Evaluation of a computer-based program to teach, reading and spelling to students with learning difficulties.

It is generally agreed that students with significant difficulties in reading and spelling benefit most from individual tuition using structured, multisensory strategies. Thompson (1988) demonstrated that the visually-based method of spelling instruction ("look-cover-write-check") was ineffective for consistently misspelled words. On the other hand, a recent evaluation of a multisensory program comprising structured phonetic instruction, drill and repetition and multisensory methodology found that over a two year period, it benefited dyslexic students more than did standard instructional techniques used with a control group (Oakland, Black, Stanford, Nussbaum, & Balise, 1998). Such "specialist" methods have a long history. They were advocated by Montessori and codified in the Orton-Gillingham program (Richardson, 1997). Orton (1957) wrote that teaching of such students should start with small units and then proceed by orderly stages from simple to more complex. One should use an "integrated, total language approach. Each unit and its sequence is established through hearing, saying and writing it."(p.6)

The connection between the teaching of spelling and the teaching of reading is well-established (Frost & Emery, 1996; Spalding & Spalding, 1957-90; Lamond & Whiting, 1999.) Successful teaching of spelling involves teaching the phonemic and orthographic structures of words, and trains the reader to recognize such structures when they encounter them in continuous text, or in individual words (Wise & Olsen, 1994).

On the face of it, a computer, programmed interactively, is well-placed to fulfil these requirements. The student, equipped with headphones, enters an individual world where material is presented in a closely structured, sequential manner, where reinforcement is always positive, and where feedback is immediate and rewarding. Thomson (1984) has summarize the advantages of computer-aided learning for dyslexic children as: provides new motivation; provides opportunity for essential overlearning; provides immediate feedback; allows the child to work at his or her own pace; is non-judgmental and predictable; avoids the necessity of handwriting; can store and access information. the disadvantages he saw included difficulty in providing multisensory output, limited adaptability to error; necessity for the child to read the instructions on the screen, and lack of human contact. The progress of technology over the years since Thomson provided this analysis means that most of the disadvantages are no longer a problem, and a program which could, in addition supply human contact would presumably have all advantages and no disadvantages!

Ten years after Thomson, Olsen & Wise (1994) summarized research findings on the use of computers in the teaching of spelling as showing benefits in motivation, individualization, repetition, and with speech, dictation. They pointed out that by 1994, many of the studies of computer-assisted spelling instruction showed small gains unless adults were present offering much support. Nicolson & Fawcett (1994), however, reported two computer-based programs which appeared capable of producing significant improvement in the spelling of dyslexic children. A rule-based program and a mastery program produced good results, and the authors suggested that the ideal might be a combination of the two. At post-test, the mastery program produced superior results, but at follow-up testing there were no differences, and the gains were largely maintained one month later (Fawcett, Nicholson & Morris, 1993).

Fawcett, Nicholson & Morris (1993) found that typing was a possible intervening variable in the programs they were investigating. They observed that in the later stages some of the more able children became over-confident, making typing errors and thus influencing the operation of the program (which of course regarded the typing errors as spelling errors. It would seem thus that some attempt to link typing directly with the teaching of reading and spelling would be useful in developing computer based learning. One program, developed before computers were available,

aimed to link typing and spelling in a learning package (Duffy, 1974). It was a linguistically-oriented typing course, aiming to strengthen fine motor coordination, eye-hand coordination, visual discrimination and visual memory. Its sequence was so constructed as to reinforce the reading and spelling patterns of phonetically regular words in English. It also advocated saying the letters or words aloud as they were typed, as an aid to remembering which fingers were to strike which keys. While there is no evidence as to the success of the method, it fulfilled the requirements of a good teaching program, in that it was multisensory, sequenced, and provided for immediate reinforcement of success. The structure of the course content (words) also bore a striking resemblance to earlier and later phonically-based programs for dyslexics (Orton, 1937, 1964; Orton-Gillingham, later developed by Gillingham-Stillman, 1960,1970; Miles, 1991; Hornsby & Shear, (1993); Spalding, (1957,1990.)

Borthwick (1993) summarized the findings of 41 studies from 1929-1983 investigating the effects if typewriting on children's literacy development. She concluded that there was a small positive effect on reading, word identification, and spelling. Subjectively, typewriting was favoured for its motivational value. Touch typing did not give more positive results that "two-finger" typing. On the other hand a 1990 study (Cunningham & Stanovich, 1990) found that handwriting was more effective for spelling practice than typewriting.

It seems clear that many variables may affect the outcomes of computer-based programs designed to teach spelling. A computer is much more than a typewriter, though typing skills are important for efficient computer use. If typing is automatic, then presumably there are more attentional resources available for learning other things. Environmental factors may be important. A computer program is rarely used without some adult support, and this may be an important factor in the success of that program. The studies by Olsen and Wise (1994) referred to above support this assertion. Factors within individuals will affect outcomes. Scrase (1998) investigated a computer-based spelling program, and found it to be effective with different groups in diverse locations with different tutors. Despite this similarity of outcomes, there were variations that were found to correlate with factors inherent in the subjects such as poor phonological skills, Irlen Syndrome (Evans et al, 1995), age, and number of exercises completed.

The present study observed a computer-based typing/spelling/reading program developed in England (Alexandre,1998). This program is based on the premise that the ordered, sequential, repetitive process needed to learn touch-typing can be structured so as to parallel a well-tried sequence of learning the orthographic structures of English. In doing so, it lays a basis for internalizing those patterns and then using them for fluent reading. The acquisition of typing skill would progressively free many students with learning disabilities from the difficulties of handwriting, allowing them to attend to the more important elements of spelling and structure in their writing.

Description of the Program

The program is based on multisensory, sequential teaching principles. Its content was derived from the teaching sequence of spelling patterns provided by Hornsby & Shear, (1993). Research has consistently found that programs based on structured, sequenced, multisensory teaching of sound-symbol relationships and orthographic patterns, particularly when in meaningful context, improve the skills of poor readers and spellers (McGuinness, McGuinness & McGuinness, 1996; Biasotto, 1993). The recommendations of the International Dyslexia Association concur with these findings. The IDA advises, "We encourage early intervention, including a multisensory, structured, sequential approach to language acquisition for individuals with dyslexia." (International Dyslexia Association, 1999). The same approach has been shown to work with adults (Guyer, 1993).

The program requires that students use consistent fingering at the keyboard, and learn to type sequences of letters. In the case of this program these sequences are the orthographic patterns found in English words. The auditory component of the program allows the student to hear the words they are typing as they type, and the screen allows for enlarged text as well as variation of background and text colour. The program also provides immediate accuracy feedback in visual or both visual and auditory form. Advantages associated with providing feedback in both modalities were demonstrated by Lundberg (1995) who showed that speech feedback in a computer training program improved outcomes for students with dyslexia in reading and spelling more than occurred for such students in conventional special education settings.

Students work at an individual computer equipped with headphones. The typing program is presented both on screen and through headphones, and (at least for children), assistance is required from a parent or other helper. The program claims to be beneficial for students who experience difficulty in handwriting. The units of the program are closely structured to maximise the probability that students will achieve better than 80% accuracy on each unit. The program manual suggests that most achieve better than 90%. This is found to be highly motivating in itself, and the immediate feedback offered by the computer, as well as the cumulative results graphs reinforce success. For many students, success in academic work involving reading and writing has been elusive.

Ten students may work with one teacher-supervisor. The functions of the supervisor are to ensure that the equipment works properly at all times, to answer questions that may arise, and to provide consistent, immediate positive feedback as units of work are completed. The emphasis on positive feedback seems important in this program.

In summary, the program aims to build students' confidence through measurable success, immediate self correction of errors and feedback of results, a multisensory approach, (seeing, hearing and touch-typing), and a planned programme of learning that is carefully structured and computerized.

A joint project between the British Dyslexia Association and Pentonville Prison in the UK was funded by the National Year of Reading in 1998-9, and reported such success that it was decided to fund the program into 13 other prisons in the year 2000 (Freeman & Broadfoot, 2000). The report was, however, anecdotal and did not report measured progress of the project participants.

The aim of the present study was to evaluate the effects of the typing/spelling/reading program on school-aged children. The sample for the study was drawn from two settings (an in-school and an after-school group).

Subjects

The two groups were, one (n =12) chosen from students in a state primary (elementary) school, and one (n =18) composed of students from different schools attending an after-school program. All students were referred to the program because of unsatisfactory progress in reading and spelling. Students from the school had some instruction in touch-typing, while those from outside had none. Subjects ranged in age from 9 to 14 years.

Method

All subjects were assessed at the beginning and end of the study for reading using the Neale Analysis of Reading Ability (Revised) (Neale, 1988), the Word Identification subtest and Word

Attack subtest from the Woodcock Reading Mastery Tests - Revised (Woodcock, 1987) and for spelling, the Wide Range Achievement Test (WRAT-3) Spelling subtest (Wilkinson, 1993).

All groups were post-tested at the conclusion of the program, using alternative forms of the tests used at pretest, where these were provided. The alternative forms for the Woodcock test were not available in Australia.

Each week, each student worked at the same individual computer equipped with headphones and CD ROM. Each group was supervised by a supervisor who had received some training and who had no part in the design or implementation of the evaluation.

The program was based on the teaching sequence developed in UK by Dr Bevé Hornsby (Hornsby & Shear, 1993), and presented from a CD-ROM in conjunction with the touch-typing program. The program was multisensory in that the screen presented the position and action for the subject's fingers pictorially, and in the upper part of the screen the responses of the subject were displayed in letters of a size and colour favoured by the subject. The sound represented by the words or letters to be typed was produced through the headphones.

The program was divided into stages and levels. Positive feedback was given after each level was completed, and there was no negative feedback. Scores for each unit were calculated by the computer and represented progressively on a graph. The units were structured closely so that scores in excess of 80% were likely to be obtained regularly, thus representing the most positive feedback these subjects were likely to have experienced for an "academic" task. The supervisor was asked to add enthusiastic positive feedback at the end of each level, and also when recording scores for the session on the student's personal record card. At the end of each session (typically completed in about 45 minutes) scores for all units completed were calculated and recorded on a score card by the supervisor. No additional work was assigned between sessions, and students in the after-school group did not participate in other remedial programs.

After three sessions, subjects were invited to withdraw from the program if they did not like it, and at the end of the program the parents (or the child in the case of older children) were asked to complete a written, open-ended survey. The content of this survey is in Appendix 1.

Test scores were converted to standard scores and differences between pre- and post-test scores were analyzed using the general linear model.

Results

Qualitative Responses

Subjects in the after-school group, where parents were involved, were asked open-ended questions to evaluate the course (see Appendix 1). Parents generally filled in the questionnaire in consultation with their child. All subjects thought they had improved their typing skills during the course. Comments indicated that some parents were as concerned with this skill as with spelling progress. For example, two responses indicated concern that the child's developing keyboard skills were not being supervised closely enough. When asked what was the best thing about the course, comments invariably included "learning to type" or words to that effect.

Comments about spelling improvement at the end of this ten-session course were less definite. Forty-six percent thought that spelling had improved, 23% thought it had not improved, while 31% were uncertain. One comment suggested that learning to spell was the best thing about the course. One other commented that confidence in spelling had definitely improved, while an older student

commented that in ten weeks they had not reached words difficult enough to challenge their spelling skills. This question would need to be decided on the basis of the pre- and post-tests. A number of responses to the question about what they would most like improved in the course indicated that the senior students wanted to get on to harder words more quickly. This is understandable when one considers that any typing course of necessity begins with single letters and gradually builds to more complex combinations of letters. One subject commented that the situation would be improved in the following term as they reached more difficult letter patterns. These comments may simply reflect the short length of the course (10 sessions), as the program seems to have been used successfully with older students elsewhere (Perrott, 1999).

Several responses highlighted the importance of positive reinforcement. Among the "best things" about the course were "getting better scores"; "the history graphs" [indicating student achievement]; "the positive feedback from the supervisors". However, it appears that positive feedback is not an unmitigated blessing. A couple of children appeared to become obsessed with scoring 100% once they had done so, and would repeat units until they achieved this. The course does not require that students repeat units unless they get below 80%, though they may opt to do so. However, repeating units slows the pace at which they develop their knowledge of letter combinations, and may not appreciably improve their typing skills. Thus, perfectionism may actually retard progress in a program such as this one. Close supervision or instruction of parent helpers seems important in such cases.

Parents and their students were also asked about the supervision of the program. Eighty-five percent of students rated the supervision as good or better, while 15% would have liked closer supervision. They defined this as more positive reinforcement (while most thought this was adequate, one parent described her child as "thriving on praise" and needing more than could be offered by one supervisor with 8 students.)

The course was conducted on one afternoon after school each week. No work was assigned between sessions. The designer of the course justifies this on the grounds that students with learning difficulties have enough trouble with homework without extra work, and that experience has shown that the program works without it. However, a number of comments were made about frequency of sessions, the general feeling being that more frequent sessions would be more beneficial, especially where a motor skills was involved. A majority of participants (54%) was satisfied with the length of the course, but almost half (46%) thought it was too short. Suggestions were twice per week, or additional homework, or an intensive (holiday or weekend) course.

The aural aspect of the program received mixed praise. Students were given the option of using the headphones or not, as it suited them. They were used successfully by 62% of students, while 31% did not use them. Some used them some of the time. Some found the sound unclear, several did not always understand the "English" accent, some did not adjust the speed of the dictation and found it easier to have the parent-helper read out the words. One just found wearing headphones uncomfortable. This appears to be an aspect that needs careful monitoring when the course is presented. Perhaps an "Australian" voice would be more helpful in Australia, but even that would have to be carefully chosen to be accessible to all students.

One comment concerned the effect on a child with attentional problems. Despite the advantage of using the hands continually, there was still, for this child a need for a more isolated situation with less movement around and less noise than inevitably occurs in a room with 18 people and 8 computers.

Quantitative Results

Parent and student responses were unable to indicate whether progress had actually been made on reading and spelling, and in any case, such responses would be highly unreliable (Macmillan, 1997). Analysis of pre- and posttest results were carried out to determine this matter.

In addition, the relatively small number of units completed in the time by some students suggested that progress in reading and spelling might well be related to the number of units completed. Students who persisted in repeating units in an effort to score 100% might in fact have disadvantaged themselves in this way. Further analyses were therefore carried out to include "Content Covered" (the number of units completed over the period of the course). The following tables display the results of these analyses.

Neale Analysis of Reading Ability

To determine whether the program had a significant effect on students' accuracy, and comprehension performance, pretest-posttest scores on these subscales of the Neale Analysis of Reading Ability - Revised were entered into a repeated measures analysis of variance (ANOVA), with treatment group entered as an independent variable to reduce within-group error variance and to determine whether pre-post gains differed across the two school groups. In addition, two groups were created on the basis of the number of modules completed over the course of the program (Content Covered). Content Covered was then also entered as a between-subjects factor, creating a 2 (pretest-posttest) by 2 (treatment group) by 2 (content covered) factorial design. Means and standard deviations for the Neale accuracy and comprehension subtest scores are shown in Tables 1-2.

Table 1. Means and Standard Deviations for Neale Reading Accuracy scores pre- and post- typing training.

	Treatment Group	N	Content Covered Group	Mean	Standard Deviation
Neale Acc-Pre	After School	5	High	121	8.15
		4	Low	101.5	6.56
		9	Total	112.33	12.45
	In School	3	High	100	24.33
		6	Low	93.33	15.47
		9	Total	95.56	17.57
	Total	8	High	113.13	18.04
		10	Low	96.6	12.85
		18	Total	103.94	17.11
Neale Acc Post	After School	5	High	126.8	16.36
		4	Low	117.0	21.86
		9	Total	122.44	18.43
	In School	3	High	116.33	12.90
		6	Low	100.17	12.02
		9	Total	105.56	14.05
	Total	8	High	122.88	15.16
		10	Low	106.9	17.75
		18	Total	114.00	18.12

Table 2 Means and standard deviations for Neale Reading Comprehension pre- and post- typing training

	Treatment Group	N	Content Covered Group	Mean	Standard Deviation
Comprehension Pre	After School	5	High	129	11.66
		4	Low	107.75	9.74
		9	Total	119.56	15.13
	In School	2	High	102.00	15.56
		6	Low	93.67	16.57
		8	Total	95.75	15.67

	Total	7	High	121.29	17.45
		10	Low	99.3	15.4
		17	Total	108.35	19.29
Comprehension Post	After School	5	High	138.2	18.79
		4	Low	108.5	6.61
		9	Total	125.00	20.93
	In School	2	High	108.5	13.44
		6	Low	106.33	9.87
		8	Total	106.88	9.82
	Total	7	High	129.71	21.81
		10	Low	107.20	8.36
		17	Total	116.47	18.66

All preliminary analyses for conformity to ANOVA assumptions produced satisfactory results. However, an examination of the raw scores for the Neale subtests indicated that four students reached the ceiling on one or more of the subtests at either the pre- or the posttest (or both). As a result, these students' data were removed from the analysis to ensure that their results did not attenuate the overall effect observed.

The ANOVA on Neale Accuracy scores indicated a significant main effect for occasion ($F(1,14) = 11.00$, $p = 0.005$, $\eta^2 = 0.44$). Based on the means shown in Table 1, this indicates that students improved significantly from the pre- to the posttest. The main effects for treatment group and content covered were also significant ($F(1,14) = 4.69$, $p = 0.05$, $\eta^2 = 0.25$; $F(1,14) = 4.00$, $p = 0.07$, $\eta^2 = 0.22$, respectively), although there were no significant two or three-way interactions at the 0.05 level.

The ANOVA on Neale comprehension scores also indicated significant main effects for occasion ($F(1,13) = 6.60$, $p = 0.02$, $\eta^2 = 0.34$), treatment group ($F(1,13) = 7.93$, $p = 0.02$, $\eta^2 = 0.38$), and content covered ($F(1,13) = 5.62$, $p = 0.03$, $\eta^2 = 0.30$), but again, no significant three- or two-way interactions between these variables at the 0.05 level. As indicated by the means shown in Table 2, the significant main effect for occasion indicates that students improved in their comprehension scores significantly from the pre- to the posttest.

Woodcock Word Identification and Word Attack Skills

To determine whether the typing program had a significant effect on students' word attack and identification skills, pre- and posttest scores were also entered into a 2 (treatment group) by 2 (content covered) by 2 (occasion) mixed design ANOVA. Again, all preliminary analyses indicated adequate conformity to ANOVA assumptions.

Table 3 Means and Standard deviations for Woodcock Word Identification pre- and post- typing training

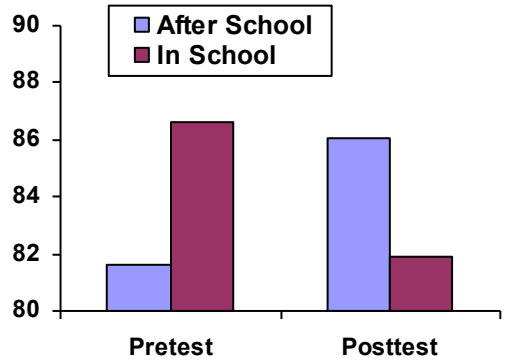
	Treatment Group	N	Content Covered Group	Mean	Standard Deviation
Word Id-Pre	After School	10	High	76.1	20.67
		4	Low	12.04	12.04
		14	Total	18.26	18.26
	In School	2	High	2.83	2.83
		6	Low	13.26	13.26
		8	Total	12.12	12.12
	Total	12	High	19.48	19.48
		10	Low	12.08	12.08
		22	Total	16.2	16.2
Word Id-Post	After School	10	High	22.65	22.65
		4	Low	9.98	9.98
		14	Total	19.45	19.45
	In School	2	High	3.54	3.54
		6	Low	12.24	12.24
		8	Total	10.95	10.95
	Total	12	High	20.98	20.98
		10	Low	10.89	10.89
		22	Total	16.78	16.78

This ANOVA indicated no significant main or interaction effects on the word identification test ($\alpha = 0.05$). All effects on the word attack test were also non-significant except one: a significant interaction effect for treatment group and occasion. As indicated by the means shown in Table 4 and in Figure 1, this indicated that the after-school students increased from the pre- to the posttest, whereas the opposite pattern was found for the in-school students.

Table 4 Means and Standard deviations for Woodcock Word Attack pre- and post- typing training

	Treatment Group	N	Content Covered Group	Mean	Standard Deviation
Word Attack-Pre	After School	11	High	78.55	25.04
		4	Low	90.0	3.74
		15	Total	81.6	21.87
	In School	2	High	90.0	5.66
		6	Low	85.5	9.42
		8	Total	86.63	8.5
	Total	13	High	80.31	23.31
		10	Low	87.3	7.7
		23	Total	83.35	18.26
Word Attack-Post	After School	11	High	84.55	27.19
		4	Low	90.25	10.11
		15	Total	86.07	23.59
	In School	2	High	78.5	10.61
		6	Low	83.0	9.98
		8	Total	81.88	9.57
	Total	13	High	83.62	25.11
		10	Low	85.9	10.17
		23	Total	84.61	19.69

Figure 1 Pre- and Post-test results on Woodcock Word Attack for In-School and After-School groups



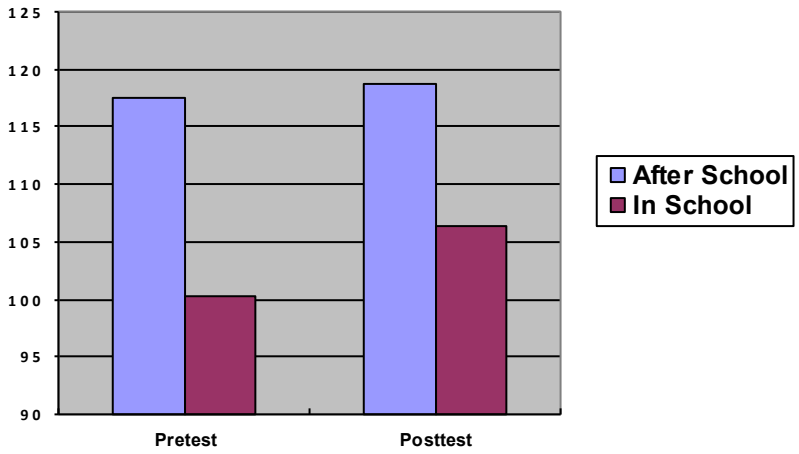
WRAT-R Spelling Test Scores

Finally, to determine whether the program had a significant effect on students' spelling skills, pre- and posttest scores on the WRAT-R spelling test were entered into an identical mixed-design ANOVA. Again, all preliminary analyses indicated adequate conformity to ANOVA assumptions. This ANOVA indicated a significant main effect for occasion ($F(1,21) = 5.21$, $p = 0.03$, $\eta^2 = 0.20$) as well as for content covered ($F(1,21) = 8.13$, $p = 0.01$, $\eta^2 = 0.28$), although not for treatment group ($\alpha = 0.05$). There was also, however, a marginally significant treatment group by occasion interaction effect ($F(1,21) = 4.01$, $p = 0.06$, $\eta^2 = 0.16$). From the means shown in Table 5 and in Figure 2, this indicated that although overall, students increased their spelling skills from the pre- to the post-test, the in-school students increased relatively more than the after school students. This effect, however, may reflect a confounding program in spelling that was taking place concurrently for the in-school group.

Table 5 Means and Standard deviations for WRAT-R Spelling pre- and post- typing training

	Treatment Group	N	Content Covered Group	Mean	Standard Deviation
Spelling-Pre	After School	11	High	122.27	17.61
		4	Low	104.25	3.40
		15	Total	117.47	17.09
	In School	3	High	104.33	5.13
		7	Low	98.43	6.80
		10	Total	100.2	6.70
	Total	14	High	118.43	17.35
		11	Low	100.55	6.31
		25	Total	110.56	16.18
Spelling-Post	After School	11	High	124.55	12.33
		4	Low	103.0	7.44
		15	Total	118.8	14.76
	In School	3	High	116.33	10.79
		7	Low	102.14	12.46
		10	Total	106.4	13.28
	Total	14	High	122.79	12.13
		11	Low	102.45	10.48
		25	Total	113.84	15.22

Figure 2 Pre- and Post-test results on WRAT-R Spelling for In-School and After-School groups



Discussion

This program was based on a phonic-based, sequenced program of remedial spelling and reading (Hornsby & Shear, 1993), integrated with a touch-typing program. Given the nature of the program, one would predict gains in typing skills and spelling ability. In that it is phonic-based with a sound component via CD-ROM, one would predict gains in word attack (decoding) and possibly word identification. Improved reading ability (accuracy) would follow, and improved comprehension should follow improved accuracy. Gains in word attack would be limited to phonic structures and elementary orthographic structures in a short course, while gains in word identification might be minimal owing to the low level of vocabulary included in the early stages of a typing course and to a lesser extend in the early stages of a course in remedial spelling and reading based sequentially on phonic structures.

Reports of parents and students indicated that improvements in students' typing skills occurred during the course, and the participants were satisfied with this aspect. because typing is a practical skill in which most if not all participants had little or no real skill prior to the course, improvement was readily apparent. One older student's parent reported that she was typing all her assignments for school following the course. This indicated an increase in ability to write over previous levels of skill using handwriting, and coupled with the availability of a spelling checker on the word processor, meant that this student had gained considerable confidence in writing. This is a fairly obvious, and thus anticipated benefit of any such program.

Standardised testing of reading accuracy indicated an improvement from beginning to end of the course. There is no way of proving that this improvement was not due to other factors, though as far as could be ascertained, participants in the after-school group were not receiving any other specific treatments for reading during the course. participants in the in-school group were, however, receiving supplementary teaching during school time, and their improvement could have been due to this as much as to the course. Later results suggest that this might indeed have been the case. In contrast to their reading accuracy, word attack skills for that group appeared to decline rather than improve, while word identification improved marginally. This suggests that skills were gained in word recognition, but not in decoding (word attack) by this group. If the supplementary reading program did not target word attack, and the in-school typing course was less effective for them, this would explain their results.

Reading comprehension scores also improved. This would be expected if accuracy improved, as comprehension is in part a product of decoding skill (Turner, 1997). One would not predict an

independent improvement in comprehension on the basis of a touch typing and spelling course, which is all the course amounted to in the 10 sessions over which results were measured.

Given that the typing course targeted word structures with a sound component, one might predict improvements in decoding ability (word attack) over the course. This result occurred for the after-school group, but not for the in-school group. This result did not appear to be a related to the amount of content covered, but only to membership of one group. It is possible that this is attributable to the environment in which the course was conducted in-school as distinct from after school, but it is not possible to know this. Certainly, the survey responses from parents in the after-school group emphasised the importance of continual monitoring of student progress and consistent positive reinforcement for all aspects of the course and student progress.

Overall, spelling improved in both groups, though the in-school group improved more. As indicated above, this may have been because of the school spelling program which was proceeding concurrently. Students who completed more modules also improved their scores more than those who completed fewer modules in this aspect of the course. In a properly designed program, one would expect this to be the case.

Conclusions

The typing/spelling/reading course resulted in gains in word attack, spelling, reading accuracy and spelling. All these gains might be predicted from such a program. The amount of content covered seemed to be significant in regard to gains in spelling but was not noticeably so in other gains made during the course. Differences between groups emerged at several point during the analyses, and may indicate the importance of conducting the course in particular ways. The parent responses to the questionnaires give this impression too.

It is impossible to rule out the effect of other experiences students were having during the conduct of this evaluation. As it was not possible to control for these experiences, one must assume that all were having inputs of various kinds at school which may have affected their results positively or negatively. The results of the evaluation do suggest however that the course had positive effects on the targeted areas, namely, typing, spelling, reading accuracy and word identification as well as work-attack.

Parent reponses indicated approval of the after-school program overall, though incidental comments from those running the in-school program were not so enthusiastic. Reports from elsewhere suggest marked gains in confidence, though this evaluation was not able to measure such gains from the course.

It seems likely that this evaluation would have produced greater effects if it had evaluated a more intensive course, where students, particularly older, more experienced students, completed more units and moved more quickly on to higher units of sound. Post-hoc discussions with the originator of the program indicated that at other sites, more experienced students are in fact moved more quickly through the program once they have learnt to touch type (normally at about the end of level 2) so that they soon encounter more challenging orthographic patterns and thus increase their potential to improve their spelling and word-attack skills at a level commensurate with their age and experience. In the present evaluation, some of these older students, despite completing more units of work, did not improve their skills in these areas to a marked degree because they had not yet encountered word structures more difficult than those they had already mastered.

Judging from the results of this study, a longer evaluation with the course somewhat more carefully structured and presented as indicated above, with more allowance for the age and experience of the participants, would produce significant gains in the targeted areas of reading and spelling. As the

program was administered only 45 minutes per week with no reinforcement between sessions, the results of this study indicate that its reputed effectiveness would be confirmed by a larger study.

Appendix 1

Touch Typing Spelling and Reading Survey

Please answer the following questions about your experience of the typing/spelling/reading course so far.

1. Was the time allocated for the course long enough or too long?

2. Did you find the organization of the course efficient? If not, what would you like to see improved?

3. Was the operation of the equipment satisfactory? If not, in what way?

4. Was the supervision of the course satisfactory? If not, what would you have liked improved?

5. Did you use the headphones? If so, did you find the sound feature (headphones) helpful?

6. What was the best thing about the course?

7. What would you have most liked improved?

8. Any general comments that might be helpful for planning future help for people with reading/spelling problems?

Notes

Westwood, P. (1999), The correlation between results from different types of spelling test and children's spelling ability when writing. *Australian Journal of Learning Disabilities, 4(1),* 31-36

Proof reading, South Australian Spelling Test, Multiple choice, and correction were correlated with spelling success in essay writing. Results showed that all the commonly used forms of spelling assessment are highly correlated. Correlations with essay spelling were: SA, .79, Proofreading, .77, Correcting, .79 (.75 for years 4,5), & multiple choice, .78 (.64).

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