework and this one (the application) when I ask him do to he will do it
Child willingness to do the application homework	The paper homework he will do it if I company him, we do it to gather but the application I just give it to him he will do it.
The amount of activities	For just one day half an hour for paper homework. This app I think it will assist the homework not replace it. Because he get home work for one day and the rest of the week he doesn't get any but this application is very good that he can use it through the week and
Relevancy to school curriculum	-and he could practice what he learned at school I am quite happy with that
Tracing exercise (boys responses)	Just he doesn't like the tracing part
Replacement to the paper homework	Yes as long as he liked it
Time saving	Yes it did save me time.
The amount of activities	Yes I think it is enough
Tracing exercise (boys responses)	The trace needs to be more simulated.

Table 6. 10: Open coding of the ninth interview with a parent participant

Codes	Interview 9 transcript
Relevancy to school curriculum	The game was quite useful, the level and stages were brilliant, the activities in them were exactly what she is doing at school yep I think it link quite well.
Ease of use/	The application was easy to use. She didn't need much guidance from me in using the program. Only at the beginning I had to tell her how to turn it on and find the game but the
Advantage of guide voice	activities were very easy for her to follow it was guided quite well.

The fraction activities	Oh yes the fraction was very good
Adding knowledge to students/	-fraction is the part that she struggles with so it was a good practice for her during this two weeks she improved a lot in the fraction . I had a meeting with her teacher this week and even her teacher said she has been improving in math. Her English was good but she like the English activities as well specially the spelling .
The spelling activities	
Child willingness to do the application homework	Compare to paper homework yes of course she likes working with game I think all the kids prefer working on these tablets instead of paper that's for sure.
Child willingness to do the application homework	Yes she was asking for it as soon as she got home from school.
Time spend on the app	Doing the same amount of homework yes the game was much quicker. The homework they normally get is about 10 spelling words, 10 to 15 basic facts and some reading. So if she was doing the same amount of work I could say the game was taking less time but she was doing much more on the game as she was enjoying playing with it. So it take more time that way but at least I didn't have to seat with her so I don't mind if take forever ☺ she was doing much more on the game as she was enjoying playing with
Parents participation in app homework	at least I didn't have to seat with her so I don't mind if it takes forever ☺
Adding knowledge to students	As I said fraction was the challenge as initially she couldn't get much of them right, but after practicing every day she mastered her level. So ye, that was the main challenge.
Advantage of using pen in the activities	The pen was a good idea I haven't seen any think like it before , well I have seen the pen I have one myself but what I mean is I haven't seen actives for kids that use pen like the way in this game there are some alphabet tracing well, as I know but nothing like this. This was brilliant .
Parents participation in app homework	I felt I didn't get to participate in her homework; she didn't need me at all as she does with the paper homework.
Advantage of guide voice /	With the paper homework I have to read the activity that the teacher gave her and explain it to her and do an example myself then she will do it and still I have to check if she gets them right
Instant checking of the answers	but with this game I didn't need to do anything it was very clear.
Time spent on the app	Yes as I said before it is much quicker than paper homework and also because I didn't have to guide her so she didn't need me and I could go and do whatever I wanted.
Parents participation in the application homework	-and also because I didn't have to guide her so she didn't need me and I could go and do whatever I wanted. Well the past two weeks she was only doing the game homework so I didn't bother to give her the teacher homework, so that was quite enjoyable for me too as I had some free time to watch my favourite TV show cause I love short land street, so usually I leave the TV on and I watch while I help her with homework I know it is not right way and it is a distraction for her and her homework usually take too long.
Time saving	The past two weeks she was going to her room and does the homework there while I was in front of the TV so yes it definitely saved me time.
Information density	Yes it was quite enough for my daughter
Relevancy to school curriculum	-as it was the same work as she brings home from school.
Replacement for paper homework	Yes I do I very like the game as it gave me some relaxing time the past two weeks.
Quality of the guide voice	Well it was good overall but I think if the voices sounded more real or you could use a kid voice as it is a kids game it was better
Relevancy to school curriculum/	- it was brilliant I liked the idea of levels and stages as I haven't seen something like it before.
Similar applications	

The open coding of the entire interview data resulted in a list of codes, or a ‘coding scheme’ as referred to by Boeijs (2010). The coding scheme contained 33 codes, shown in alphabetical order in Table 6. 11. The next section will explain how the segmented data were reassembled and put together in a meaningful way.

Table 6. 11: Coding scheme for interview data

Codes
1. Adding knowledge to students
2. Adding knowledge to parents
3. Advantage of doing it by themselves
4. Advantage of the guide voice
5. Advantage of the application over paper homework
6. Advantage of using pen in the activities
7. Child interest in the application homework
8. Child willingness to do the application homework
9. Diversity of the activities
10. Ease of use
11. Engaging the brain
12. Instant checking of the answers
13. Interaction between school and home
14. Interest from other members of the family
15. Introducing technology to children
16. Leading to practicing more activities
17. Parent participation in the application homework
18. Recommendations
19. Reduction of arguments between parents and child when doing homework
20. Relevancy to school curriculum
21. Replacement for paper homework
22. The amount of activities
23. The content of the English activities
24. The content of the maths activities
25. The fraction activities
26. The skip counting activities
27. The spelling activities
28. Time saving
29. Time spent on the app
30. Tracing exercises
31. Similar applications
32. Student’s progress
33. Quality of the guide voice

6.4 Reassembling the data

An important and difficult part of the analysis process is reassembling the data. Reassembling is done in order to create a meaningful answer to the research question. After the open coding, all segments or parts of segments coded with the same code were compared to each other to consider how similar or different they were and thus

to check the consistency of the coding. Some segments were recorded as a result and moved to the respective group of coded data.

The findings are summarised in Table 6. 12 and show the final results of the iterative coding process. The first column of the table contains the coding scheme that emerged from the open coding; the second column contains the references to the interviews that were the source of the data related to each code. For instance, the third row shows the code “Advantage of doing it by themselves”; the reference “Interview 2 and 7” indicates that segments from the second and seventh interviews contained data labelled with this code.

Table 6. 12: Final results of the iterative coding process

Codes	Interviewee Responses
Adding knowledge to students	Interviews 2 ,3 ,4, 6, 8, 9
Adding knowledge to parents	Interviews 3, 4, 8
Advantage of doing it by themselves	Interviews 2, 7
Advantage of the guide voice	Interviews 2, 4, 6, 7, 9
Advantage of the application over paper homework	Interviews 1, 3
Advantage of using pen in the activities	Interviews 1, 2, 3, 4,5, 6, 9
Child interest in the application homework	Interviews 1, 2, 4, 7
Child willingness to do the application homework	Interviews 1, 2, 3, 5, 6, 8, 9
Diversity of the activities	Interviews 3, 5, 6
Ease of use	Interviews 1, 2, 3, 4, 5, 6, 8, 9
Engaging the brain	Interviews 2, 3, 6
Instant checking of the answers	Interview 6
Interaction between school and home	Interviews 2, 3
Interest from other members of the family	Interviews 3, 4
Introducing technology to children	Interview 6
Leading to practicing more activities	Interview 4
Parent participation in the application homework	Interviews 4, 7, 8
Recommendations	Interview 1
Reduction of argument between parents and child when doing homework	Interviews 3, 5, 6
Relevancy to school curriculum	Interviews 3, 4, 5, 6, 7, 8, 9
Replacement for paper homework	Interviews 1, 2, 5, 6, 7, 8, 9
The amount of activities	Interviews 2, 4, 8
The content of the English activities	Interviews 2, 3, 6
The content of the maths activities	Interviews 2, 3, 7
The fraction activities	Interview 4
The skip counting activities	Interview 1
The spelling activities	Interviews 3, 4, 9
Time saving	Interviews 2, 3, 4, 5, 6, 7, 8, 9
Time spent on the app	Interviews 1, 2, 4, 5, 6, 9
Tracing exercises	Interviews 1, 2, 5
Similar applications	Interviews 3, 9
Student's progress	Interviews 4, 8
Quality of the guide voice	Interviews 4, 9

After comparing all of the codes, categories were created in order to put the data back together by grouping the relevant codes. After several rounds of data collection the following categories were created: Helping busy parents, Catering for individual learning needs, Handwriting, The content of the application, Quality of the information, Enjoyability, , and Interface. Figure 6. 3 illustrates the categories that have been created and the codes related to them in the form of a 'code tree' as referred to by Boeije (2010). As shown in Figure 6. 3, the codes "Time saving", which contains segments referring to how the application saved time for parents, "Reduction of the arguments between parents and child when doing homework", "Parents participation in the application homework", "Replacement for paper homework", and "Advantage of the guide voice", were categorised under the "Helping busy parent" category. The next category, which was named "Catering for individual learning needs" contains four

codes: “Relevancy to school curriculum”, “Adding knowledge to students”, “Engaging the brain” and “Student’s progress”. There were many interview segments that contained data labelled by these four codes, and the common point made was giving an opinion about the different ways the application was catering for the individual child’s learning needs.

The “Handwriting” label was created for a group of three codes that referred to the handwriting aspect of the application.

Another category was the “The content of the application”. This category contained codes referring to the quality of the content of the application, including the different codes used to label data referring to the quality of the Maths and English activities respectively. “Quality of the information” was a category used to group the codes that indicated the effectiveness of the quality of information provided in the application.

All codes related to data that contained comments about the quality of the application in terms of the interface were grouped together and labelled as “Interface”.

The last category—“Enjoyability”—grouped codes that contained information about children’s responses to the application. The codes in this group indicated the level of the child’s enjoyment while using the application referring to factors such as the amount of time that children were spending on the application, the amount of work done with the help of the application (more or less compared to the paper-based homework), since most of the interviewees mentioned that children spent more time on the application compared to paper-based homework as they enjoyed playing on the application, and the willingness of the child to do their homework using the application.

The categories emerged here contain meaningful information that will be used for further discussion on the feasibility and usefulness of the application as a replacement for paper-based homework. This discussion will be carried out in the next chapter.

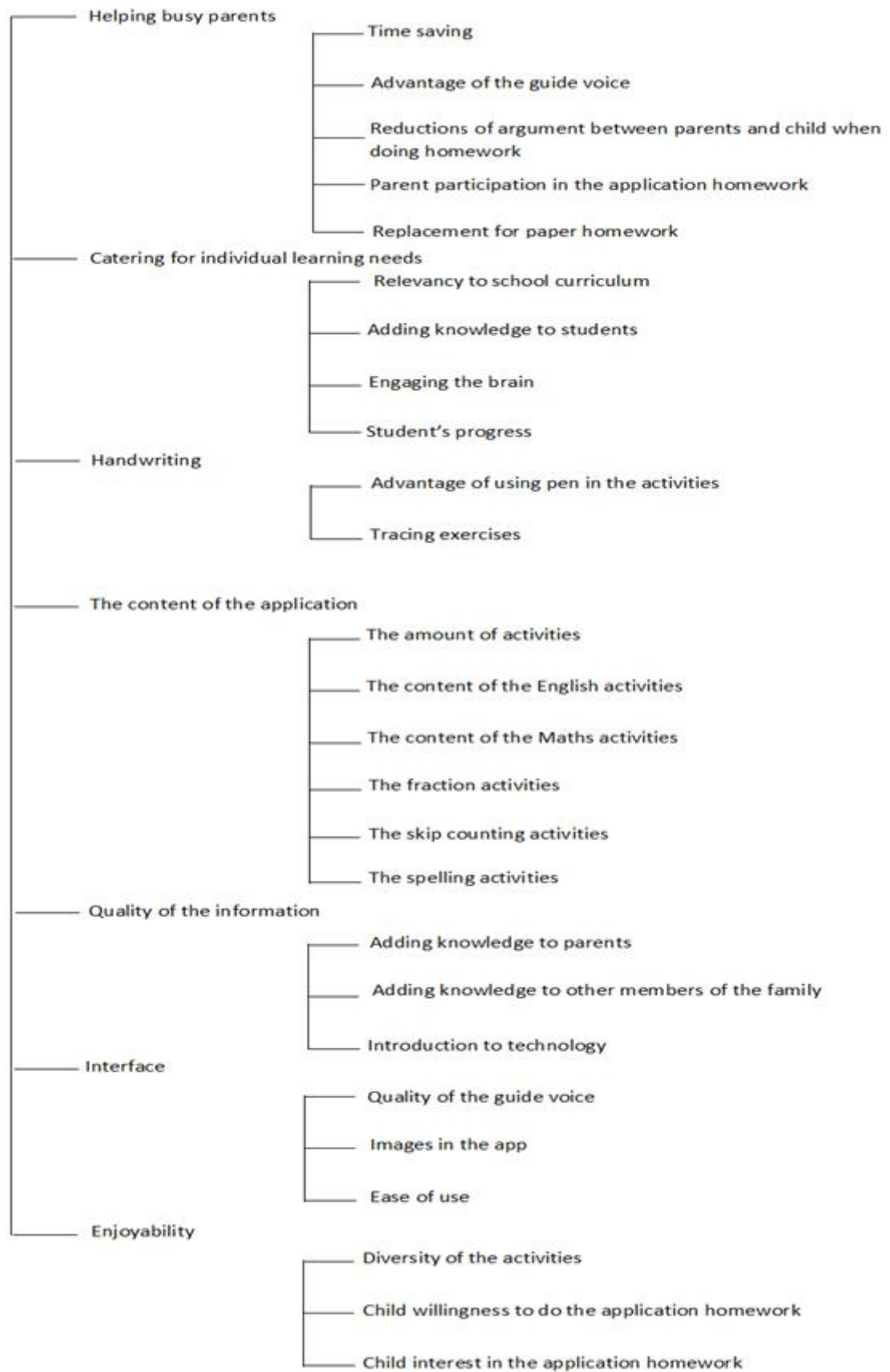


Figure 6. 3: Code tree resulted from categorising the codes

6.2 Summary

This chapter presents the findings of the analysis of the interview data collected during the evaluation phase and explains the process of the evaluation, including selection of participants. In line with using qualitative semi-structured interviews as the data gathering technique, a qualitative data analysis approach was applied to analyse the data gathered. Data were first segmented then coded using a pen and paper based coding method, and reassembled by grouping the codes that emerged from the open coding process into categories that created a meaningful representation of the data. Overall the findings indicated that parents (either busy or not) were willing to start using the mobile application as a replacement for paper-based homework. The next chapter will discuss the findings and their implications in more depth.

Chapter 7: Discussion and Conclusion

This chapter discusses the findings presented in chapter 6 with respect to the research objectives and their implications. The categories emerged from data analysis in chapter 6 is used here for further discussion on the feasibility and usefulness of the application as a replacement for paper-based homework.

7.1 Discussion

As shown in the previous chapter, the data gathered from the interview responses were grouped in seven different categories to highlight useful information. Some of the findings fit with expectations of outcomes, while others provided new insights. A discussion about these findings follows below.

7.1.1 Helping busy parents

As mentioned, one of the objectives was to develop an application that could help busy parents. The results of the evaluation show that the application has met this objective, and that the application helped busy parents in several ways. First, the application saved time for parents. As stated in chapter 2, lack of time was the most significant problem for busy parents, especially for single parents. All parent participants stated that the application saved them a lot of time by reducing the time they spent helping their children with their homework. Parents stated that the application allowed children to do their homework independently, as one interviewee said: “It will definitely save time because I don’t have to sit by her and tell her what to do.” This has left parents with more time for other things; a parent added “I have more time for other things such as cooking or spending time with my other kids or housework.” Even the parents who were not working outside their home or were not very busy found the application useful in terms of time saving as it left them more time for relaxing: “the past two weeks she went to her room and did her homework there, while I was in front of the TV. So yes it definitely saved me time.” Overall parents had more time for doing other things, including doing things with their children that they enjoyed (rather than homework). Figure 7. 1 illustrates a student doing the homework application independently.

As stated in chapter 2, although parental involvement with children’s homework is a positive factor in children’s learning, it may lead to arguments and disagreements between parents and children. Consequently, this may result in frustration for both and even make children hate homework (Dobkin, 2007). Most parent participants mentioned that they had problems making children do their paper homework: “I have complaints with paper homework, she cries; no



Figure 7. 1: Student doing the homework application independently without the need of parents [permission to use the picture was obtained from the parent].

I do not want it.” Using the application as a replacement for paper homework was very motivating for the children: they were willing to do their homework without any argument or without parents even asking them. One participant said, “Well, she is not a big fan of homework. I have to ask her to do her school homework otherwise she won’t do it, but with the application she was asking **me** to play on it.” Therefore, the application helped to reduce parent and child arguments over homework. As Cooper and Valentine (2001) point out, even if homework does not result in arguments some parents might not have enough knowledge to help their children and may even confuse them by using techniques different from those used by the teachers at school. Therefore as stated in chapter 5 the application was designed in a way that follows the school curriculum and the activities are similar to what children are doing at school; additionally the activities were designed to use the methods they are taught at school. Hence parents felt assured of the quality of the activities and that their children’s learning needs were met: “I was sure that she was doing homework and not wasting her time, so I could do my work or spend some time with my little ones while she was playing on the app.”

One of the factors that helped parents save time was the use of the guide voice, since the guide voice told the child what to do and there was no need for parents to explain. The student could follow the activities in the application easily without any help. One parent said “obviously pen and paper require more time because you have to physically write everything but here you have someone asking you to do things like ‘add two numbers’ or ‘write the words’ and things like that. I think it is more time consuming when it is in the book.” Another advantage of the guide voice was that parents could hear what their child was doing without sitting by them: “I could be in the kitchen and I could hear her getting questions correct. You could hear if she got it right or if she got it wrong.”

By using the application for homework, children were able to be more independent and did not need their parents’ help. All the parents mentioned that with the application there was no need to sit by their child and lead them through the activities as they had to do with paper homework. One parent mentioned, “[My child] was much more independent doing it by himself rather than me sitting by him and telling him what to do all the time.”

Most of the parent participants thought that the application could be a very good replacement for paper homework for various reasons: “Yes definitely I support this idea. I support this app instead of these papers that kids bring home from school.” By using the application, parents will not lose the opportunity to participate in their children’s homework; they can do the activities together whenever they want or have the time for it. This was a positive characteristic of the application that was mentioned by several parents: “I can choose not to sit with her when I don’t have the time and if I want to watch her I can. So I don’t lose anything but it could save me time.” Other

parents liked the application as it provides them with time for relaxation: “I like the game as it gave me some relaxing time the past two weeks.”

Some parents liked the application but to be used it in conjunction with paper homework rather than as a replacement as they thought using pen and paper was still required. Holding an actual pen and writing on paper had a different feeling: “I think they have to learn to write on paper as well to improve their handwriting because it is much softer on the screen.” Another parent added “I would not totally eradicate paper homework. I would want to encourage him to learn traditional way as well, but of course these days everything has apps and programs.”

7.1.2 Catering for individual needs

Another important objective of the application was to cater for individual student’s learning needs. As stated in chapter 2, each student’s level of learning skills and abilities need to be considered when teaching or assigning activities. One indicator of how well the application catered to individual learning needs was the match between the activities and the school curriculum. All parents found that the application was very relevant to what their children were doing at school and bringing home for homework. They all mentioned that the activities were very similar to the homework: “Choosing her stage for math was very relevant to the homework she brings home, so the exercises were quite similar. For English the same.” Another interviewee added, “The math was very good and very much in tune to what she was doing at school. So that’s great.”

As discussed in chapter 2, one of characteristics of high quality activities is to help students develop new knowledge. An activity results in optimal learning if contains the appropriate level of challenge for a particular student. However activities should not be too challenging so that the student gives up doing the activity nor too easy so that the child is bored—both will result in low academic growth (Strickland, 2007).

According to Vygotsky (1978), learning activities that are not in the student’s ZPD (Zone of Proximal Development) will not help build new knowledge. Therefore student developing new knowledge could be another indicator of how well the application catered for individual learning needs. Therefore, the activities in the application were designed to incorporate the right degree of challenge for each individual student by keeping them in their ZPD (following the recommendations provided in the New Zealand school curriculum). Participants confirmed that the application added knowledge to the students and that the activities had the right level of challenge for their children: “It was challenging, not very easy but it made her think to come up with an answer.” One participant mentioned that her child was not very good at subtraction and using this app made him learn more. Another stated that using the application taught her child how to spell some words that she had a problem with before. Another participant noticed some improvement in her child with fractions: “Fractions were the challenge, as initially she couldn’t get much of them right, but after practicing every day she mastered her level. So yes, that was the main challenge.” Participants also

noticed that by practicing the activities there was noticeable progress and that the children had mastered their levels and were ready to move up one level: “She got about 80% correct initially in the English section and doing more every time she was getting better and better.” Additionally the activities engaged children’s brain and made them think: “The math was brilliant. For her at that level it was just the right amount of challenge; she had to think to subtract. It made her think.” Overall most participants agreed that the application activities helped children develop new knowledge.

7.1.3 Handwriting

One of the requirements of the application was to incorporate handwriting in the activities. Parent participants were satisfied with using the stylus; children liked to use the stylus as it made the activities more enjoyable and the practice of handwriting more fun: “The pen was a good idea. ... I haven’t seen activities for kids that use a pen like this. ... This was brilliant.” Participants confirmed that the tracing activities were advantageous as they helped children in their handwriting practice and taught them to write properly. One participant mentioned: “The pen was definitely a good idea because it teaches them how to write properly. It teaches them where to start, how to create the lines, and it helps them to write neatly. And yes it will be very useful to have the pen with the app.”

7.1.4 The content of the application

As the duration of the evaluation was two weeks, the application activities covered two weeks of homework activities. Most of the parent participants were happy with the amount of homework activities and confirmed that they were similar to the assigned homework activities by teachers: “for what she normally gets in a week, yes it was enough.”

Some thought more English activities were required: “Math was good but I would have liked to see a little bit more on the English side. I would have liked to see more spelling [exercises] because at their age they are just starting to learn how to write, so I think more spelling will be helpful.” However, the quantity of the maths activities was considered sufficient and the contents were found to be of high quality and challenging. All participants made positive comments on the math exercises, noting that they presented an appropriate challenge for each individual student and followed the same approach as in the school curriculum. For instance, as explained in chapter 4, students at Stage 3 should be able to count all of the objects in their minds so that they no longer rely on physical material to solve simple addition and subtraction problems. In that respect, a participant whose daughter was at Stage 3 said, “The maths I felt were similar to what she is doing at school. Mia is very good at calculating addition and subtraction in her head and occasionally using fingers. So it was very good that you didn’t have any images for her level.” One of the high quality activities of the maths area is the fraction activities. As stated by teacher interviewees (see chapter 4), fractions are a subject that students have problems understanding. In the application,

fractions were represented by images of objects the children were familiar with in the real world (such as pizza or biscuits), and they started with simple problems such as halves or quarters and moved to more complicated examples as advised by the teacher interviewees. As a result of using the application, many improvements in learning fractions were reported by the parents. For instance, one of the participants stated that “Fractions are the part that she struggles with, so it was good practice for her during these two weeks. ... I had a meeting with her teacher this week and even her teacher said she has been improving in math.” Another participant added: “I liked the fractions in the math section, ... math was designed pretty well overall, but the fractions were the best.” The other activities that the participants specifically mentioned as being relevant were the skip counting activities: “The skip counting was good, the skip counting by 2 as well as the skip counting by 5—those were good.” She added: “It was quite relevant because at the moment they are doing skip counting and simple additions.”

One of the participants said that the activities were more than what they get at school, however she was pleased that her son could do more activities: “because he gets homework for one day and the rest of the week he doesn’t get any, but this application is very good that he can use it through the week and he can practice what he learned at school. I am quite happy with that.”

Another activity that was valued highly was the spelling activity. As was explained in chapter 5, in the spelling activity the guide voice asks the student to write down a word and the student writes it down. Later they are given the opportunity to check their answers. The parent participants reported this activity as a particularly useful one: “spelling on the English side was very good because she had to think how to write the words, so that was challenging.” Some of the participants thought that this activity was better than the tracing activity as it was more challenging and required more complex thinking. “The spelling section was very good as she had to write the word herself and then check to see if she got it right rather than tracing the word.” A participant added: “I liked the spelling section. It was challenging and she enjoyed it.”

7.1.5 Quality of the information

The results of the evaluation imply that the application has provided high quality information. The application content was useful and helped students as well as their parents, since the parents gain new knowledge about the levelling system used at school and also their children level. Categorising the activities based on maths stages and English levels (explained in chapter 4) was something new for most of the parent participants, as most of them were not familiar with the way homework activities were categorised. The teacher interviewees also indicated that this would be a great advantage to parents as it familiarises them with the school curriculum. Teachers felt that when they talked to parents about their child’s progress and moving them up from a level or stage parents would be able to better understand the concept: “I like how it aligns with the NZ number series and stages ... which makes it really useful ... for

parents as well because they will get an understanding of what the teachers are talking about when they say your kids are at this stage and this is what they need to know, so I think that's really good." Parent participants were also satisfied that from the application they learned more about their children's abilities and what they are doing at school: "I loved the levels and stages that you had in the app. To be honest I didn't know much about these levels and stages ... It was something new for me."

Participants also mentioned that the application played a good role as an intersection between home and school since the parents became more interested in knowing which level or stage their child was at: "I didn't know much about these levels and stages. ... When you told me about the stages I had to go and ask her teacher." This gave them a better understanding about the school curriculum: "It is a good interaction between school and home as we learn about what they are doing at school."

Additionally, participants mentioned that the application was interesting enough to attract the other young children in the family and they gained new knowledge as well: "Mia loved the game, even though one child was meant to be doing it my other one was doing it as well, and both loved it." It added new knowledge to the younger children as well; a participant said: "She is only 4 ... [and] she learned the letter 'M'." Figure 7. 2 illustrates a picture of a Year 1 student doing homework while her younger sister watches.



Figure 7. 2: A Year 1 student doing the homework application. [Permission to use this picture was obtained from the parent.]

7.1.6 Technology

Cordes and Millers (2000) suggest that technology is very important in the everyday lives of the children and therefore it should be open to them. Using the application for homework will help children be more open to technology at an early age, as a participant said: "children will be introduced to technology in early ages, which is good." According to parent participants, introducing children to technology is beneficial especially since they are using technology (tablets or computers) at school, so by using them at home and becoming more familiar with them, develops children's confidence in using technology. One of the participants mentioned that using the application helped children be more open to technology: "because they have them [tablets or computers] at school I want her to be open to them, open to using them." Therefore, apart from the academic benefits, effectively integrating technology in the

school curriculum (e.g., homework), opens children's eyes to the world of technology and helps develop confidence and self-esteem in terms of technology.

7.1.7 Interface

As stated in chapter 5, two features that were expected to have a negative effect on the quality of the application interface were the guide voice and the images used in the application. Since the voices were computer voices (recorded using an iPhone) they were not of good quality and it was noticed by the parent participants: "it would have been better to have nice voices that sound more real." (As explained in chapter 5 it was not feasible to have a good voice because of the associated cost.) Participants also insisted that there was a need for more images: "I think children would like to see more images." Since most of the images were drawn by the researcher using Microsoft Paint, providing a large number of images was a very hard and time consuming task—well beyond the time limit. Despite these issues the application was still attractive to children: "It is very good. I really liked it. My son loved it. I think this is a great idea for both children and parents." Moreover, the application layout was simple and the GUI was a winning GUI (Helander, Landauer, & Prabhu, 1997). Designing a winning GUI is an important aspect in mobile application design. As shown in chapter 5, four factors defined by Gilutz and Black (2010) were put into consideration in designing the GUI: age, technology experience, complexity and familiarity. If the interface was simple and the children were familiar with the shapes or images used in the GUI, it would be easier for the children to work with it (Gilutz and Black, 2010). Therefore the GUI were designed to be very simple containing only few buttons (each button has an image representing its responsibility and also they are familiar images that children have seen on devices such as remote controllers) and the activities were designed using shapes and images used at school (e.g., image of pizza in the fraction activities) and also based on the school curriculum, and also considering teacher interviewees' advice about the vocabulary used by the guide voice—similar to the vocabulary used by teachers at school. As the GUI and the flow of the activities were familiar for the students it was easy for them to follow the activities and they did not encounter problems when using the application as one participant said "it was easy; [My child] had no problem working with it." Additionally, the fact that the children needed no help from parents when using the application indicates that the layout was sufficient and the purpose of each button was clear: "The application was easy to use. She didn't need much guidance from me in using the program. Only at the beginning I had to tell her how to turn it on and find the game, but the activities were very easy for her to follow. [The application] was guided quite well."

7.1.8 Enjoyability

Overall the application seemed to be more enjoyable for students compared to paper-based homework. Children spent more time doing the homework application compared to paper homework, resulting in gaining more practice: "If she was doing the same amount of work [as the paper homework] I could say the game was taking

less time but she was doing much more on the game as she was enjoying playing with it." Another participant added: "The homework she is getting at school is limited, so it will be done when she finishes all the tasks, but with your application she was starting all over again as she finished each task. But I didn't really mind as long as she didn't need my help. I was happy seeing her doing more exercises." Parents confirmed children's willingness to do the application homework, and that there was no need for parents to ask their children to do it: "She was asking for it as soon as she got home from school." The parent added: "She has asked for it couple of times since it has gone."

7.2 Gender differences

The results of the evaluation illustrate interesting gender differences in response to the application. This was an unexpected result that could be useful to consider in the further design of the application in the future.

Tracing exercises were seemingly enjoyed by girls more than boys. Boys were not willing to do the tracing over words: "he didn't like the tracing over the words, he skipped it."

Boys needed more diversity in the activities in order to maintain their interest whereas girls could spend a long time on one activity without getting bored: "Initially he was good, he was asking to do it, but then he got bored of it. ... I think with girls it is different. They could sit down for hours drawing a picture....."

Studies have consistently reported different interests or behavioural responses by male and female students. One area that has been studied for gender difference is the use of computers. For instance, a study by Shashaani (1997) showed that males and females had different attitudes toward the use of computers. Later Mumtaz (2001) also noticed a gender difference in responding to different sorts of computer activities in her study.

The implication of this finding is that an additional factor that should be considered in order to design activities for students is the gender difference, and that the female and male interest and attitude towards different sorts of activities should be investigated in detail to inform the design of the activities and the way they are imbedded in the application.

7.3 Summary

This chapter has presented a discussion about the findings from analysing the data gathered from parent's interview. It's argued the main strength factors of the application (which were categorised in chapter 6) in details and specify parent's points of view on each factor. Next chapter will conclude the research, knowledge the limitations of the research, and will suggest recommendations and directions to future research.

Chapter 8: Summary and conclusion

This chapter presents a summary of the main milestones and highlights major accomplishments. It also knowledge some research difficulties and limitations that encountered. Finally it's suggests recommendations and directions to future research.

8.1 Thesis summary

The objective of the research was to develop a means to facilitate the work of parents of Years One and Two students in New Zealand who were interested in their children's academic success and were willing to help them with their homework but did not always have the time or the means. The introductory chapter explained the nature of homework assignments for Year One and Year Two students, and how homework is seen as useful to children's academic success. The role of handwriting as an important factor in improving learning was discussed. The issues around completing homework assignments were identified and briefly explained.

In chapter 2, selected research on various aspects of the child learning process was reviewed and more specifically research on the importance of homework for children's academic success and the impact of handwriting on learning (Focusing particularly on the effect of handwriting on brain development in comparison to typing). The issues regarding parental involvement in children's homework and issues regarding the completion of homework were discussed in more detail. One of the fundamental problems in education (finding a way to adapt instruction in order to accommodate for student differences) was highlighted and some relevant prior work was reviewed.

Chapter 3 introduced the design science approach as the research methodology adopted in this study. Prior studies aiming to discover a suitable approach for IS/IT discipline research were reviewed, and the approach introduced by Hevner, March, Park and Ram (2004) was adapted for this study. The development process was regarded as the most essential part of design science cycle as it contributes to its continuous progress. The major study objectives were highlighted and related to the research approach. Detailed descriptions of the specific design steps were included e.g., a description of the data gathering and data analysis methods used.

Chapter 4 presented the findings from the first round of interviews with primary school teachers. Two main points emerged. The first point indicated that all homework and school activities in New Zealand schools must be designed according to New Zealand curriculum designed by the Ministry of Education. The second point specified that New Zealand schools used standards for reading, writing and maths that established the level of literacy and maths skills that could be expected to be achieved by the end of each period (a school term or a school year). Each child should be assigned to a standard based on their level of skills. The New Zealand curriculum and the levels and stages related to Year One and Year Two students were investigated and presented to be used in the design of the application.

Chapter 5 explained in detail the design of the mobile application and how it was informed by the findings of the first set of interviews (presented in chapter 4). The chapter explained how the design of the application would meet the study objectives. The platform chosen for the development was introduced along with the programming language. The chapter includes precise descriptions of the activity design drawing from the New Zealand curriculum, and explains how the activities were categorised to cater for individual learning needs. The results of one of the important parts of the design science cycle—obtaining feedback from stakeholders (teachers)—were discussed.

The designed application was tested and validated by nine participants from different regions of Auckland. Chapter 6 gives a brief description of the participants and the processes of evaluation, data gathering, and data analysis. It discussed how the data were prepared and segmented, coded using an open coding method, and reassembled. It described the categories that emerged from the data reassembling and provided information for the discussion in this chapter.

8.2 Conclusion

Few numbers of motivations has driven this research. First was the use of computers for doing primary school student homework. Although there are some educational computer games that have been designed for primary school students, however, there was no evidence available of the use of educational computer games that focus on homework and replace paper-based homework.

Second was to incorporate handwriting in educational computer games. As mentioned in the earlier chapters use of handwriting in doing educational activities plays an important roles in learning development. Considering this, there was no evidence of computer educational games replacing paper homework and incorporating activities that need to be done using handwriting.

Third was the need to explore what helps to design educational computer games for primary school students that focus on student differentiation and cater for individual student learning needs.

Homework (tasks that children bring home from school) plays an important role in children's academic development. Homework tasks serve as an extension to class room teaching and learning and are an indispensable part of the learning process.

With young students, homework yields better results when done under the supervision of a parent or another adult. However today's busy parents may find it difficult to allocate enough time for helping their children with homework, leaving them both overloaded and worried about how this would affect their children's success.

This study aimed to show how a tablet software application may provide a solution to the problem and help decrease the need for parental involvement. The software

application design ensured that parents spent less time assisting children with homework at the same time giving them confidence that the application based homework was not less effective than paper based homework and thus would have a positive impact on children achievement.

According to the result of the evaluation, the application met this objective in two different ways. First, to assure parents of the quality of the activities embedded in the application, the activities were developed following the New Zealand school curriculum. Furthermore the activities were aligned with the learning levels and stages assigned to individual students at school and matching the child's current learning needs. Second, the design included a guide voice to guide the student through the activities, and a GUI based on images with which students would be familiar; these design approaches made it possible for children to work more independently and require less help. As a result children doing home on their tablet application saved parents time: children did not need a parent to sit by and guide them throughout the activities which is the case with paper based homework. At the same time parents were confident about the quality of the tablet-assisted learning.

Additionally children enjoyed doing the application homework, as it was similar to a computer game – and playing computer games has always have been fun and attractive. Second since the activities had appropriate challenges appropriate to the individual student's learning level (as assessed at school) the risk for a student to start losing interest, or give up quickly was minimised. Finally the application is not only a help for parents, it actively helps the student to learn by keeping him or her in their "Zone of Proximal Development" (Vygotsky, 19978), which leads to optimal learning and academic success. Overall parents strongly supported the adoption of the application as the replacement for paper based homework.

8.3 Limitations and directions for further research

The application was developed as prototype and was evaluated by a small sample of parents therefore the results are of limited validity. Further research may include developing a more comprehensive set of interview questions that would allow parents to provide more feedback informing the next stages of the development of the application. More specifically it would be helpful to collect data related to gender differences: the evaluation results showed that gender difference is an important factor influencing a child's interest in the different activities. Further study is needed in order to investigate this factor in more detail and to find out how the issue can be addressed.

As already mentioned the application was designed and coded by the researcher herself who encountered problems with sourcing suitable images. At a next stage the application would need professionally crated images that would be both more relevant and more attractive. Similarly the guide voice used should be very clear and

understandable – best would be a professional recording, of an actor with good diction and accent.

With respect to the pedagogical approach, the designer may consider incorporating into the application books from the *“Ready to Read”* book series students are given to take home every day, and designing some activities related to each book in order to increase children’s comprehension when reading the books.

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Appendices

Appendix A: Auckland University of Technology Ethics Committee (AUTEC) Approval for the first round of teacher interview



MEMORANDUM

Auckland University of Technology Ethics Committee (AUTEC)

To: Kassie Petrova
From: Rosemary Godbold, Executive Secretary, AUTEC
Date: 23 August 2012
Subject: Ethics Application Number **12/177 Developing an android application for an android tablet to help parents keep their children motivated for learning.**

Dear Kassie

Thank you for providing written evidence as requested. I am pleased to advise that it satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC) at their meeting on 23 July 2012 and I have approved your ethics application. This delegated approval is made in accordance with section 5.3.2.3 of AUTEC's *Applying for Ethics Approval: Guidelines and Procedures* and is subject to endorsement by AUTEC at its meeting on 10 September 2012.

Your ethics application is approved for a period of three years until 23 August 2015.

I advise that as part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 23 August 2015;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. This report is to be submitted either when the approval expires on 23 August 2015 or on completion of the project, whichever comes sooner;

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are reminded that, as applicant, you are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

Please note that AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to make the arrangements necessary to obtain this.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all written and verbal correspondence with us. Should you have any further enquiries regarding this matter, you are welcome to contact me by email at ethics@aut.ac.nz or by telephone on 921 9999 at extension 6902. Alternatively you may contact your AUTEC Faculty Representative (a list with contact details may be found in the Ethics Knowledge Base at <http://www.aut.ac.nz/research/research-ethics/ethics>).

On behalf of AUTEC and myself, I wish you success with your research and look forward to reading about it in your reports.

Yours sincerely

Dr Rosemary Godbold
Executive Secretary
Auckland University of Technology Ethics Committee

Cc: Asra Rahimi greenfall2006@yahoo.com

Appendix B: Invitation letter for the first round of teacher interviews

An Invitation Letter



Asra Rahimi, MCIS Student
School of Computing and Mathematical Sciences
Auckland University of Technology

10 July 2012

Dear Prospective Research Participant:

My name is Asra Rahimi. I am currently working on my Master of Computer and Information Sciences (MCIS) thesis at the Auckland University of Technology (AUT). I

would like to invite you to participate in my research project taking part in a one-to-one interview on selecting suitable activities for children to be used in my application. I would appreciate your willingness to participate in this research. I believe your experience and knowledge will help in selecting good materials for content of the application. Your participation in this research is entirely voluntary and you may withdraw at any time prior to the completion of the data collection, without any adverse consequences.

I intend to collect data for my research by performing in-depth interviews with participants. An interview should take no more than 45 minutes and will take place at a location and time convenient to you. More formation about this project is provided in the attached "Participant Information Sheet".

Please contact me to indicate accepting the invitation at the email address provided below. You may also wish to complete and return the atached consent form; however you will be able to complete it at the beginning of the interview as well.

Any concerns regarding the nature of this research should be notified in the first instance to the Project Supervisor: Krassie Petrova, Senior Lecturer, School of Computing and Mathematical Sciences, Auckland University of Technology, phone: 09-921-9999, x.5045, email: krassie.petrova@aut.ac.nz.

Yours sincerely,

Asra Rahimi

MSIC student, School of Computing and Mathematical Sciences
Auckland University of Technology
Phone: 021 268 5935, Email: vtd9492@aut.ac.nz

Attachments: Participant Information Sheet, Consent Form

Appendix C: Participant Information sheet for the first round of teacher interviews

Participant Information Sheet



Date Information Sheet Produced:

10 July 2012

Project Title

Developing an Android application for an Android Tablet to help parents keep their children motivated for learning

An Invitation

My name is Asra Rahimi. I am currently working on my Master of Computer and Information Sciences (MCIS) thesis at the Auckland University of Technology (AUT). I would like to invite you to participate in my research project taking part in a one-to-one interview on selecting suitable activities for children to be used in my application. I would appreciate your willingness to participate in this research. I believe your experience and knowledge will help in selecting good materials for content of the application. Your participation in this research is entirely voluntary and you may withdraw at any time prior to the completion of the data collection, without any adverse consequences.

What is the purpose of this research?

The purpose of this study is to design an application to help parents improve their children's academic success and to ease the work of parents and save their time when helping their children with their homework. Also the application will teach children time management skills, make the learning enjoyable for the children and improve children's language arts (specifically writing) as well as their maths and English skill.

How was I identified and why am I being invited to participate in this research?

You are being invited to participate in this study because you were identified as a primary school teacher with significant experience in teaching year1 and year2 student and are familiar with their ability and their needs.

What will happen in this research?

Upon agreeing to participate in the research, you will be approached in order to set up an appointment at a time and a place you are comfortable with. This could be your class room. If you have not signed up a consent form prior, it will be given to you at the start of the interview session. The interview consists of questions related to content of your teaching and activity that you give to children for their homework. The interview session is expected to last not more than 45 minutes. The proceedings of the interview will be recorded; the audio clip will be analyzed by a software product. The outcomes of the analysis will form part of my thesis. Subsequent research papers may draw on the findings of the analysis as well.

What are the discomforts and risks?

There are no anticipated discomforts or risks. However, if you find a question sensitive and do not wish to answer it, you will be able to do so.

How will these discomforts and risks be alleviated?

You can refuse answering a question, or answering it very briefly, without explaining the reasons for that.

What are the benefits?

The major benefit we as researchers expect is to be able to gather good quality data, complete the project successfully. Participants will not benefit directly but will appreciate the fact that more children will be completing their homework successfully due to the help provided by the mobile application. Also the application will be provided free of charge to the participants. This study will also contribute towards an academic qualification for the researcher but there will be no financial benefits from

developing the application as it will not be marketed. It is hoped that the findings of the research will be disseminated through publication in an academic journal or conference.

How will my privacy be protected?

The identity of the interviewees will be known only to the researchers (the Master's student and her academic supervisor). No personal and business details that may reveal the identity of a participant will be used in any subsequent report and publication. The individual participants will not be known to each other. The original interview records will be stored in secure storage for a period of 6 years after the completion of this study. The consent forms will be stored at a separate secure location, for a period of 6 years. The material will be destroyed once the storage period expires.

What are the costs of participating in this research?

There is no financial cost involved in the study. However, 45 minutes of your time are required.

What opportunity do I have to consider this invitation?

Your participation is entirely voluntary. If you are not able to make the decision immediately, you can still contact me within 2 weeks of receiving the invitation. .

How do I agree to participate in this research?

By signing and returning to me the consent forms.

Will I receive feedback on the results of this research?

The results will be first published in the form of a thesis. If you wish to, you will be sent an email with the thesis URL once it is available online.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this research should be notified in the first instance to the Project Supervisor, Krassie Petrova, krassie.petrova@aut.ac.nz, 09-921-9999, x.5045.

Concerns regarding the conduct of the research should be notified to the Executive Secretary, AUTECH, Dr Rosemary Godbold, rosemary.godbold@aut.ac.nz, 921 9999 ext 6902.

Whom do I contact for further information about this research?

Researcher contact details

Asra Rahimi, MCIS student, School of Computing and Mathematical Sciences
Auckland University of Technology
Phone: 0212685935
Email: vtd9492@aut.ac.nz

Project supervisor contact details

Krassie Petrova, Senior Lecturer, School of Computing and Mathematical Sciences
Auckland University of Technology
Phone: 09-921-9999, x.5045
Email: krassie.petrova@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on **23 August 2012**, AUTEK Reference number **12/177**.

Appendix D: Invitation Letter for the Principal

An Invitation Letter



Asra Rahimi
Master of Computer and Information Sciences Student
School of Computing and Mathematical Sciences
Auckland University of Technology
Phone: 021 268 5935, Email: vtd9492@aut.ac.nz

10 July 2012

Dear School Principal:

My name is Asra Rahimi. I am currently working on my Master of Computer and Information Sciences (MCIS) thesis at the Auckland University of Technology (AUT). I would like to invite a maximum of two of your teachers with experience in teaching

years 1 and 2 students to participate in my research project taking part in a one-to-one interview on selecting suitable activities for children to be used in the Android tablet application I am developing as part of my thesis.

I would appreciate your permission to approach teachers, invite them to participate and conduct the interview at the school premises. I believe that the teachers' experience and knowledge will help in developing the content of the application. The participation in this research is entirely voluntary and they may withdraw at any time prior to the completion of the data collection, without any adverse consequences. I intend to complete an interview with a maximum of two teachers only from your school.

I intend to collect data for my research by performing in-depth interviews with participants. An interview should take no more than 45 minutes. It will be structured around several questions. The participants will be under no obligation to answer a question, if they do not want to. The interview will be recorded with a digital recorder. The information collected during the interviews will be considered private and will be used for this research study only. The identities of the participants and their personal and business details will be known only to me and my academic supervisor, and will not be revealed in any subsequent publication including my Master's thesis. More information about this project is provided in the attached "Participant Information Sheet". Any concerns regarding the nature of this research should be notified in the first instance to the Project Supervisor: Krassie Petrova, Senior Lecturer, School of Computing and Mathematical Sciences, Auckland University of Technology, krassie.petrova@aut.ac.nz , 09-921-9999, x.5045.

I hope to hear from you soon, granting me the permission for contacting and interviewing teachers as described above.

Yours sincerely,

Asra

Appendix E: Participant Consent form for the first round of teacher interviews

Consent Form



Project title: *Developing an Android application for An Android Tablet to help parents keep their children motivated for learning*

Project Supervisor: *Krassie Petrova*

Researcher: ***Asra Rahimi***

- ☐ I have read and understood the information provided about this research project in the Information Sheet dated 30th of November 2012.
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed.
- ☐ I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ☐ If I withdraw, I understand that all relevant information including tapes and transcripts, or parts thereof, will be destroyed.
- ☐ I agree to take part in this research.

- ☐ I wish to receive information (email) about where I can find a copy of the report from the research (please tick one): Yes ☐ No ☐

Participant signature:

.....
.....

Participant's name:

.....
.....

Participant's Contact Details (if appropriate):

Email :

Date:

*Approved by the Auckland University of Technology Ethics Committee on 23 August 2012 AUTECH
Reference number 12/177*

Note: The Participant should retain a copy of this form.



Appendix F: Teacher's Interviews questionnaire

1. First round of interview with teachers

Tentative interview questions

Interview number:

Date:

Question related to Year 1 and Year 2 students:

1. Let us discuss the different levels of math you teach and the requirements for each.
2. Let us discuss the different levels of English you teach and the requirements for each.

3. What subject's you are teaching to year1 students other than math and English?
4. What sorts of activities do children respond to?
5. What activity do you use to engage the reluctant students?
6. What resources do you use to design the activities that you give to the children?
7. Are there any specific learning areas that require more practice than others?



8. Would you have any suggestions about exercises, or just ideas about exercises that I could use in my application?

Appendix G: Auckland University of Technology Ethics Committee (AUTC) Approval for the development and the evaluation Phase

5 December 2012

Kassie Petrova
Faculty of Design and Creative Technologies

Dear Kassie

Re: 12/177 Developing an android application for an android tablet to help parents keep their children motivated for learning.

Thank you for your request for approval of amendments to your ethics application.

I have approved the addition of the interviews with existing participants as a minor amendment to your ethics application

I remind you that as part of the ethics approval process, you are required to submit the following to AUTC:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 23 August 2015;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. This report is to be submitted either when the approval expires on 23 August 2015 or on completion of the project.

It is a condition of approval that AUTC is notified of any adverse events or if the research does not commence. AUTC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this. If your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply there.

To enable us to provide you with efficient service, please use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,



Dr Rosemary Godbold
Executive Secretary
Auckland University of Technology Ethics Committee

Cc: Asra Rahimi greenfall2006@yahoo.com

Appendix H: Invitation letter for the Development and Evaluation phases

An Invitation Letter



Asra Rahimi, MCIS Student
School of Computing and Mathematical Sciences
Auckland University of Technology

30 November 2012

Dear Prospective Research Participant:

My name is Asra Rahimi. I am currently working on my Master of Computer and Information Sciences (MCIS) thesis at the Auckland University of Technology (AUT). I would like to invite you to participate in my research project by testing a mobile application and sharing with me your experiences and impressions in an interview. Your participation in this research is entirely voluntary and you may withdraw at any time prior to the completion of the data collection, without any adverse consequences.

I intend to collect data for my research by asking participants to test my application and then performing in-depth interviews with participants. Testing the application should not involve more than a total of 4 hours; it will be done without my involvement and will take place during a two week period, at times and locations convenient to you. An interview should take no more than 45 minutes and will take place at a location and time convenient to you. More formation about this project is provided in the attached "Participant Information Sheet".

Please contact me to indicate accepting the invitation at the email address provided below. You may also wish to complete and return the atached consent form; however you will be able to complete it at the beginning of the interview as well.

Any concerns regarding the nature of this research should be notified in the first instance to the Project Supervisor: Krassie Petrova, Senior Lecturer, School of Computing and Mathematical Sciences, Auckland University of Technology, phone: 09-921-9999, x.5045, email: krassie.petrova@aut.ac.nz.

Yours sincerely,

Asra Rahimi

MSIC student, School of Computing and Mathematical Sciences

Auckland University of Technology

Phone: 021 268 5935, Email: vtd9492@aut.ac.nz

Attachments: Participant Information Sheet, Consent Form

Appendix I: Information sheet for the Development and Evaluation phases

Participant Information Sheet



Date Information Sheet Produced:

30 November 2012

Project Title

Developing an Android application for an Android Tablet to help parents keep their children motivated for learning.

An Invitation

My name is Asra Rahimi. I am currently working on my Master of Computer and Information Sciences (MCIS) thesis at the Auckland University of Technology (AUT). I would like to invite you to participate in my research project taking part in testing a mobile application helping young children to do their homework and subsequent one-to-one interview reflecting on your experiences and impressions. I would appreciate your willingness to participate in this research. Your participation in this research is entirely voluntary and you may withdraw at any time prior to the completion of the data collection, without any adverse consequences.

What is the purpose of this research?

The purpose of this study is to design and evaluate an application to help parents improve their children's academic success and to ease the work of parents and save their time when helping their children with their homework. It is envisaged that in addition the application will teach children time management skills, make the learning enjoyable for the children and improve children's language arts (specifically writing) as well as their maths and English skill.

How was I identified and why am I being invited to participate in this research?

You are being invited to participate in this study either because you already participated in my research as an interviewee where you provided feedback about suitable activities to be included in the application, or because you were identified as a parent of a child who is a year 1 or year 2 student, and you are involved with your child's homework as a supportive parent.

What will happen in this research?

Upon agreeing to participate in the research, you will be approached in order to be given an Android tablet with the application loaded and instructions about how to start it. Testing the application should not involve more than a total of 4 hours; it will be done without my involvement and will take place during a two week period, at times and locations convenient to you. After the testing period (up to two weeks) you will be approached again to set up an interview appointment at a time and a place you are comfortable with. If you have not signed up a consent form prior, it will be given to you at the start of the interview session. The interview consists of questions related to the characteristics of the app and how the experiences and impressions of the participants about it. The interview session is expected to last not more than 45 minutes. The proceedings of the interview will be recorded; the audio clip will be analyzed by a software product. The outcomes of the analysis will form part of my thesis. Subsequent research papers may draw on the findings of the analysis as well.

What are the discomforts and risks?

There are no anticipated discomforts or risks. However, if you find it difficult or inconvenient to test the application, you can withdraw your participation without any need to explain the reasons why. If you find an interview question sensitive and do not wish to answer it, you will be able to do so.

How will these discomforts and risks be alleviated?

You can refuse testing the application and/or answering a question, or answering it very briefly, without explaining the reasons for that.

What are the benefits?

The major benefit we as researchers expect is to be able to gather good quality data, complete the project successfully. Participants will not benefit directly but will appreciate the fact that more children will be completing their homework successfully due to the help provided by the mobile application. Also the application will be provided free of charge to the participants. This study will also contribute towards an academic qualification for the researcher but there will be no financial benefits from developing the application as it will not be marketed. It is hoped that the findings of the research will be disseminated through publication in an academic journal or conference.

How will my privacy be protected?

The identity of the interviewees will be known only to the researchers (the Master's student and her academic supervisor). No personal and business details that may reveal the identity of a participant will be used in any subsequent report and publication. The individual participants will not be known to each other. The original interview records will be stored in secure storage for a period of 6 years after the completion of this study. The consent forms will be stored at a separate secure location, for a period of 6 years. The material will be destroyed once the storage period expires.

What are the costs of participating in this research?

There is no financial cost involved in the study. However, an estimated maximum of 4 hours of your time will be needed for testing the application, and 45 minutes of your time are required for the interview.

What opportunity do I have to consider this invitation?

Your participation is entirely voluntary. If you are not able to make the decision immediately, you can still contact me within 2 weeks of receiving the invitation. .

How do I agree to participate in this research?

By signing and returning to me the consent forms.

Will I receive feedback on the results of this research?

The results will be first published in the form of a thesis. If you wish to, you will be sent an email with the thesis URL once it is available online.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this research should be notified in the first instance to the Project Supervisor, Krassie Petrova, krassie.petrova@aut.ac.nz, 09-921-9999, x.5045.

Concerns regarding the conduct of the research should be notified to the Executive Secretary, AUTECH, Dr Rosemary Godbold, rosemary.godbold@aut.ac.nz , 921 9999 ext 6902.

Whom do I contact for further information about this research?

Researcher contact details

Asra Rahimi, MCIS student, School of Computing and Mathematical Sciences , Auckland University of Technology
Phone:0212685935, [Email : vtd9492@aut.ac.nz](mailto:vtd9492@aut.ac.nz)

Research supervisor contact details:

Krassie Petrova, Senior Lecturer, School of Computing and Mathematical Sciences , Auckland University of Technology

Phone: 09-921-9999, x.5045, Email: krassie.petrova@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on *05 December 2012* , AUTEC Reference number *12/177*.

Appendix J: Consent form for the development and evaluation phase

Consent Form



Project title: *Developing an Android application for An Android Tablet to help parents keep their children motivated for learning*

Project Supervisor: *Krassie Petrova*

Researcher: ***Asra Rahimi***

- ☐ I have read and understood the information provided about this research project in the Information Sheet dated 30th of November 2012.
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed.
- ☐ I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ☐ If I withdraw, I understand that all relevant information including tapes and transcripts, or parts thereof, will be destroyed.
- ☐ I agree to take part in this research.
- ☐ I wish to receive information (email) about where I can find a copy of the report from the research (please tick one): Yes ☐ No ☐

Participant signature:

.....
.....

Participant's name:

.....
.....



Participant's Contact Details (if appropriate):

Email :

Date:

Approved by the Auckland University of Technology Ethics Committee on 05 December 2012 AUTECH

Reference number 12/177

Note: The Participant should retain a copy of this form.

Appendix K: Teacher's Interview for the development phase

Teacher's Interview questions

Interview number:.....

Interview date:.....

You have had a chance to trail the app at home. The app provides homework exercises very similar in content to the paper based homework exercises given to children at school but different in the way the child does the homework. I would like you to elaborate on how the app compares with doing homework on paper.

1. Can I get your opinion on the activities designed in this app? Please elaborate.
2. Do you think the app covers suitable material for homework? Please elaborate.

3. Do you think the material covered here for each week, is enough? Is there anything needs to be included? Please elaborate.
4. Do you think the app provides a better alternative for doing homework compared to paper based homework? Please elaborate.
5. Do you have any suggestion for changing and/ or improving the app? Please elaborate.



Appendix L: Parent's Interview Questionnaire

Parent's Interview questions

Interview number:

Date:

You have had a chance to trial the app at home. The app provides homework exercises very similar in content to the paper based homework exercises given to children at school but different in the way the child does the homework. I would like you to elaborate on how the app may have made a difference compared to doing homework on paper.

1. What are your general feelings about playing the game?
 - What do you think about this application being linked to school by “levels” and “stages”?
 - Was it easy to use the application and follow the guide? Please elaborate.

- Do you feel that you gained any new knowledge or skills from playing the game? If so, what were they
- 2. How does your child's readiness/willingness to do the homework using the app compared to paper homework? Please was your child willing to do the app homework without you urging him/her?
- 3. How long did it take for your child to do the daily homework on the app? Was it significantly less or more than the time normally taken in doing paper based homework? Please elaborate.
- 4. What do you think were the main challenges in the game?
 - How easy were those challenges to overcome?
 - How useful in the specific context the context was the information provided?
 - What do you think about the amount of information you received as a participant?
 - What do you think about using the pen in the activities?
- 5. How did the app contribute to you being positive and supportive while participating in your child's homework? Please elaborate.
- 6. Did the app save you time? Please elaborate.
- 7. Do you think the app covers enough material as homework? Please elaborate.
- 8. Would you support using this application instead of paper based homework? Please elaborate.

9. Do have any suggestions for improving the app? Please elaborate.

Appendix M: Teacher's interview responses

1. First round of teacher's interviews

Interview number: 1

Date: 27/8/2012

Let us discuss the different levels of Maths you teach and the requirements for each.

We do an assessment to see what level the kids are at. Assessment is based on New Zealand curriculum for example some kids don't know anything about math not even numbers nothing, some kids know how to count to 20 some kids know how to count to 10 so we have got like 3 different groups so you group them according to the assessment, So if they know how to count to 20 you teach them how to add or subtract up to 5 and the group that know how to count to 10 you teach them how to count to 20 and the group that they don't know anything you start from counting to 5.

So you begin with:

Number formation, number recognition, and counting really simple things

Let us discuss the different levels of English you teach and the requirements for each.

Literacy: you have got two components writing and reading. Some kids know how to write their names some don't know even how to hold a pen, some know how to read really simple sentences and some know how to read chapter books, so you have got those levels as well and the main thing is for reading it is a more complicated than

writing because reading is not just knowing how to read but understanding it so if they can understand it is better than just reading anything so if my student can read this and if I ask him a question they have no idea what they read so their comprehension is nowhere near the level so you have to drop them down a level. But for writing is different you have got to look for surface features and deep features so for surface features they use capital letters they use a full stop they use..... or spelling. For deep features they use vocabulary so which vocabulary make sense for the text, they use different sentence starters (e.g. don't just use "I went to...I went to...") and longer sentences as well.

How do we start teaching **beginners**; for reading you use a really simple books like "this is a Cat" or "a Cat" and you have got a picture of it and it is all repetition and the only word that will change it will be the end word, and the end word would link to the picture so it helps the kids to know what this is and those are the word you focus on the most. So you should ask them which one is this which one is that show me this word show me that word. So they basically learn through the words. Because before they were expose them just through the Alphabet which it was very complicated because they have to learn all 26 letters and when you put them into words it was completely different it will make different sounds so the kids got confused so the new rule or the regulation if you like is you teach them words straight away you give them a book and they start to read and you give them a pen and they start to write even if scrabble it doesn't matter they start to do it.

What subject's you are teaching to year1 students other than math and English?

We do science we do social study we do art which is four component like visual art, dance, drama and music. We do Maori. We also do PE, health, fitness, and ICT computers. So we have got quite a lot. As well as assembling items, and performances as well. But only math and English is suitable for your app I think.

What sorts of activities do children respond to?

From my experience they respond better to anything hands on for example if I tell them write from 1 to 20 on a piece of paper they are not as motivated as they are on the computer or on a laptop or on the white board just on anything different that a pen and a paper at the same time you need to have a balance like for my students 2 days they have to work on their books and 2 days on the computer and the last day is hands on free activity. So you have to have this balance because otherwise it is too much on other side.

What activity do you use to engage the reluctant students?

Depending what subject it is for example for my student for hands on activity I give the three different activities which are the same objective and the same goals so they get to choose for example all three activities are about subtractions but one is snake and

ladder one is crocodile one is chicken, so if it is a boy he definitely goes for crocodile. Same idea but having a little twist in it to get them to go for it more, something that they want.

What resources do you use for the activities that you give to the children?

We follow New Zealand curriculum which you can find it on the New Zealand curriculum website: <http://nzcurriculum.tki.org.nz>

And also nzmaths has got good sheets for download. Go to

<http://www.nzmaths.co.nz/resource> and use the "I can sheet" and I can show you some books that you can borrow later.

Are there any specific learning areas that require more practice than others?

Yes a lot more! Things like fractions in math is very complicated as we know as the number gets bigger it is just a big number but in fraction is different the bigger the number the smaller the proportion so that's one area that lot of the kids struggle with so we have to give them so much practice, we have to bring in lots of real life experiences like cakes and biscuits just to get them see what it looks like cause they can't comprehend it.

For reading it is different because it depends on the topic so if it is a topic that they have completely no idea about them you have to show them like videos on you tube, bring a professional person or just different books on it. Same thing for writing.

Would you have any suggestions about exercises, or just ideas about exercises that I could use in my application?

For math exercise we have got the numeracy books, government gives each school a certain amount of boxes and within these boxes there are different kits or activities suited for different year levels so you have got junior, middle and senior year kit. And for junior they have kits that uptight to their level so there is activities that target their knowledge and there are activities that target their strategy. For year one it is just knowledge. They have got activates that are hands on or activities that they can go online and do it. The online ones teacher should set it up for them and they go online and start playing with it. Other activities will be things like play do they love to do that, white boards

Interview number: 2

Date: 31/8/2012

Let us discuss the different levels of Maths you teach and the requirements for each.

I have got quite a range in my class right now. What the standard is for year 2 is that they have got to count on for adding, so if they got $8+6$ they hold the 8 in their head and they count on 7, 8, 9,....till they get to the answer. So that's what they need to be able to do I have got kids that they're able to do that as well so they are starting to split numbers so that's like adding for example $8+6$ you start adding to 8 to make 10 so taking 2 from the 6 and 6 become 4 so $10+4$ is 14.

According to New Zealand curriculum stage 4 is year 2 so that's:

1. addition to 10
2. subtraction facts to 10
3. Doubles and halves to 20. doubles like $7+7$ is.
4. 10 facts like $10+8=?$
5. 100's knowledge e.g. $200+300=500$ they should know that because $2+3=5$ therefore $200+300=500$, the same with $20+30$

6. For multiplication is basically skip counting, so skip counting 2's, 5's and 10's.
7. Recalling 10 facts, like what numbers make up 10 so they should say 4 and 6
8. Recalling decade number like $60+40=100$, so I teach them $6+4$ is 10 therefore $60+40$ is 100
9. Solve division problems by equal sharing in ones, twos and fives
10. Advanced counting is for year 2
11. They are working with the doubles why doubles are important is because if they know what's $7+7$ so $7+8$ is $7+7$ +one more!
12. Going through 10's so $9+6$ is $10+5$
13. Number of 10's and 100's and centuries and 1000's
14. Round the three digit whole numbers to the nearest 10 or 100 recall the multiples of 100's that add to 1000 so it is $400+600$
15. Record the results of mental multiplication calculations using equations and diagrams (which that's just what they do in class)
16. Sharing by equal sharing cause if you are going to do the tablet app it could be sharing beans or whatever!
17. And multiplication
18. Fraction which will be all the halves and quarters
19. Solve multiplication problems using repeated addition so 3×6 is $6+6+6$
20. Use the commutative property, e.g. $4 \times 6 = 6 \times 4$ so you know one by looking at the other one
21. Dividing by sharing using addition to predict
22. Last one is the fractions

These are all on nzmath which is very handy! Just go on the website and there are all the planning sheets. Use the stage 3-4 for year 2 beginners and the stage 4-5 for advance students which are the starting to go to year 3. But you need to work on stage 3-4 for your app.

Let us discuss the different levels of English you teach and the requirements for each.

There are basic words that they need to know, there is an essential words list.

The red level in this list is level 3, 4, 5, yellow is 6, 7, 8, and blue is 9, 10, 11, so green is where they should be at after one year at school. Then year 2 is orange which is level 12, 13, 14, so they are moving to Turquoise for second year so those will be 15, 16, 17 and the rest is year 3 and up.

So you do lots of sight words and stuff there is lots of these words in those stories. In sight words they should be instantly recall the words so you can do activities like memory for example "raw" and "saw" they should be able to recognize them cause they get confused or "made" and "make".

We do a lot of games like "bling" it work like this:

Kids holding some cards, and for example let's say they have a card with "gr" so they look at the pictures and look for something that start with "gr" like "green" and they go and pointed out in the picture. Or the games like "bling bingo". And there is a game that you looking at the endings and they have to put the card on and match up like rat, rug, and rad. So it is based on changing that front letter

What sort of activities do you use for handwriting practices?

I mostly write on the board!

Have you heard about the "Casey the caterpillar" program? That's what they start with at school, it has language that tells this story and has all different languages for all what each bit is called, those like "open mouth", "short stick".

This is a book called "The code breakers" which we use for spelling for example the first page shows you the differ ways that can you make the long "a" sounds it is like "ai", "ea", "ay" so you can see all the different once in this book and it helps with their spelling. So they know the long "a" sound can be made by different spelling patterns. Most challenging once are long "e" and long "o" and then it shows the short sounds as well. So you can borrow this book it is quite useful because it will help with their spelling once they start learning they know how to make sounds and they will know lots of the sounds made by two letters instead of just one letter.

What I mainly do for writing is I start with where is the letter start like most of the words are like "C" so if you want to write "a" you start as a "C" and back up around and "G" start as a "C" then comes round "d" start as a "C" then goes up down. So it is

basically learning what shape the letters start with. It is quite hard in this age cause lot of them stuck in their handwriting. Some of my kids have really nice hand writing but some of them not it is really hard to try changing them at year2, the handwriting is starts from year1 but I recommend starting earlier than that like drawing the shapes and pen control, where to hold a pen cause when they are drawing when they are babies they hold the pen as what they call “cylindrical Grasp” and now I have kids that they trying to hold it in a way that called “Modified Tripod Grasp” and it is really hard to get them to pinch the pencil in the correct way so it needs to be taught a lot earlier. Because I find it they are quite stuck with handwriting in that age.

What subject’s you are teaching to yea2 students other than math and English?

Quite a lot but they are mostly physical activities like dancing and sport and outside activities so for your app maybe some brain quiz or something.

What sorts of activities do children respond to?

Competition! They very like it when they do their work faster than others.

What activity do you use to engage the reluctant students?

I basically use rewards like “do your work and you get to go on the computer!”. Actually when the activities are in their level they like to do it when it is not too hard for them they enjoy doing it especially in maths which I find really easy because they enjoy it, reading is fine as well because you are in a little group so it is not really hard to motivate when they are in the group and then the writing is probably the hardest to motivate. You do something that have a little game around it mostly the competition games they like to when for example they quite enjoy it when they do their basic fact faster than the other person.

What resources do you use for the activities that you give to the children?

nzmeth is really good for Maths if you go to nzmeth and you search for planning sheets, this basically what we use this is where all my planning came from, and they have all the knowledge you need. Is there a similar website for English? NO, that would be lovely! But no there isn’t. But we have books with essential levels and they have words that come in handy. You know how readings broken up into groups like color wheels and they get colored books. So there is essential words that they need to know for those I have sheets that you can borrow.

Are there any specific learning areas that require more practice than others?

It depends on individual actually but fraction is a common thing that they have problem in math and also handwriting they struggle with the most

Would you have any suggestions about exercises, or just ideas about exercises that I could use in my application?

I would recommend exercises that they have following or tracing shapes on them so they have letters or shapes with either dot on them or point so that they know where to start cause they don't know where to start the letter from. And as they improve they get to words and sentences.

Interview number: 3

Date: 30/8/2012

Question related to Year 1 and Year 2 students:

Let us discuss the different levels of Maths you teach and the requirements for each.

I have done very little lately and I did a lot when I was in the class room.

Basically anything that I have done with my present student would have been very basic stuff. Because I found that they often don't know the very basic facts. For example some second year students have no idea what is multiplication. So we did that sort of things. Also addition and subtraction. What is happening with my students is that parents bring a book from school that shows which level is their child at or if they have a Maths book they brought that along so I have been able to look at the work involved talk to the child about some of it work out what they can do what they can't understand. So I guess the levelling basically comes from the school and then I have been able now that the child for example is in year 2 should be able to do that but he can't so I concentrate on what they don't understand

Let us discuss the different levels of English you teach and the requirements for each.

Because each of the children I have is as an individual and not in a class setting I look where the child is again what they are not coping with for example capital letters at the beginning of sentences that basic thing and concentrate on that. When I was teaching before probably you had levels within the classroom situation. The books are they had which were levelled you have a series of books and this will be level 1, level 2 ,if a child could read a specific book then basically he was on that level so that helped

sort of sort out the levels. But with the students that I have now basically I cope with the individual child so it is a bit of different situation.

What subject's you are teaching to year1 students other than math and English?

Some language: because English may not be their first language (ESOL).

To some extent Social studies, we talk about different thing in the world or in our area

Some other work that I would be giving them will be involved with science. If you got a child that is particularly interested in something you try to give them information so they will be more interested I guess

What sorts of activities do children respond to?

Activities that aren't boring, because if you have child or children in your class and they are bored with what you are doing because you are doing the same thing all the time, they are not going to put their interest in what they do. One very simple thing which I have used even with a seven year old, they have to come up with a list of words, first word just have to be of one letter (e.g. I or a) the second one has to have two letters the next one has to have three and so on and I had one child that got to eighteen letter word not easy but they were interested they wanted to do it they wanted to get to twenty-six letter word. So you find something that you find different. I also give them brain teasers like a little question that the answer may seem to be obvious may not be and the delight I have in that is when a child comes up with an answer totally different to the one I have got but he explains it and it make sense and I tell him how wonderful he is so it getting this going and they actually go home and want to do their homework and they want to bring it back and they want to talk about it

What activity do you use to engage the reluctant students?

You have to find what they are interested in, not that they can do are what they are interested in all the time. For example if you have a child who likes lady Gaga and thinks she is the most wonderful creature , you can actually ask to write about her for home work or find a picture of her on the net or download something from the net. So because it's something they want to do it's something that they will do. But you can't do that all the time. The other thing is to try do make whatever you do interesting, this is easy enough with one child but it is difficult with class of twenty-five or thirty but I think if you are reasonably a good teacher you are going to make the effort to find the stuff that are interesting . you can have activities that work for every one for example for the Olympics all the school concentrated on that so it was on for the three weeks and they had their Olympic at school, so kids would have to come up with what they want to try at and it will be medals and stuff at the end so that made something that every child could participate in the school in the three weeks period something unusual only happens every four year. But if you could get something like that called the centre of interest that help with an actual class at school

What resources do you use for the activities that you give to the children?

I use to use ESOL place in Papatoetoe, I use to use their resources those are basically for adults but their material is very suitable for school children, but now I basically use resources from library or the internet

Are there any specific learning areas that require more practice than others?

Maths, because Maths doesn't stay the same. I have noticed some of the children I have been working with they have a different way of doing adding double digit which they have learned and can use and I haven't got a clue about. Because over the years educators bringing different ideas how you do Maths for different kinds of Maths which makes it difficult for me!

Would you have any suggestions about exercises, or just ideas about exercises that I could use in my application?

Not any at the moment.

2. Second round of teacher's interview

Interview number: 1

The tracing exercise will be good for the fine motor skills

It will be probably a good thing to have the letters both in capital and small. You need to make sure like for the "A" you have a place name or something like that so you actually use a capital for or you could have them next to each other so that they can see there is a big "A" and little "a". And for the pictures name you could have the words start with sometimes capital "A" or sometimes small "a" so they can still recognise it as both and then when it is a big "A" they have to trace the big "A" and when it is a little "a" they need to trace the little so they are identifying that they can be drawn in different ways.

The little book is very good

Levels are very good too.

Could you have the words that a person says it in a sentence so once they found it they put it in a sentence for instance for the letter "to" it says "I went **to** the park." and then they have to draw it so it reinforcing to them the context as well or it can flashes up with sentence as well or the word can stay in the red and the sentence in different colour. This could be really good because I found it especially with teaching that a lot of the kids can read the word and then not know how to write it so it's connecting these two which will be really helpful. Cause a lot of kids will be able to read the words but they can't write it or they can write it but they can't find them when they go to look at the word cards so it is a good connection between reading and writing. Also this could reinforce when to use the word as well.

Maths

Counting : this is very good as a lot of kids are coming in as they learning the numbers they are writing them back to front especially 2's 3's and 5's, 6's and 9's also. The stages are awesome they are fantastic.

Counting by pictures (up to 5): This is very good, that's perfect with the pictures they actually can count them, I really like that.

Addition: for the stage 0 they need pictures so that they need to count the pictures because in stage 0 they will be counting before they can find the answer they wouldn't just to visualize $5+5$ they actually need to count 1,2,3,4,5,6,7,8,9,10 so you need to put a picture of apples or ladybugs or something. They might need pictures for stage 1 as well.

Counting by pictures (up to 10): if you put the pictures in to straight rows if the kids are up to the stage where they can skip count for instance if they see 3's in a row they can go 3, 6, 9 rather than counting them all.

Backward counting:

Skip counting:

Fraction: for stage 3 make it more easier, may be just one quarter one half's and simple thinks like that and they could get aggressively harder but may be start with some easier ones. Do one half and one quarter and maybe before to go to something like this making finding one half of the picture. Maybe half like 10 people and they have to colour in five of them before you got the $\frac{3}{8}$'s or things like that. Or they can colour in half of a square or something like that or a circle. Starting with easier one is better because it will be a bit tricky to start with something like $\frac{3}{8}$.

I think the application is awesome and it will be really handy for teachers as well because it will be a good follow on activity so if you are working with a group and you say ok you can go and work and the iPad on this activity so that would be really good and I like how it aligns with the NZ number series and stages and things like that which makes it really useful and both for parents as well because they will get an understanding of what the teachers talking about when says your kids are at this stage and this is what they need to know, so I think that's really good. The liking is good and actually doing the writing and thinking about it making the links between what they have seen and what they can do whit the writing. It is will be a good alternative for paper homework as it incorporate the writing because that's one thing that's going to get lost with using new technology we can see that's happing at school where the kids handwriting is not as good as it was in the past so it is very good that it uses the handwriting.

The activities are definitely enough for one week specially if you are using it alongside other tools as well but it is really good for the maths and the readying.

Interview number: 2

The reading levels is good but I will have some comments on the letter formation like "a" and "g".

The counting is really good; in this stage its only number recognition like 1 is just an object and if you say 2 it's going to be two objects or two sets of things. For instance I have a sheet that has numbers like 1, 2, 3, 4, 5 on aside and I have a pictures of one banana and three apples and five oranges and they have to match the numbers across so they actually identify that 3 is 1,2,3.

The activities are enough for one week. Because some kids they take a week to just learn the number 1 or some kids will learn the all five numbers in one day, so it depends on the kids as well. And even some kids when they come to school they are already at stage 4 because they have been into preschool but some kids have no ideas.

The tracing for writing which you designed for counting is very good because some kids will just scribble it out otherwise.

Additions should be up to 10 they will be up to 20 at stage 4. Some can't count beyond 10 especially the backwards it is the hardest thing to teach them. So you can have that for advanced kids.

More images will be good.

At stage 2 they have to image the numbers and for them to hold a number in their head is a bit hard if they don't have it mentally in front of them.

As soon as they can grasp up to 20 that's when that they can grasp up to 100. Because 1-20 is the hardest as there is no specific pattern in them but as soon as they get to 19, 20 ... they will identify the pattern and learn the rest easier.

The backwards and forwards activities are good I like them. But you have to make sure the vocabulary that you use is correct because if you just say fill in the blanks they won't know they could just put any numbers in their so if you say the number before, they remember the word before and that mean the number that way and the after is going that way and they will understand maybe a bit easier and the vocabulary should match the vocabulary use in the classroom like they use "before and after" instead of blank or fill the blanks. Or you can have a number and two blanks after so you can just say what is the number after this and they can fill in the blanks or you have the number 5 and then two blanks and say what the numbers are before.

Skip counting is good see how you have used different terminology in the other one you have said fill in the blanks and this one you said skip counting so you have to be consistent so just be care full with the words that you use either use skip counting or you use before and after you have to use one of them cause this is something, when the kids hear fill in the blanks in the first stage and move up to this stage they get confused they will be like "oh what is she talking about?" I think you should change the first one this one is better.

The fraction is good.

Depending what is happening in the classroom because sometimes they will be doing fraction like they have different strength to cover for example they might be doing geometry but if they doing addition and subtraction in the class that should be more than enough to cover it. I rather have more than less. If you have more the kids will be covered but if you have less kids might get board or go off. If they don't finish it, that's ok but I rather have more than not enough. Maybe add a few more like matching the numbers or things like pulling the pictures. Could you do like a countdown a racing one like timing it and kids have 10 or 5 seconds to identify that how many pictures are there and they have to quickly write it down and you have a high score and kids can type their name and know their scores.

I don't think it is a better alternative to pen and paper but it is a good alternative because still will need pen and paper in most circumstances but it is a good way for students to experience a something different other than pen and paper specially with the new technology and that which is good. I think the application will be more engaging for the kids to do a lot more because will want to do it more than the old fashion pen and paper and they will enjoy it a lot more but weather it is better for the education or not I can't really say cause it is all depends on the child. If you have the pen so it will be perfect. I think it will be a good application and the kids will really enjoy it.

Appendix N: Parent's responses to the interviews

Interview number: 1

It was good one thing that sometimes kids were faster than the game and when they push next it voice overing, but apart from that Mia loved the game , even that one child meant to be doing it my other one was doing it as well, and both loved it ,

It was more about writing skills actually It thought them to write in a proper way cause when they do it themselves they tem go from everywhere and not from the right way, so it gives them a head start on that, I thought it was good for that..

That is a good idea especially with the writing aspect of it

The skip counting was good, the skip counting by 2 as well as the skip counting by 5 those were good.

Willingness: Yes she was good. Yes she was asking for it as soon as she got home from school.

Well they both take the same amount of time but the application is more fun, well I have more complains, she is crying no I don't want it

There wasn't any challenge it was easy to follow I think that what you want

It was quite relevant cause at the moment they are doing skip counting in the maths and simple additions, the English as well like the writing over the words I think that's very relevant.

The pen was good initially but the kids are a little bit rough so the top of it was falling off so I had to fix it so they used their fingers. They like drawing on it they were like oh look what I can draw! No you meant to be writing.

The fact that I dint have to monitor her, it was positive on the fact that she was coming home and saying mammy I want to do my homework because it was fun cause the homework are never fun. In the fact that she want it when she come home

Yes because normally getting her to set by me to do the homework it was a mission because she doesn't like doing homework, she always doing it with dad.

Yes for what she normally gets in a week yes it was enough.

Yes, if all the kids in the class were doing it then yes. It will be a good idea and the teacher was able to see it like the normal weekly tasks

Between those two line that you have for writing if you could have dotted line it was better so the kids know e.g. a shouldn't go over that line. The equations when they do them today and the want to do them the next they it will start again if you could do them in set of 10 questions and them the other set of 10 questions it will be good.

Interview number: 2

It is very good I really liked it my son loved it, I think this is a great idea for both children and parents and for the future of homework

I think it was great because it makes children like doing their homework as it is so related to what they do at school and it is a good interaction between school and home

Yes very easy, he could do it by himself he could follow the guide easily I didn't even helped him.

Yes he did in my point of view this seems a new idea for student and I think they will like it and yes he definitely learned new things from this app. The subtraction was good he is not very good at subtraction and using this app he learned more and the app made him think.

Of course he liked using the app, I think all children willing to use the table homework rather than paper homework. Yes he definitely was willing to the app more than paper homework.

No I didn't need to urge him at all he was willing to do it by himself without me even asking him the only thing I was asking him was to put it away when playing with it after a while.

I think the paper, the paper will take more time for him to do because this app is easier to use specially using the pen was easier for him rather than using the pencil and he was doing the homework much faster on the app than the paper.

Math was more challenging. And it took more time for him to do than the English.

He was trying to solve the problems and overcome the challenges, which were good because increased his knowledge.

The pen was definitely a good idea because it teaches them how to write properly. Teaches them were to start how to create the lines, and it well help them to write neatly. And yes it will be very useful thing to have the pen with the app.

Well when we first get the tablet yes I had to set by him to see how the tablet works and how to use it, I told him how to use it and how it works but rather than that he didn't need me to help him with anything using the app. And I think this is good because child will gain confidence and self-assurance and the child don't need parents to seat with them and help them with the homework.

Yes of course it will save me time because he will do it by himself and he won't need my help anymore, so defiantly it will save me time so I have more time for other things such as cooking or spend time with my other kids or housework or even this app could be very good for parents how work outside this app will be very helpful do them I think cause the child will be confident to do it on his own and won't need his parents help.

I think it needed more in English math was good but I like to see a little bit more on English side. I like to see more of spelling cause in their age they just start learning writing so I think more spelling will be helpful. Only one more page of spelling will do.

Yes definitely I support this idea. I support this app instead of these papers that kids bring home from school, because first of all you can find tablets or I pads in most houses now a days. Second it will be a great help to parents and also children will be introduced to technology in early ages which is good.

No nothing more I can say maybe later if something comes to my mind I will let you know.

Interview number: 3

I really like the application because it was just what I wanted. I always looked for something in app-store that covers the material she is doing at school but I couldn't find any and I found your application quite relevant to what she is doing at school.

Well I loved the levels and stages that you had in the app. To be honest I didn't know much about these levels and stages it was good to know, it was something new for me. When you told me about the stages I had to go and ask her teacher. So choosing her stage for math it was very relevant to the homework she is bringing home so the exercises were quite similar. For English the same.

Yes it was easy; she had no problem working with it.

☺Well as I said I didn't know about the stages so I gained some knowledge myself☺. I liked the math activities it was challenging. English she learned how to spell some words that she had problem with before so yes definitely she gained knowledge. And her sister learned a new alphabet letter she is only 4 she know some letters but she learned the letter "M".

Well she is not a big fan of homework. I have to ask her to do her school homework otherwise she won't do it but with the application she was asking **me** she wanted to play on it.

Willingness/Yes, yes.

Well we do 20min of homework together every day but with the application she didn't really need my help but she was spending more time playing on the application compare to paper homework.

Spelling in the English side was very good because she had to think how to write the words so that was challenging math were good addition was good, subtraction was more challenging for her.

It was challenging, not very easy but it made her think to come up with an answer so that was good.

The pen is brilliant idea I haven't seen any application that use pen well there are some that do tracing I have downloaded for her before but it was just tracing the letters or colouring but using pen in your application the way you used it was brilliant. I liked the way that you had 2 lines and kids should write between the lines that were good that help them to write nicely. Yes the pen was good.

Because the exercises were so relevant to what she is doing at school , so she could choose her level or stage I was sure that she is doing some homework and not wasting her time, so I could do my work or spend some time with my little ones while she is playing on the app.

It will definitely save time cause I don't have to seat by her and tell her what to do the application is very clear what to do.

Yes, Math was very good, English the spelling was very good and also I liked this "letter of the week" that you had in English side that was excellent it was practicing the letters in different ways. Like in few tasks kids should find the letter then it was tracing and filling the blanks so having different way for the same exercise was very good kids don't get bored. It was good it was enough.

Yes, it will be a great help well I can choose to not to seat with her when I don't have the time and if I want to watch her I can so I don't lose anything but it could save me time. The exercises were good so yes if you market it I will buy it.

No it was good ...Just market it soon.

Interview number: 4

I felt the levels and stages suited Mia quite well. Because she got about %80 correct initially in the English section and doing more every time she was getting better and better. It would have been nice to see more challenging questions amongst the easier ones. One thing that “I” didn’t like, not her! Sounds of the words were not similar it was better to have nice voices which sound more real.

The maths I felt was similar to what she is doing at school. Mia is very good at calculating addition and subtraction in her head and occasionally using fingers. So it was very good that you didn’t have any images for her level because I looked at the lower stages and I noticed that you have images that children can use for counting but at her level you didn’t have any. This was good. But still I think it would be good to have cute voices😊.

The application was easy to use. It was also easy for Mia to delete it😊. Mia didn’t need much guidance from me in using the program. She got confused initially with some of the text as the “a” for example was in a format she had never seen before as well as the “t” having a flick on the bottom etc. I think the text should represent basic alphabet shapes or font.... whatever you call them.

I don’t think Mia gained any new skills in playing the game however she did gain some knowledge. Mia enjoyed the fractions the most as this is something she has never done before. Once I explained how they worked she soon mastered it by counting the squares etc. So yes she gained some knowledge.

Initially Mia was on the tablet non-stop trying the different levels and tasks even the ones that wasn’t her level. Once she had mastered them all, she preferred to only do the exercises in her level. She also let her 3 year old sister use it while she sat with her showing her what to do. Also, she has asked for it couple of times since it has gone.

This is a hard question as the home work she is getting at school is limited so it will be done when she finishes all the tasks but with your application she was starting all over again as she finishes each task. But I didn't really mind as long as she didn't need my help I was even happy seeing her doing more exercises. But along with the homework tasks she gets at school she also has a reading book each day reflecting the level she is at.

Fraction! hmmm, I very liked the fraction in the math section, well... math was designed pretty well over all but fraction was the best. And in English section I liked the spelling part that was very challenging.

They were fair, they were fair.

The information we were provided with covered what we needed to know.

Using the pen itself was a brilliant idea because I very want Mia to practice handwriting I want her to be able to write neatly.

In tracing section there was no correction if the children were to write over the words incorrectly. Initially Mia was writing over the words but after a day or two she started skipping this part of the task. Then as you said the images will be captured and can be checked by teacher that will be good. Spelling section was very good as she had to write the word herself and then check to see it she got it right rather than tracing the word. I liked the spelling section it was challenging and she enjoyed it too.

I felt I didn't get to participate in Mias homework, only when she got an error such as when incorrect words came up in the answer – if I remember correctly it was around the _make question. It was good that I didn't have to seat by her to know what she is doing I was able to hear the voice while I was busy doing my own work.

For me I felt the app would be good if there were more activities, it was enough for two weeks but I want her to do more.

The app didn't save us anytime as she played on the app and then had to do her school homework 😊 However if she could only use the app_ and that's what you really meant_ it will definitely save me time but I'm not sure about her cause she love playing with it so she will probably spend more time on the app than she would on the school homework.

If you mean only for two weeks, it was fair. However I like to see more in English section. You could add a section that children could pick a topic and write about it. What they get at school for homework is some spelling word and a reading book and also a piece of writing and some basic facts. You have covered them all but the piece of writing that they get each week.

Yes I do, with a bit of improvement it will be a great app I think children would like to see more images. With some minor improvements yes I will definitely buy the application.

Thank you for allowing us to be part of your research. It has certainly opened my eyes to the world of technology and where things are heading. I think you are extremely talented being able to design an app that works for a tablet. I have been a little critical so far but I think this is the whole point of the interview so you can improve the application. As I mentioned before the text should represent basic alphabet fonts, also the voices need to be changed you could add more images. Also the tracing exercise I didn't quite like to be honest possibly removing the drawing over the letters feature as this is hard to monitor then it could be a tool I would consider if Mia was at the bottom level in the class.

Interview number: 5

First he very liked it but at the second week not so much I think it needs to be more diverse more activities more rewards most of the games have eggs or fishes or something like that to collect. I think that's the reason he didn't want to continue using it.

That was fabulous, it was very good. But the game needs to be more interesting

Yes it was easy he could do it on his own he didn't need help to do it, it was good.

No not really. For the tracing there was no way of monitoring if he wrote it in a right order. I don't see how they have got to that letter? Like if they draw the letter "h" like they first go down and then make a tunnel, so it is not correct to start from the tunnel and stick a stick to it because I know with my son he doesn't form that in correct order

Initially he was good he was asking to do it but then he got board of it but he possibly get board of his paper homework as well unless it keeps changing to different tasks or keep doing the same thing but different words

I think with girls is different they could set down for hours draw a picture and hang on to that buy

He normally does about 10 minute of written stuff and then we do reading separately which takes 10 minute as well with the application it is hard to say because there is no end to it but it took 30 minute at the first week but 10minute at the second week.

The maths was much more challenging

Yes it was, they don't bring math home so I can't comment on the math I only see the English side but the English seemed quite relevant

I loved it I will buy one too that's really good,

Truly he did that on his own but with paper homework I had to seat down with him so with that one I could be at kitchen and he being in the room doing it on its own so I don't really need to support him in the same way it nice that he could do homework without me but that will make me lazy I think 😊

Yes for sure

With the math I can't compare cause he doesn't bring maths home but I suppose it is good so it will be in addition to what he do at school so that's really good with English I think it does need a bit more content but there is more challenges with the math, addition and fraction was challenging, but yes for two weeks it was enough.

Not instead of in conjunction with.

More reward like they have in reading eggs that's really cool it doesn't have to be as complicated as that just some rewards that they can do something with it or jut the reward kind of works for them.

Interview number: 6

It was great that kids could go off and use it without parents, as a parent I always like to know what she is doing so I was walking in out to see what stage she is up to so it was great that she could do that and it was great that she could use a bit of technology cause we are not a high tech family it was great for Mia to have go off it and they do specifically using them at school too.

Yes very easy, very easy.

The technology side of it like how to use it and backing out and things like that yes she did. The level of the work: the math was very good very much in tune to what she was doing at school so that's great the English was a bit too easy the tracing was very easy. There was no repercussion for her if she didn't trace it nicely. But yes if you are capturing them as image or whatever and send them to the teacher or print them out and teacher is able to say like hay Mia you haven't print it very nicely yes that would be good. Yes that would then work but if she was just playing with it that's very easy.

Pretty much the same cause I don't have problem with Mia doing her homework.

She loves doing homework, but yes certainly because it was a novelty she wanted to use the tablet so there was a certain novelty about it but I don't have an issue with her doing homework. But after the novelty comparing with pen and paper I think for her will be pretty much the same. But because they have them at school I want her to be open to them, open to using them but whether she uses it for homework or uses them for other things during school time it doesn't matter as long as she is using it at some point the technology side of it. Certainly was a benefit using a tablet for homework!

For busy parent in the fact that you could send it straight to the teacher that would be great cause there won't be any homework bags, have you got it? Have you forgotten it? That sort of thing pack your bag... so yes that side of it was a bonus

Because she was so willing to do it she was on it for 30 minutes going to different ones like adding subtracting so I would say 30 to 40 minutes at a time she was playing on it.

Well paper homework is only what her teacher gives her so when she finished the requirement of the teacher it might be spelling or whatever may be 20 minutes to half an hour the homework might take but I think it was the certain novelty side of it that she wanted to keep playing with it. But I know with Mia that she will spend as much time on the tablet as she would on pen and paper because she loves homework she is crazy! 😊

I loved the Maths the math was very on level to what she was doing at school so it was very challenging. It was quite challenging for her you could swap from addition to subtraction quite happily. But it didn't come up randomly for instance there will be

adding and they might get a tricky one as subtract, so that would get her thinking: “am I adding? Or am I subtracting?” well that might come in the higher level.

The level was very good for the math and kept the score and congratulated them when it comes to a certain score so she felt good about that which was different than what it would be for pen and paper where it’s gonna get back to the teacher and its gonna get marked and get a sticker on it or something like that. In the app instantly she got a score and got recognized by a clap, so that was good and the fact that the levels were very good for her.

The math was brilliant, for her at that level it was just the right amount of challenge, she had to think to subtraction. It made her think.

It was great that you had a lot of different tasks to do so that whole separation of addition and subtraction for her was great but if you had that other side that was mixed

Yes! I like it, you still need to make sure that they holding their pen properly you never want them by technology to lose that skill of being able to write every wan can use the math and use the keyboard but they still need to learn how to write it is just another form that can give them enjoyment and the challenge in a different way of doing it, so it is good it’s not just setting down with pen and paper.

I probably say yes. But I am that sort of parent that likes watching their child while they do homework. Did it save me time? Yes it probably could have it was my choice not too but one thing I could be in the kitchen and work in the kitchen and I could hear her getting it correct when she got an addition said correct you could hear if she get it right or if she get it wrong you could pop back in and say hey Mia where you having trouble lets work this through so that side of it you could hear things you are not just relying on pen and paper that you actually have to physically look at it you could actually be out of the room but you still will be able to hear things.

I am sure that it could save me a lot more time but it is just that sort of parent I am. That’s what I choose to be but I am sure it could have saved me time.

Yes I think so, Maths brilliant maybe on English side you could do more spelling. The English I didn’t think was as challenging as math. I like to see more spelling than reading.

Yes.

No I think it’s brilliant just the English a bit more challenging and we covered that and just make sure the printing they are learning at school is what they are doing on the application.

Interview number: 7

It was quite helpful actually we tried the level where my son was at that and also we tried the level below that and above that as well initially when we tried the level up he was happy but because he knew the level below that and every time he was going level up he was happy and he was really proud about himself.

I think it is initial but once it is gets going it will help parents a lot more.

It is great that the teachers know what is happening. I think it was a good idea because it is kind of "play for learning" I would say, and children would like technology rather than seating down and writing.

When I was watching him when doing the app he knew mostly at the level he was because he knew everything it was more like a fun for him rather than like you know... gaining one level up or down. It was like "oh I can do this I well do this", it is motivating.

The main thing he didn't have to write it on a paper.

Obviously it was easy for him I guess as it is a finger touch and using a pen on screen.

Yes he wanted to use it all the time.

Obviously pen and paper require more time because you have to physically write everything but here you got somebody asking you to do things like "add two numbers" or "write the words" and things like that. I think it is more time consuming when it is in the book.

Uploading sometimes was slow; I didn't find anything that is challenging.

It is what they are at the moment doing at school. I think it follows what teachers do at school.

I think they have to learn to write on the paper as well to improve their handwriting because it is much of a softer with the screen. It is kind of a... my son he gets board writing it was easy for him and I think because he didn't have to use eraser it was easier for him I guess. I think with writing (pen and paper) they get board faster and distracted faster.

I think he was much more independent doing it by himself rather than me seating by him and telling him what to do all the time, tell him don't get distracted don't do this don't do that..... Yes he was doing it independently. With normal homework you have to be there and as I said it's like a play time for them and at the same time learning.

It was a set think that one may be if you add more as you go probably but initially for that particular time it was good but then but probably after a week or two they don't want to go back and do the same thing so you need to update it all the time so they get more new stuff.

I would not totally eradicate paper homework but I would want to encourage him to learn traditional way as well but of course these days everything are apps and programs for him like to get an idea what is addition subtraction he can do it easily it helps but then for me personally I think they need paper homework at some stage. So I think not replacing it but it is good for student who want some help at learning basic facts math and English writing and reading like sounds phonics and stuff the app helps like I mean in their own time they can do whatever in there but at the same time for me where I came from they need to do how much efforts it takes to do it on paper. That's how we learned right?

As I said you keep adding more stuff to it and make it much more complex as they go. I think it is on developing things as you keep developing things you get more ideas. But overall my experience was good it was enough for that period of time.

Interview number: 8

In my point of view it was very good for both parents and the kids because parents don't need to seat by the children and they can do it by them self and parent will know about what level they are at school that's really good.

Yes it is good, it is linked very well.

It is very easy, quite easy; there was no problem for my son.

Yes definitely he did, in both English and Maths.

Well the paper home work he had to do it cause the teacher set this homework and this one (the application) when I ask him do to he will do it

The paper homework he will do it if I company him, we do it to gather but the application I just give it to him he will do it.

For just one day half an hour for paper homework. This app I think it will assist the homework not replace it. Because he get home work for one day and the rest of the week he doesn't get any but this application is very good that he can use it through the week and he could practice what he learned at school I am quite happy with that

Just he doesn't like the tracing part

Yes as long as he liked it

Yes it did save me time.

Yes I think it is enough

Yes.

The trace needs to be more simulated.

Interview number: 9

The game was quite useful, the level and stages were brilliant , the activities in them were exactly what she is doing at school yep I think it link quite well.

The application was easy to use. She didn't need much guidance from me in using the program. Only at the beginning I had to tell her how to turn it on and find the game but the activities were very easy for her to follow it was guided quite well.

Oh yes the fraction was very good, fraction is the part that she struggle with so it was a good practice for her during this two weeks she improved a lot in the fraction. I had a meeting with her teacher this week and even her teacher said she has been improving in math. Her English was good but she like the English activities as well specially the spelling.

Compare to paper homework yes of course she likes working with game I think all the kids prefer working on these tablets instead of paper that's for sure.

Yes she was asking for it as soon as she got home from school.

Doing the same amount of homework yes the game was much quicker. The homework they normally get is about 10 spelling words, 10 to 15 .basic facts and some reading. So if she was doing the same amount of work I could say the game was taking less time but she was doing much more on the game as she was enjoying playing with it. So it take more time that way but at least I didn't have to seat with her so I don't mind if take forever. :D

As I said fraction was the challenge as initially she couldn't get much of them right, but after practicing every day she mastered her level. So ye, that was the main challenge.

The information we were provided covered what we needed to know.

The pen was a good idea I haven't seen any think like it before , well I have seen the pen I have one myself but what I mean is I haven't seen actives for kids that use pen like the way in this game there are some alphabet tracing well, as I know but nothing like this. This was brilliant.

I felt I didn't get to participate in her homework; she didn't need me at all as she does with the paper homework. With the paper homework I have to read the activity that the teacher gave her and explain it to her and do an example myself then she will do it and still I have to check if she gets them right but with this game I didn't need to do anything it was very clear.

Yes as I said before it is much quicker than paper homework and also because I didn't have to guide her so she didn't need me and I could go and do whatever I wanted. Well the past two weeks she was only doing the game homework so I didn't bother to give her the teacher homework, so that was quite enjoyable for me too as I had some free time to watch my favourite TV show cause I love short land street, so usually I leave the TV on and I watch while I help her with homework I know it is not right way and it is a distraction for her and her homework usually take too long. The past two weeks she was going to her room and does the homework there while I was in front of the TV so yes it definitely saved me time.

Yes it was quite enough for my daughter as it was the same work as she brings home from school.

Yes I do I very like the game as it gave me some relaxing time the past two weeks.

Well it was good overall but I think if the voices sounded more real or you could use a kid voice as it is a kids game it was better but it was brilliant I liked the idea of levels and stages as I haven't seen something like it before.