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AN APP AS 'READING GLASSES' – A STUDY OF THE INTERACTION BETWEEN INDIVIDUAL AND ASSISTIVE TECHNOLOGY FOR STUDENTS WITH A DYSLEXIC PROFILE.

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Abstract:

For a couple of years a great many programs for tablets and smartphones have been available for assisting students with difficulties in reading and writing. The aim of this study was to investigate whether a multifunction application (Prizmo) for iPhone/iPad had the potential to provide assistance for students with a dyslexic profile.
Twelve students and their teachers participated in this intervention study, 7 students from primary school grade 5 and 5 students from the first grade of secondary school. All participants used the Prizmo application during the regular school day for 4-6 weeks. The pupils were measured by decoding tests before and after the interventions. The results show that the word decoding ability increased for several of the students and also that they found the app useful even after the end of the study. The teachers who carried out the interventions involving the app emphasize its ease of access and the positive effects for the students. Multifunctional programs like Prizmo, text scanning and a text-to-speech synthesizer may enhance students' reading ability and motivation for future studies.

Keywords:

Assistive technology, applications, dyslexia, students, teachers

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1 Introduction

Reading ability is a significant factor for future educational choices and for getting a job. A large number of studies have shown that failure in the literacy domain may have negative consequences for self-esteem and psychological well-being (Clegg, Hollis, Mawhood & Rutter, 2005; Elbro, Dalby & Maarbjerg, 2011; Jacobson & Nordman, 2008). Students with difficulties in the written language often have a feeling of not managing schoolwork as well as their class mates (Burden & Burdett, 2005). It is therefore important that schools acquire competence in the area of reading and writing disabilities such as discerning different kinds of reading disability, how to remediate these problems, and the consequences of what reading and writing difficulties may have for students' acquisition of knowledge, performance and self-esteem.

Some students have reading disabilities that are quite resistant against remediation, especially those with early and prolonged difficulties with decoding words. Even if they receive intensive and systematic interventions their reading development is slow. Assistive technology (AT), which is quite well known among teachers, has been used for several years to scaffold students with reading disabilities and dyslexia. AT include any digital application that enables a user to comprehend text by supporting one or more components of the reading process (McKenna & Walpole, 2007). Spell checkers as well as text and speech recognition by computers are examples of assistive technology that have been used to support students with disabilities in the written language. In recent years these programs have also been accessible for smart phones and tablets. The cheaper and the easier the programs have become to handle, their accessibility has increased, since users can even carry the smart phone or tablets in their pockets or in a handbag. Hence, it is possible to use programs that scaffold reading and writing wherever you are.

There has been an almost explosive development of applications (apps) for smart phones and tablets that can be used to support reading and writing, a development which has been difficult for users and researchers to keep up with. Because of the relative novelty of the technology and the rapidity in the development of equipment and programs, the research is still very scarce regarding their potential to scaffold people with reading and writing disabilities. The present study had the intention to investigate if their easy accessibility gives tablets and smartphones the possibility to act as a form of 'reading glasses' for individuals with a dyslexic profile. The specific aim of this study was to investigate whether a multifunction application (Prizmo) for iPhone/iPad had the potential to provide assistance for students with such difficulties.

The term assistive technology (AT) is generic and used to describe assistive, adaptive and rehabilitative devices for people with varying degrees of disability. Essentially, these technologies are aimed at assisting or expanding human functions or capabilities (Lane &

Mann, 1995). ATs may range in complexity from sophisticated computerized communication systems and software programs to a simple telephone handle. Alper and Raharinirina (2006) contend that, despite current legislation, little is known about the specific issues associated with AT, its uses and for whom it is appropriate. In a review in the field of reading and the role of AT, Edyburn (2006, 2007) identified the need for more research. Concluding that there was a lack of empirical studies and recognizing that the use of AT to enhance reading performance was a relatively new and interdisciplinary field, he decided to define a research agenda to encourage more targeted studies. Furthermore, SBU (The Swedish Council on Health Technology Assessment, 2014), whose purpose is to assess health care interventions, describes in a report the lack of scientific evidence for using assistive tools in training and compensating for reading and writing problems among compulsory school students. According to Englert et al. (2007), a US National Commission on Writing suggested in 2003 that 'new technologies can advance both the teaching and learning of writing'. Cullen, Richards and Frank (2008) supported this idea and extended it to spelling as well as writing. However, there is currently very little research to bear out that using assistive tools should create better readers and writers. A few minor studies have been conducted in Sweden (Björn, 2010; Föhrer & Magnusson 2000, 2003; Svensson, 2009). On the international level, there are some studies that have explored the field (e.g. Goldfus & Gotesman, 2010; Macaruso & Hook, 2007; Maccini, Gagnon & Hughes, 2002; Schmitt, McCallum, Hale & Obeldobel, 2009). The results emerging from these studies are very positive towards using assistive technology.

The traditional way of approaching reading and writing difficulties is to use specific exercises to train students to become better readers. There are plenty of computerized remediation programs with the purpose to scaffold reading. Another variety is trying to compensate for the difficulties by evading the problem (like using glasses to compensate for impaired vision or a wheelchair for walking). For students with severe reading problems and dyslexia it is usually not enough to try training their ability. "Trying harder will not help a child with dyslexia" (Siegel, 2013, pp.143-144). There is a great risk that they will lose even more of their reading ability unless they can also use compensatory measures. Thus, they have to use both training program and AT. Furthermore, AT can be assumed to provide an indirect training effect by increasing students' motivation, interest and time for text processing (Kristensson, 2013; Svensson, 2012). Even among teachers the confidence in assistive technology is strong, and the general opinion is that assistive technology is good for students with writing problems. These technologies affect literacy levels positively. Students not only become better at reading and spelling, but their motivation to read and write also increases. This may in turn improve students' self-image when it comes to school work (Föhrer & Magnusson, 2003; Föhrer, 2008). Several international studies (Edyburn, 2007; Goldfus & Gotesman, 2010; Gregg, 2012; McKenna & Walpole, 2007) highlight the benefits of using assistive technology, as well as pointing

to the risks of practising reading for a long time with students with severe reading difficulties. *"If a child repeatedly fails to read and to understand printed text, how much data documenting this failure needs to be gathered before we have enough evidence that the child can't perform the task"* (Berkeley, 2011, pp. 55). How can AT help this child advance in reading skills given the time, texts, tasks, and grouping configurations that are available in the classroom? In the current study the potential to provide assistance for students with reading and writing difficulties by a multifunction application for iPhone/iPad is going to be investigated.

1.1 A multi-functional app

In this study a multi-functional application called Prizmo was used. The reason for this choice is that this app, unlike previous assistive technology, combines several multiple functions. Prizmo is an OCR (Optical Character Recognition) reader with built-in speech synthesis. This app is compatible with iPhone 3GS, iPad 3 or later versions, and with iPod Touch. Thus it is not primarily developed for use in school. As its primary functions are scanning text and synthesizing speech it can function as a tool for students whose reading difficulties are due to poor word decoding. A supporting function in speech synthesis is that a yellow rectangle marks the words that are spoken (a "Karaoke feature"). This feature makes it easier to accompany the spoken text if desired. The use of applications like ATs may indirectly have a positive impact both on word decoding and reading comprehension, as motivation, interest and time for text reading increase (Kristensson, 2013; Smith, 2012).

2 Method

2.1 Participants

A total of 118 students were screened, 64 students in the fifth grade at primary school and 54 students in grade one at high school. The students who scored at least one SD below the average value for each grade on a word-decoding test (Jacobson, 2001) were chosen for the next step in the study. A total of 42 students (14 from grade five and 28 from the first grade in the upper secondary school) performed below 1 standard deviation (SD) on the word chains test. In step two, these 42 students individually performed a test in which they were to read pseudo words (Rack, Snowling & Olson, 1992). Pseudo word reading is a phonological processing test chosen because phonological ability seems to be a core factor in dyslexia. The students that performed one SD below mean on a word decoding test and on a phonological decoding test were asked to participate in the study and fulfilled the criteria for a dyslexic profile. Out of a total of 17 students, 12 accepted to participate, seven students in the fifth grade at primary school and five in the first year of

high school. Three of the students' teachers in grade five and two in the upper secondary school grade one were linked to the study

2.2 Procedure

At the initial stage of the study the 12 participating students, their teachers and the project leaders had to carefully review the study design and purpose as well as the user manual that was distributed. This was done to ensure that all participants received the equivalent information and were able to raise questions about the study and its contents. The teachers and students also obtained a protocol, in which they were asked to write down thoughts and reflections that emerged in connection with the use of Prizmo. IPads with the Prizmo app were distributed to all students during the startup.

Students were informed that they were going to use and try the different features of the application during a period of 5-6 weeks. It would thus be used in class 4-6 times per week, 30-40 minutes per session. In the end each student would have used the application on 20 occasions. The features of the application to be used was to photograph the text, prune the scanned text, adjust the reading speed, listen to and finally save the scanned text. This was followed by 5-6 weeks during which the 12 participating students followed the instructions they had received. They attended the regular teaching with the difference that they brought with them their assigned iPad with its protocols and manual. During the intervention each teacher had the responsibility for his or her students. However, the project leaders were available to answer questions and to provide technical support throughout the project period.

At the end of the study, individual interviews were conducted with each student and teacher. The questions concerned the students' experience regarding the Prizmo application and its usability. The interview questions were:

- What do you think is good about Prizmo?
- What do you think is less good about Prizmo?
- Would you be willing to continue using Prizmo? If yes, in what context?

This part also included a grading of the various functions of Prizmo. After the individual interviews, test session 2 took place, in which each student was tested individually by a word chains test. Interviews were also conducted with each teacher. The interview began with the teachers' ratings of the various features of Prizmo. Then the teachers received the same semi-structured questions as the students about their experiences of the use of the application. Data collection and interviews were carried out by two students at the Special ed. Teacher training program at the Linnaeus University in connection with their master thesis (Isovaara & Kvick, 2013).

2.3 Materials

Word decoding was assessed by the word chains test (Jacobson, 2001), in which the participant silently read chains of Swedish words where the blank space between words had been removed. Each chain consisted of three semantically unrelated words, and the child was instructed to mark each word boundary with a pencil. The chains were constructed so as to involve no ambiguities regarding boundary locations and contained a large proportion of high frequency words. The number of correctly marked word chains in two minutes was used as a measure of general word decoding skill. It was impossible to complete all 80 word chains in that time. The word chains test had test-retest correlations with an interval of 12 months between measurements of r = .80–.90 in different groups of children in grades 1–6 (Jacobson, 2001).

Phonological processing was assessed by a pseudo-word reading test. A list of pseudo words was presented to the participants. The participants' task was to correctly read aloud as many of these (80 items) as possible in one minute. The pseudo words presented consisted of one to four syllables. Data for comparison was available from previous studies (Svensson & Jacobson, 2006; Svensson, 2009).

3 Results

In Table 1 the results for the word chains test at test sessions 1 and 2 are shown, i.e. before and after the intervention took place. Both raw scores and stanine points are reported.

Table 1. Result, Word chains test, Test session 1 (T1) and Test session 2 (T2).

		T1		**T2**	
	Individual	score	stanine	score	stanine
Grade 5	1	9	1	9	1
	2	13	3	20	5
	3	7	1	10	2
	4	9	2	10	2
	5	13	3	13	3
	6	12	1	15	2
	7	11	2	13	2
Grade one high school	1	8	1	12	1
	2	14	1	22	3
	3	22	3	24	3
	4	22	3	25	3
	5	16	1	21	2

The results show that 10 students improved their word decoding on a raw score between 1 and 8, while 2 students noted the same results at both test sessions. By using standards from the word chains test (Jacobson, 2001), a comparison can be made between the increases in raw scores that the students in this study made and the expected increases in raw scores. The expected increases vary slightly depending on where the student is located on the stanine scale. For this reason, we have chosen to look at the norms (Jacobson, 2001) for the lower scale points (1-3) in which we find the results from the participants in this study. According to test norms, the expected increase is on average 2 word chains (raw scores) per academic year for students who are within

the 1- 3 range on the stanine scale in the 5th grade. According to test norms, the expected increase is 3 word chains between the last year of primary school and the first year of secondary school.

After the study, both students and teachers rated the most essential features of Prizmo (Figures 1 and 2). The ratings were based on a five-point scale and were supplemented with a few questions of a summary character regarding functionality. The rating of "save text" has been left out of the diagrams since only a few participants tested this function, the reason being that the students had no need for saving texts.

3.1 Pros and cons of Prizmo - students' perspective

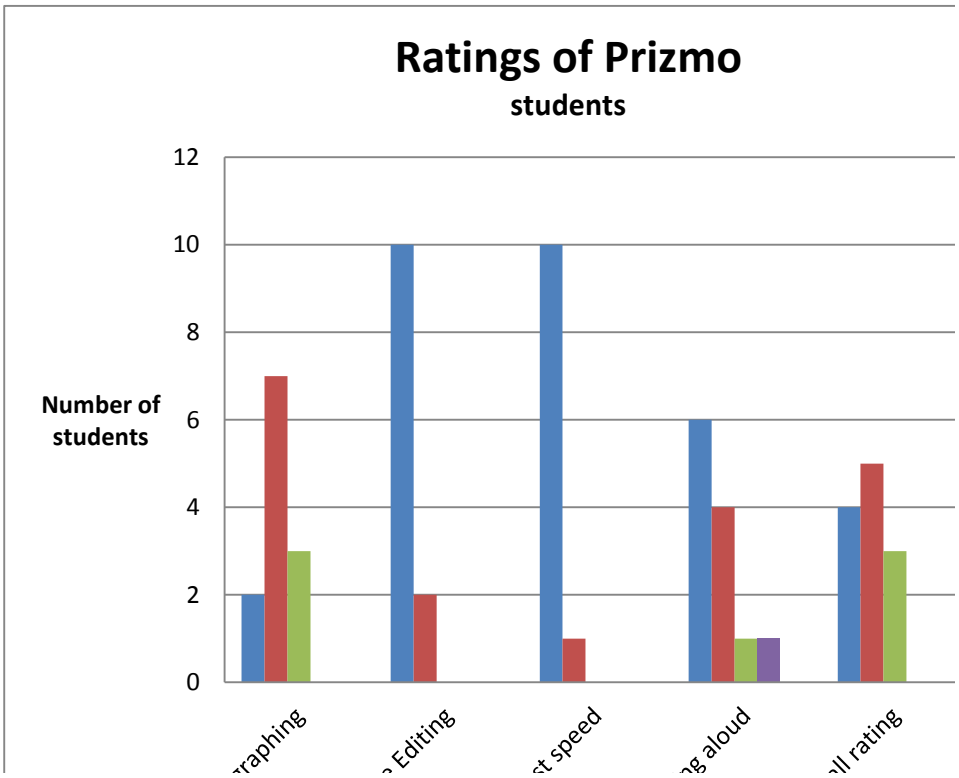

Figure 1. Students' rating of Prizmo

As a complement to the rating of Prizmo, open-ended interview questions were put to all students. A summary statement of the interpretation of student responses on what was considered good about Prizmo is that it gave access to texts and moved the focus and energy to the content rather than to the decoding: "I can concentrate on the content instead of spending all energy on trying to understand what it says. You can sit and listen to text instead of struggling to read what it says" (Student in upper secondary school).

Student answers concerning what was not so good referred to picture quality when photographing. Two students also made the assumption that the smartphone (iPhone) would be easier to deal with than the tablet (iPad): “IPhone is to be preferred to the iPad since it is difficult to carry it along everywhere” (Student in grade 5).

Students were unanimous about their wish to continue using Prizmo as decoding support: “I am going to use Prizmo both in school and at home when doing homework” and “You work while using it, so focusing becomes easier” (Students in grade 5).

3.2 Pros and cons of Prizmo - teachers’ perspective

Figure 2 shows the five participating teachers’ ratings of Prizmo.

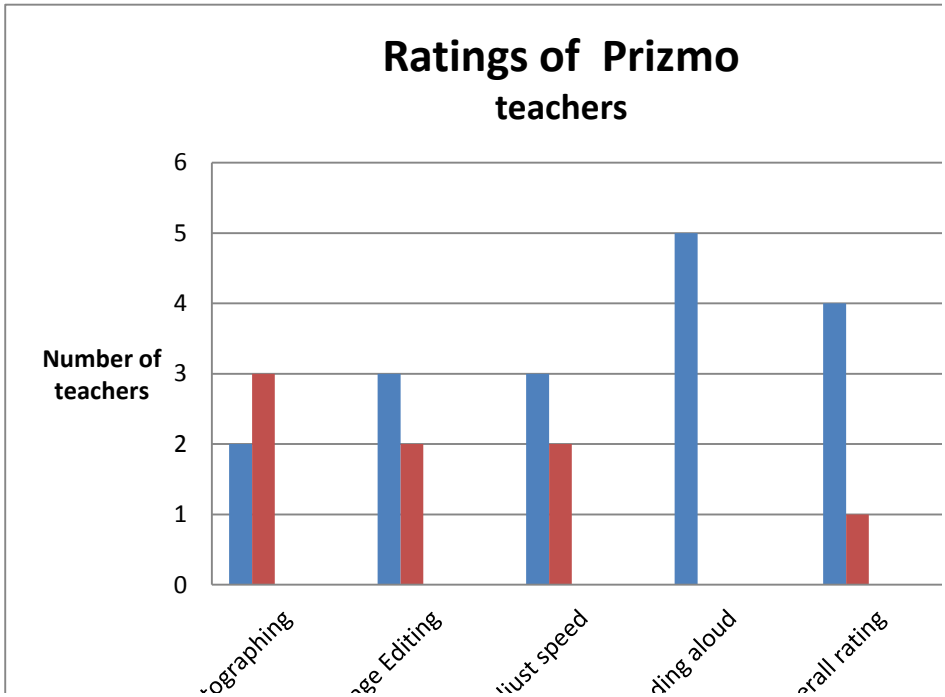

Figure 2. Teachers´ rating of Prizmo**.**

As a complement to the rating of Prizmo, open-ended questions were also put to the teachers. The teachers’ teacher ratings reveal that they are largely based on their experience of how students have approved the program. The teachers also welcomed the use of Prizmo, highlighting various advantages both as reading support and as a motivational tool. According to one teacher, students not only become better at reading and spelling, but their motivation to read and write also increases: “A good tool for secure reading and increasing self-confidence, and fun to use” (Teacher, grade 5). An upper

secondary school teacher commented on the usability of Prizmo: “Very usable! Needed only a brief introduction and then they (the students) got started. They are now able to get on in the books without teacher support at the time.” As the photography part turned out to be rather difficult, one teacher made this comment: “Photographing was difficult at first but I noticed that it is a matter of getting accustomed to it” (Teacher, grade 5).

In sum, there was agreement among the teachers about the user-friendliness of Prizmo: “For students with reading difficulties this app helps when they read long and/or complex texts. It also means that, as a teacher, I don’t need to load text books in all kinds of different subjects – splendid, I can do other things during that time” (Teacher, grade 5).

4 Discussion

The aim of this study was to investigate whether a multifunction application for iPhone/iPad had the potential to provide assistance for students with reading and writing difficulties. The overall result shows that both students and their teachers emphasized the usability of Prizmo in a literacy context. Since Prizmo has no explicit reading training function, the difference in the test results on the word chains test between the first two test sessions is surprising. This compensatory program seems therefore also to give transfer effects on word decoding according to the principle that keeping up with the language makes language skills increase to ultimately make better readers. On average, the students in grade five increased by 2.3 word chains between the two test sessions, and the increase for secondary-school students was on average 4.8 word chains. According to test norms (Jacobson, 2001), the expected average increase is 2 word chains (raw scores) per academic year for students who are within the 1-3 range on the stanine scale in the 5th grade. Given the time period (approximately 7 weeks, compared to a full academic year), the increase is substantially higher than expected. Although word decoding ability was not trained specifically during the intervention, the participants grew better at decoding words afterwards. The explanation could be that they use more written text with the help of the technology; in other words, they practise their reading. In interpreting this increase several factors should be taken into account. First, the increase may be a training effect as a result of the short period that elapsed between T1 and T2. Secondly, it would have required a larger selection group and a control group to weight the results against to enable drawing general conclusions. Part of the increase may be due to indirect training effects from the use of Prizmo. One example of an indirect training effect is an increase in motivation for schoolwork as the students had the opportunity to assimilate the content of the texts on their own. This in turn gives more time for the task of text processing, which is in itself an exercise. It probably also felt motivating to participate in the study and be allowed to use new technological tools. Before the study we thought that the photography part would be a critical point. Photographing was also the function that was said to be twisty in certain cases, but it was still rated as easy. One

of the teachers expressed that the photography element was difficult for some students to start with but that it soon became a matter of habit. The chief reason for not testing the "save text" function is that the students had no need to save the scanned texts.

In our experience, traditional reading instruction whose mission is to serve struggling readers have been slow to embrace the potential of technology and continued research in the area of ATs is necessary. The purpose of the study was to evaluate the usability of this multifunction application in pedagogical settings. A technical device that is too complicated will not be used even if the need for compensation exists. That this application is deemed to be user-friendly is clear. From the teachers' point of view the students not only become better at reading and spelling, but their motivation to read and write also increases.

5 Conclusions

Thanks to its accessibility and applicability for persons with reading and writing difficulties and dyslexia, applications like Prizmo have a potential as assistive technology. The same study could have been implemented with some other tool for reading and writing with the same result (assuming high user ability), since it is the interaction between the individual and the surrounding factors that is crucial, not the app in itself. Assistive technology can therefore work as a small key that opens big doors and acts like those reading glasses that were written up as a metaphor in the heading. Limitations of this study were the small number of participants and the number of tests that measure literacy. Continued research in the area of ATs is essential with the ongoing explosion of new technologies. A summarizing interpretation of the interview answers to what was considered good about this multifunction application is that it gave access to texts which would otherwise have been considered hard to approach and that focus and energy shifted from word decoding to the content of the texts.

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