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Laptops which talk: liberating dyslexic learners

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ABSTRACT

This paper describes a number of case studies in which laptop computers with speech synthesis were used in order to determine the cognitive and motivational effects on the literacy and academic self-esteem of disabled students. Students who have poorer than average reading and writing skills, are disadvantaged in all areas of education. Such disadvantages are often related to lowered academic performance and self-esteem. Computers have been used for remedial teaching for some time, but it is only recently with advances in technology and reductions in price that it has become possible for children to have a computer when and where they really need it: in the classroom to help them with their class work. By using a laptop computer with speech synthesis as an aid reading and writing impaired students may be able to participate more fully in classroom activities.

Main conference themes: integration
Educational areas: primary education, secondary education
Study topics:
Secondary keywords: case studies, literacy, portable computers, research, special needs, voice

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INTRODUCTION

Children may have problems with reading and writing for varied reasons, some physical, some psychological and others environmental. As children become older their inability to read and write as well as their peers can become a source of embarrassment and low self-esteem. This low self-esteem stems from being poor at spelling, having bad handwriting, being slow at writing and lacking confidence in what has been written. This means that these children do not know if what they have written is spelt correctly and so are embarrassed to put their thoughts on paper for others to ridicule.

Word processors can help students to overcome these problems. MacArthur [1] found that word processors give students the power to produce neat, printed work and to correct errors without damaging the appearance of the paper. This is especially motivating for those students whose written work is typically characterized by poor handwriting and errors. The ability of the word processor to combat these problems was summarized by Wanderman and Fais [2]:

> "No longer does a mistake mean a re-write. No longer does a paragraph out of place mean a re-write. No more white out. No more illegible handwriting. No more worry about the most mundane part of the writing process, the physical act of getting the words on paper. Now our students can worry about more important things, like what they are trying to say. The computer is a prosthetic writing tool for learning disabled students in that it helps compensate for a great number of their weaknesses. The effect this has on their image of themselves as learners and idea producers is profound. With the aid of a computer, many learning disabled people can now see their ideas, outside of their heads, in legible written form for the first time."

However most human interaction with computers relies on the user being able to read information from a computer screen which gives problems when the user has reading difficulties. As early as 1985 Pournelle [3] suggested that voice synthesis might be the solution. Research by Cohen [4], Borgh and Dickson [5] and MacArthur [1] support this and suggest that spoken and written language are intertwined for inexperienced or poor writers, and that hearing the computer 'speak' their written words may encourage them to take an audience's perspective on their work and that writing with a 'talking' computer may also prove motivational in both acquiring, and using writing skills. Research by Olson, Foltz and Wise [6] and by Kurth [7] found that the students who benefit the most from the technology of voice synthesis, are

those who have reading and writing problems and that as children become skilled readers and writers the voice synthesizers may become less helpful.

In order for the computer to be a practical solution it needs to be available at all times. Yau [8], Peacock and Breese [9] have successfully used laptop computers in their research with learning disabled students.

In summary, a great deal of research has been directed at helping children with dyslexia and other specific learning disabilities including a number of studies which have made use of computer aided instruction. However, none of these studies have taken place under 'conventional' classroom conditions where the technology was provided just for those students who need it, in order to facilitate their participation in the normal classroom activities. By using a laptop computer with voice synthesis as an aid reading and writing impaired students may be able to participate more fully in classroom activities. Previous research has shown the potential for this technology. It is the aim of the study described here to see how effective the application of this technology may be.

Research Questions

The study focused on the following questions:

- Would learning disabled students show an increase in basic literacy skills after using a laptop computer with voice synthesis?
- Would using a laptop computer with voice synthesis result in an increase in self-esteem among learning disabled students?
- Would learning disabled students show an improvement in their attitude towards school after using a laptop computer with voice synthesis?
- Would learning disabled students spend more time on a task when using a laptop computer with voice synthesis?

METHODOLOGY

The study follows the 'baseline reversal' methodology commonly employed in single-subject experimental design [10], see Fig. 1.

This experimental design has four elements: baseline-1, intervention-1, baseline-2, intervention-2. The students behaviour is observed under alternating baseline (without computer) and intervention (with Computer) conditions; if changes in behaviour coincide with experimental manipulation, relationships are established.

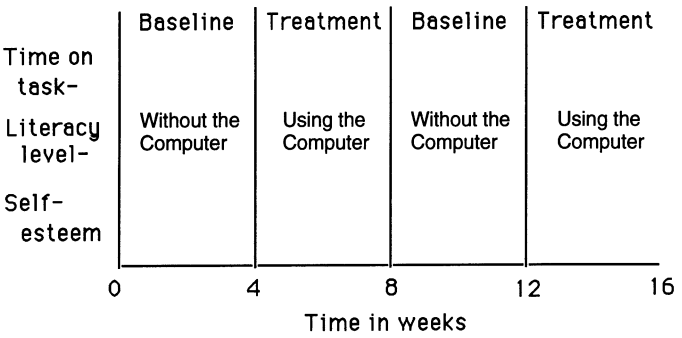

Fig. 1 The 'baseline reversal' [10] methodology employed

Subjects

Seven students in the age range of 11 to 13 years were selected as subjects for individual case studies. The students were selected in consultation with their teachers and The Dyslexia-Speld Foundation of Western Australia as students of average intelligence who have reading and writing problems.

Computer equipment used

Subjects were provided with Toshiba T1000SE notebook computers fitted with an Accent Mini voice synthesiser, running SoftVert text to voice software and PFS First Choice was used as a word processor. A dot matrix printer was provided for 'hard copy'. An external battery recharger was provided to help overcome battery management problems. (The students were instructed to remove the battery from the computer and replace it with a recharged one from the recharging unit only when the low power warning light flashed on the computer). The equipment and software were chosen as a compromise between cost, durability and ease of use. The aim being to show the potential of readily available and affordable technology.

The laptop computer with voice synthesis was used to complete the students' normal class work (the student remained in his/her ordinary class for the duration of the study). The computer could be made to read aloud (or through headphones) anything on the screen, including material previously prepared by the teacher and work which the student had produced. Many of the worksheets and printed notes which were given to the class, were scanned into the computer using optical character recognition technology. A printer was used to produce a paper copy for marking.

The study focuses on four dependent variables: literacy, attitude to school, self-esteem and time on task. Literacy is being assessed by using some of the

tools provided in the West Australian Ministry of Education's [11] 'Benchmark' literacy tests. Attitude to school and self esteem was measured using a self-esteem inventory adapted from those developed by Lawrence [12] and also by a survey over the classroom teachers. Time on task was measured by observation techniques.

Procedure

Each subject took part in a sixteen-week study. The study was divided into four-week blocks, four weeks with the computer and four weeks without.

During the study the student's work was monitored and samples taken. The samples were then scored to determine writing skill levels using the 'Monitoring Standards in Education' essay marking guide. At the beginning of the first block and at the end of the last block the students completed an attitude questionnaire on computers and the self esteem inventory. The students were observed regularly noting the time spent on task and other behaviour. The students remained in their classes and did their normal class work with or without the computer as an aid. Notes which the student would normally hand write from the board were typed into the computer and as far as is possible all class work which the students had to do, was aided using the computer and voice synthesis. Classroom teachers were surveyed at the end of the final block on various aspects of the students work and their attitude to school.

All students had limited training on the use of the computer and the software before the start of the field trial. This included battery management and the need to save work frequently, as these were areas which previous studies indicated were a problem to students.

FINDINGS

Literacy

No major increases in literacy have been detected in the analysis of the work samples taken. However results from four of the teacher surveys referred to various improvements in the areas of spelling, comprehension, punctuation and composition.

There was an improvement in the presentation of the students work due to the use of the printer and the spelling checker, but no change in other areas such as vocabulary and structure.

The voice synthesiser was used by the students to read their completed work back to them. This encouraged more editing in order to correct syntax and to change words which did not sound correct when read aloud.

Self-esteem

Five of the students have shown improvements in self esteem (Fig. 2). This may in part be due to the positive attention they have received by being part of the study and not only to the introduction of the computer.

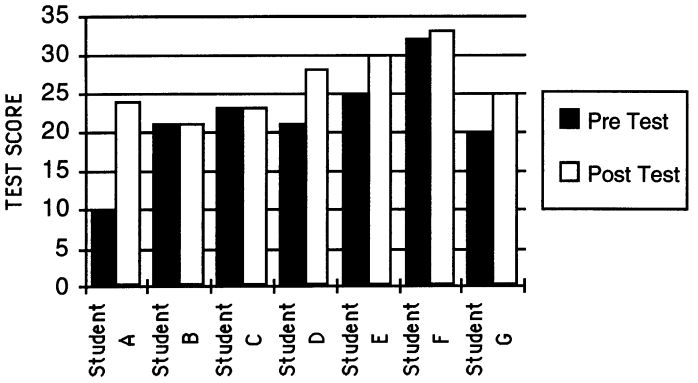

Fig. 2 Student self-esteem: pre- and posttest results.

Only one of the students had a very low self-esteem at the start of the study and this student exhibited the greatest positive change. Many of the other students all had a nonacademic school subject in which they had success such as sport or art, and this would help to maintain a positive attitude towards school and help to boost their self-esteem.

Attitude towards school

All of the students showed an improvement in their attitude towards school during the course of the study. Teachers reported that activities which involved the use of the computer were embarked upon far more enthusiastically than before the introduction of the computers. It will have to be seen if this improvement in attitude is maintained over the longer term.

Two of the students became interested in the computer itself asking about programming and wanting to learn more about how it works in order to customize its operation. This gave them a new interest at school with an appropriate increase in attitude.

Time on task

After an initial 'learning period' when the computer was first introduced (during which time spent on task drops), there was a general trend for students to spend more time on task with the computer available.

There has been a great variation in the quantity of work produced with some students producing much more work and others the same or less. Some of this variation may be due to differences in typing skills, but teacher surveys indicated that students spend a lot more time editing with the computer; this phenomenon was also established by Borgh and Dickson [4] in their research.

Training

It took approximately two weeks for the students and teachers to become comfortable using the computers and for the novelty value of the presence of the computer (and the observer) in the classroom to become accepted by the other students.

Computer and key boarding skills

All students acquired many computer skills such as cutting and pasting text, saving and loading files, etc. and were comfortable in using the computer to do their work. Indeed the speed at which the students acquired knowledge about the computer and its use, was surprising particularly as these students have had no prior contact with MSDOS computers and had no computer at home. The schools computers were BBC microcomputers in line with most primary schools in Western Australia.

Many of the students had little or no keyboarding skills, being two fingered typists at best, but this was not the great problem one might imagine. This might have been due to the fact that the students writing skills were very poor and the positive reinforcement of the neatly printed output made up for any keyboard frustration. This was also found to be the case in research by Wanderman and Fais [2].

Classroom Environment

The style of room environment may have a bearing on the results obtained. Some of the schools involved are very conventional in both teaching style and layout, others were open plan schools with students sitting in groups. Many lessons in these schools were team taught with up to three teachers teaching up to seventy students. The observational data show that the children in the conventional classrooms spend more time on task, but this may well be a fallacy.

In the more conventional classroom environment students have less opportunity to be off task or to seem to be off task. As many activities are beyond the ability of the dyslexic student to complete, they become experts at looking busy, but with very little work to show for their industriousness. In the open plan school students are often out of their seats and can seem to be off task. One student observed talking to another may in fact be receiving peer

but the observer sitting across the room may well record this interaction as being off task. In addition to this the students' books and materials are not kept at their desks, but on shelves located around the room, thus encouraging more legitimate classroom wandering than in other more conventional classroom environments.

Teachers attitude towards computers

The teachers attitude to, and familiarity with, computers seems to be reflected in the students productive use of the technology and attitude to it. Those students having a computer literate and/or supportive teacher were far more productive. This was reflected in research by Yau [8], Peacock and Breese [9] who found that giving the students the technology is not enough; support for the students in the form of training and backup is necessary as well as catering for those students in the design of the lessons.

CONCLUSIONS

It would seem that while not a panacea, there are both educational and motivational benefits for the child with learning problems from access to an unobtrusive and always available laptop computer with voice synthesis.

The present study indicates that further research is needed to determine what effect a teacher's attitude towards computers and computer literacy has upon the computer use of the pupil as well as research into classroom design and structure, and the effect on learning disabled students work.

1994 saw the introduction of a whole new generation of computers. This new generation of computers heralds an age where computers will be capable of voice control and of 'learning' and 'interpreting' human voice so that we will be able not only to have a talking word processor, but one which we can control and input text by voice. While this will be a great novelty for most of us, for the learning of physically disabled it will bring a freedom which we take for granted, but they can only dream about.

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