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A field study report of intensive computer keyboard training with schoolchildren

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A video-based keyboard skills training programme was used to teach primary and secondary school students to touch type, in ten 45-min lessons. Previous research (Glencross and Bluhm, 1986) had found the programme to be successful in training a variety of personnel in the workforce. In all, 197 students (105 females, 92 males) received instruction over a two-week period. The influence of age (11–12, 13–14, 15–16, 17–18 years) and sex on keyboard operating speed and accuracy were examined. Speed tests were conducted after the second and ninth lesson. Significant improvements in speed of typing were recorded for all age categories. Age and sex were found to be associated with speed of typing and rate of improvement across tests. Error rates remained constant across tests.

Keywords: Computers, keyboards, training, schoolchildren

Introduction

The present paper reports a field study of the application of an intensive computer keyboard training programme to children in Australian primary and secondary schools and those about to enter the workforce. This is the second part of a study reported previously in this journal (Glencross and Bluhm, 1986).

A number of earlier business and educational studies and reports (e g, McMullan, 1982; Keeves, 1982; Headley, 1983; Policies Commission for Business and Economic Education, 1984) have emphasised the emergence of new approaches to information processing which will change the manner in which students learn and are taught in the future. Emphasis will need to be placed on the skills needed to accompany and facilitate the introduction of computer technology. Keyboard skills, using the correct touch-keying procedures, must be developed in parallel with the introduction of computer facilities and computer-based instruction in schools, in the community and in the workplace. This, according to Frankeberger (1985), is essential for three main reasons. Firstly, to prevent the formation of poor keyboard habits; secondly, to improve the efficiency and accuracy of computer use; and thirdly, to make the task of learning to type easier.

The previous study (Glencross and Bluhm, 1986) reported the success of an intensive two-week keyboard training programme, based on psychological principles, to teach a variety of personnel in the workforce. The purpose of the present study was to assess the effectiveness of this programme in teaching children at the upper primary and secondary school levels to touch type, as an integral part of computer usage.

The Human Information Processing model views people as information processing systems, dealing with the reception, storage and transmission of information, and has been proposed to incorporate a chain of mechanisms or processes: perceptual (input), translatory, effector (output) and feedback processes (e g, Welford, 1986). In developing this intensive keyboard training programme, a number of information processing principles have been utilised. These technical principles are reported in detail in a number of Technical Reports (Glencross, 1978; Glencross, 1981a, b) and are described in the earlier paper in this journal (Glencross and Bluhm, 1986). The previewed text information must be passed to short-term memory (STM), where it is temporarily stored prior to being output. Storage is limited by STM capacity and redundancy of text material. Keyboard performance may be enhanced by presenting the novice with digrams or trigrams (groups of two or three letters) containing at least one letter of the preceding trigram or word, thereby reducing the STM load and facilitating response repetition and organisation. Translation from text may be made more efficient via the use of meaningful text materials (Herschman and Hillix, 1965; Shaffer and Hardwick, 1968, 1970) which enable input and output to be grouped into larger units – for example, as words or phrases as opposed to letters or syllables. Thus the operator can overcome the limitations of the intermittancy of the central decision processes, and produce a series of smooth, flowing finger movements by

The video keyboard training programme 'COMPUTRAIN' is available as a commercial package consiting of 10 video tapes, one instructor's manual and 15 trainee manuals. Enquiries should be directed to D.J. Glencross.

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exploiting the redundancy of the language, previewing the text and grouping the input information and the responses.

Feedback serves to indicate the discrepancy between intent and actions provided the movements are not too fast. This feedback-dependent behaviour occurs in the novice but is reduced with increased skill as the operator is able to form larger and larger units of action, and can order and monitor the motor activity via central processes alone (Keele, 1968). In the initial stages of learning, augmented and supplemented feedback is effective (e g, Bahrick *et al,* 1955; Christina, 1970) as is the 'pacing' of information presentation as long as the speed of presentation is not excessive (Holding, 1965).

The keyboard training programme has been developed using the above framework and principles, including augmented tactile, supplementary auditory and visual information, reduced information load, and incorporating audiovisual techniques as the educational medium (see summary in Table 1). Information processing capacity seems to improve with age up to about 18 years (Noble, 1978; Thomas *et al,* 1981; Thomas, 1980). Some evidence exists to suggest that females are better at rapid manipulation tasks (i e, tapping) (Noble, 1978), which may be indicative of a potential advantage for females at tasks such as keyboard operation. Any performance differences resulting from sex or age factors may be useful in determining course designs to meet the needs of specific subgroups within the population.

Method

Subjects

The subjects were 197 school children (105 females, 92 males) aged between 11 and 18 years, for whom the data were complete for both typing tests. All subjects indicated that they had not had any formal training or experience in typing on a keyboard. For the analyses the group was subdivided into four age categories: (1) 11–12 years (N = 51, 23 females, 23 males); (2) 13–14 years (N = 58, 37 females, 21 males); (3) 15–16 years (N = 48, 25 females, 23 males); (4) 17–18 years (N = 40, 20 females, 20 males).

Apparatus

All courses used standard 'QWERTY' electric keyboards. The keys were covered with white paper discs to encourage spatial/kinaesthetic rather than visual encoding of letter position. The 'F' and 'J' keys in addition were raised with rough disc covers to enable the children to locate their fingers on the home keys effectively by touch. A National VHS recorder with 22 inch (56 cm) National colour television was used to present the course which had been recorded on ten VHS colour video tapes. Each video tape was of 45–50 min duration.

Keyboard training course format

The training programme was conducted over a period of two weeks, with one lesson presented per day lasting 45–50 min. In all, 10 lessons were presented.

All children were supplied with written information explaining what the course involved as well as manuals containing lesson content and practice exercises. Before beginning the course, children were provided with short questionnaires requiring details related to age, sex, previous keyboard experience and other relevant information. Questionnaires on which evaluative statements regarding lesson content and practice for each lesson could be recorded were also provided (Glencross, 1981a).

Courses took place at the primary or secondary school with which the groups were affiliated. Participants in all courses were seated at desks with typewriters before them,

Table 1: Summary of course format and content

Lesson No	Content	Format
1	One half of keyboard	Letter sequences followed by three-letter words.
2	Remaining half of keyboard	Letter sequences and three-letter words. Speed test 1.
3	All keys	Letter sequences then three-letter words.
4	All keys	Letter sequences and four-letter words.
5	All keys	Four- and five-letter words at slightly faster pace, without 'look at fingers' sequence after first half of lesson.
6	All keys	Letter sequences followed by four- and five-letter words watching TV only to practise common errors.
7	All keys + shift keys	Four- and five-letter words beginning with capital letters.
8	All keys	Phrases and sentences at own pace while watching the TV only.
9	All keys	Sentences at own pace while watching TV. Speed test 2.
10	All keys + number keys	Number sequences, two-figure numbers, word and number combinations and sentences.

facing the video-monitor in the centre-front of the room, such that all could observe the monitor without difficulty.

Two equivalent two-minute typing tests were given after Lessons 2 and 9 and provided measures of speed (words per minute, WPM) and accuracy (errors per minute, EPM). Words per minute is expressed in the standard form of every five keystrokes per minute being equivalent to one word. Only two tests were possible due to the practical restrictions under which the study was completed.

Course and format

Course content and lesson format remained the same as in the previous study (Glencross and Bluhm, 1986). On the video screen, the target letters were visually illuminated in the sequence and verbally announced to the children before being typed. Letters were introduced via three modes: a 'look at fingers' sequence in which subjects would type in the required letters or words while watching their fingers to ascertain accurate keystroking; a 'look at printout' sequence in which subjects observed the consequences of their action by viewing the papers upon which they typed; and a 'look at TV' sequence, whereby the subject typed the required letters as they were highlighted on the TV monitor. In later lessons the rate of letter presentation for each successive mode was increased. The 'look at fingers' sequence was dropped halfway through Lesson 5 in order to phase out dependence upon this form of feedback. By Lessons 9 and 10, all supplementary feedback had been phased out and the subjects were essentially copy typing. The content of the ten lessons is summarised in Table 1. More detailed information can be obtained from the previous study conducted using this programme (see Glencross and Bluhm, 1986).

Although the video tape course is self-instructional, an instructor was used to administer typing tests, supervise the children and monitor their progress; ensuring that they maintained correct postures and keystroking habits.

Results

Speed

The mean keyboard operating speeds for both sexes and each age group are presented in Fig. 1. The results of the study clearly show that the keyboard training programme was successful in teaching children, who had no previous keyboard experience, to touch type. There is, of course, a third data point implicit in these results; given the 'blind' nature of the lessons and the absence of any training, base-line performance before Lesson 1 would have been at or near zero.

Highly significant increases in speed occurred from Lesson 2 to Lesson 9 for all age categories: 11–12: $F(1,49) = 263{\cdot}94$, $p < 0{\cdot}0001$; 13–14: $F(1,56) = 318{\cdot}65$, $p < 0{\cdot}001$; 15–16: $F(1,46) = 322{\cdot}02$, $p < 0{\cdot}001$; 17–18: $F(1,38) = 259{\cdot}64$, $p < 0{\cdot}001$. After two lessons, depending upon the age category under study, the children typed from about four to seven words per minute, but up to 14 WPM after nine lessons.

Age significantly affected keyboard typing speed ($F(3,189) = 22{\cdot}31$, $p < 0{\cdot}001$). Speed increased with age and this pattern was the same for both male and female groups.

Age and extent of improvement over the two tests were also found to be related. A significant Age x Test interaction ($F(3,189) = 11{\cdot}24$, $p > {\cdot}001$) revealed that the older the child, the larger the increases in typing speed from the first to second test.

Significant sex differences in typing performance were found. Females typed significantly faster in all but the 11–12 years age category: 11–12: $F(1,49) = {\cdot}418$, $p = {\cdot}521$; 13–14: $F(1,56) = 25{\cdot}99$, $p < {\cdot}001$; 15–16: $F(1,46) = 5{\cdot}13$, $p = {\cdot}028$; 17–18: $F(1,38) = 7{\cdot}04$, $p = {\cdot}012$. For example, the mean WPM typed by females above 12 years in the first test was 6·05, but only 4·93 for males, and 12·21 and 9·89 for females and males respectively in the second test. The improvement made by females, across tests, was greater than that of males in the 13–14 and 15–16 years age categories: 13–14: $F(1,56) = 11{\cdot}18$, $p < {\cdot}001$; 15–16: $F(1,46) = 4{\cdot}90$, $p = {\cdot}032$.

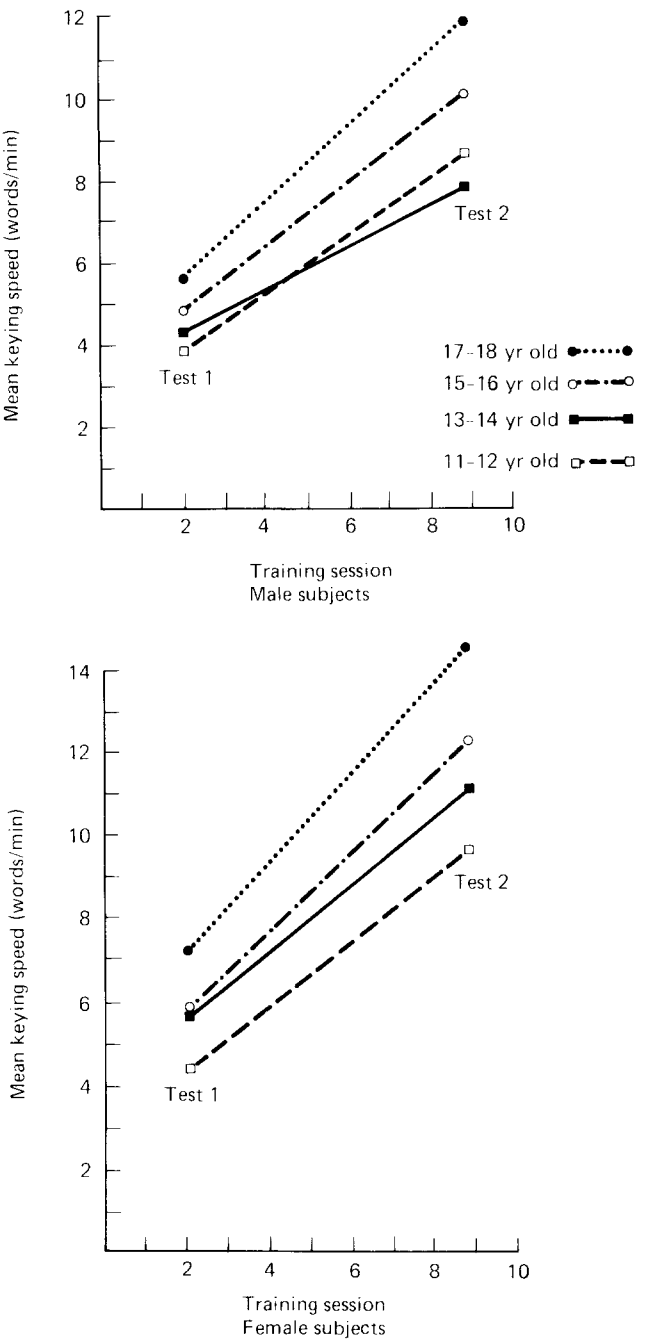

Fig. 1 Mean speeds (Words/min) for males and females and different age groups

Accuracy

Accuracy was expressed as the number of incorrect key strokes per minute. The mean error rates for each group are presented in Fig. 2. Error rates were generally very low and remained stable across tests, except for the 11–12 years category in which a significant increase in accuracy was recorded ($F(1,49) = 30{\cdot}23$, $p < {\cdot}001$).

Sex differences in accuracy were significant for the 15–16 years age category only, in which females made more errors than males ($F(1,46) = 12{\cdot}73$, $p = {\cdot}001$). No significant effects in terms of errors were observed for Age, Age x Test, or Sex x Test conditions.

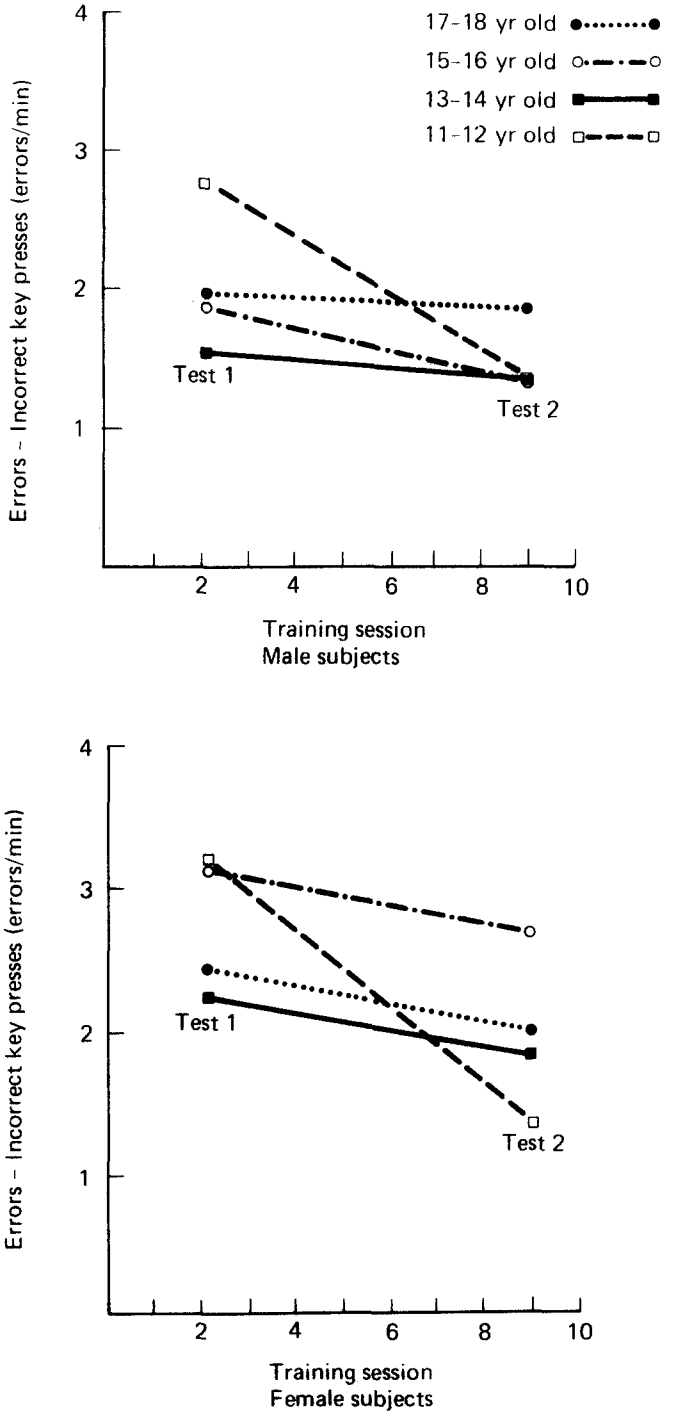

Fig. 2 Mean error rates (Errors/min) for males and females and different age groups

Summary of results

- Typing speeds increased significantly for all age categories tested.
- Age significantly affected typing speed. Older students typed faster and made greater improvements between tests.
- Females typed faster than males in all but the youngest group tested. Greatest improvements were made across tests by females in the 13–14 and 15–16 years old categories, than by males. Those females in the 15–16 years old category did, however, make more mistakes than males of the same age.
- Accuracy remained constant with only the youngest group (11–12 years) improving across tests.

Discussion

From the results it is evident that children between the ages of 11–18 years learnt to touch type effectively using an intensive video-based keyboard programme. The most consistent significant effect was the improvement in speed over the two typing tests. Speed, depending upon the age and sex category under study, varied from about 8 to over 14 WPM after just nine lessons. Although not reported here, there was a further improvement by the end of Lesson 10.

Error rates remained relatively consistent with only the 11–12 years age group demonstrating a significant drop across tests, suggesting that improvements in speed were not obtained by sacrificing accuracy for speed. Typing speeds increased with age, supporting previous findings that performance, in terms of reaction and movement times (Noble, 1978; Thomas *et al,* 1981) and information capacity (Thomas, 1980), increases up to about 18 years of age.

Females outperformed males in all but the 11–12 years age category. This supports the general evidence of female superiority on some rapid manipulation tasks (Noble, 1978), although it is possible that females could be more highly motivated to acquire keyboard skills due to different employment expectations regarding such abilities.

The suitability of intensive video keyboard training for upper primary and secondary level children suggests that the implementation of the recommendations advanced in the Keeves (1982) report is practical. That is, given the changing technological emphasis in both education and employment, as well as the introduction of computers into schools, a keyboard skills course such as the above could and should be integrated with current schools curricula, making keyboard skills a salient and eventually essential requirement.

One of the objectives of this and the earlier study (Glencross and Bluhm, 1986) was to investigate the suitability of intensive programmes for training or retraining the workforce and for those about to enter the workforce, particularly in the efficient use of computers. The first and essential step was seen to be the acquisition of touch typing skill for all computer users, to ensure the efficient use of the new technology. Such short intensive programmes as indicated in the present report seem to provide one means for such training.

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