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The Use of Computer Assisted Instruction in Preschool Education: Making Teaching Meaningful

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Computers are increasingly a part of preschooler's lives. The purpose of the present paper was to discuss research avenues employing computers as a learning tool and to analyse the results obtained by this method at the preschoolers' learning level. Specifically this research was to determine if computer assisted instruction (CAI) was a useful tool to enhance cognitive, emotional, linguistic, and literacy skills in preschool children. CAI programmes may never replace the book and the blackboard but one should be aware that they were more accessible by young children, who learn better with pictures and sounds, and the proper use of appropriate programmes could make a considerable difference.

KEY WORDS: technology; computer assisted instruction; preschool education; interactive learning environments; cognitive skills; literacy skills.

INTRODUCTION

Computer technology holds promise for improving student achievement and teacher quality in educational programmes at all levels. Computers were first used as tools for teaching in 1950 when appropriate programmes were first elaborated. To date, development has been rapid and technology has been acknowledged as an additional teaching tool. Major instructional uses of computers in schools during the last few years were computer assisted instruction (McKethan, Everhart, & Sanders, 2001). Computer assisted instruction (CAI), combined with traditional methods, was more helpful to students in reaching their educational-training goals (Kinzie, Sallivan, & Berdel, 1992). According to Rasmussen and Davidson (1996), one of the most significant advantages of CAI is the potential to individualise instruction so as to meet the particular needs of the student. Moreover, the presentation of the lesson material in various ways (text, audio and graphics) renders teaching by computer an interesting and effective learning tool. While bearing the problems of today's classrooms in mind (overcrowding, educational programme overloading), teachers at all levels are coming to view the use of CAI as a means of improvement of their teaching.

Preschool students should not be excluded from the virtual learning world simply because of their age and developmental levels. The integration of computers and telecommunications into preschool education has become a high priority for everybody involved in the learning process. The present paper's purpose was to discuss research avenues employing computers as a learning tool and to analyse the results obtained by this method at the preschoolers' learning level. Specifically this research was to determine if CAI was a useful tool to enhance cognitive, emotional, linguistic, and literacy skills in preschool children. CAI programmes may never replace the book and the blackboard but we must be aware that they are more accessible by young children, who learn better with pictures and sound, and

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the proper use of appropriate programmes may make a considerable difference.

Spencer and Baskin (1997) noted that CAI can be used as a tutor to present concepts, information, or skills normally presented through conventional teaching methods. They reported that 4- to 5-year-old children learned the alphabet, learned to count, and learned how to discriminate between similar and different objects by interacting with a CAI programme to present information, receive responses, and offer new information based on the children's responses.

Fletcher-Flinn and Gravatt (1995) reported that CAI was more effective than traditional instruction for a wide range of skills in maths, science, art, reading, and writing with an average effect size of .24. CAI effectiveness was demonstrated for preschool, elementary, and secondary grade levels, as well as special education. The largest effect size (.55) was for the preschool group.

Din and Calao (2001) examined whether preschool children using CAI programmes on Playstation game consoles acquire spelling, reading and basic mathematical/arithmetic skills better than children who do not have such access. Forty-seven preschool children, aged 5–6, constituted the sample for this research, from a lower socio-economic background and all were Afro-American. Pre- and post-tests were carried out on both groups (experimental $n = 23$ and control $n = 24$) to assess the level of achievement (Wide-Range Achievement Test R-3). The duration of the intervention programme was 11 weeks. The children played with the game for 40 minutes daily, 5 days a week, and for at least 30 minutes daily at home with their parents. The children of the control group attended the school's usual programme without using the Playstation game.

Results demonstrated that both groups improved in spelling and reading, but the progress for the experimental group was much greater than that of the control group. On the other hand there was no difference in knowledge of arithmetic, probably because children were not sufficiently mature and it is difficult to achieve an effect in sectors where children lack the requisite maturity. However, the sample of this research was also too small to be able to derive generalities from it concerning the population at large.

Shute and Miksad research (1997) examined the effect of CAI on cognitive development for preschoolers. The sample included 51 children between the ages of 2 and 10 months to 5-years-old, in a preschool in South Australia. Pre- and post-tests were carried out to compare the children's cognitive differences. The intervention programme lasted 8 weeks. Results showed that CAI had greater effect on increasing verbal and oral performance, although not on (basic mathematical skills) basic arithmetic. Performance in general on these specific skills was not increased by computer usage as against traditional teaching methods. It is thus a myth that computers are the "magical toys" they are broadly perceived to be. Their use did however increase the children's attention span, especially in children who had attention difficulties. However, the sample was a small one in this case as well.

On the other hand results from a research which also took place in Australia had shown that children who used CAI based activities, scored significantly higher on the Test of Early Mathematical Ability—TEMA2 (Elliot & Hall, 1997). The sample for this research constituted of 54 preschool students who were identified as at risk for early learning difficulties. Children were placed into three groups. Two groups used computer based math activities and the third participated in noncomputer—based math activities but used computers for other areas.

A study by Reitsma and Wesseling (1998) investigated the effect of CAI on the potential for development of word production and recognition of their 'families' by preschoolers. The study had a twofold objective: (a) to evaluate an alternative method of teaching potential word production and recognition for preschoolers using computer and (b) to determine the effects of such instruction on subsequent reading ability. A number of exercises were applied, with words, instructions and comments by means of digital high-tech. 25 children were taught the correspondence of letters-sounds for 12 weeks. Another 28 were taught a vocabulary by using the same computer programme, and a further 45 (the control group) had no access to the specific computer programmes. All the children showed improvement in phonological compositions. Greater improvement was observed, however, in the classes where the teacher regularly used a variety of activities for the evolution of phonological ability. The results also demonstrated a considerable difference for the children taught through computer. In fact, the transferred effects of the exercises for word codification through computer were noted only a few months after the initial reading lessons.

For their intervention research Segers and Verhoeven (2002) developed a child friendly CAI programme to enhance the early literacy skills of preschoolers in Netherlands. In their study the participants were all immigrants (25 children with

average age 65.4 months for the first study and 30 children with average age 57.3 months for the second one). The training consisted of three 25-minute sessions for the first study and six 15-minute sessions for the second one (across a period of 3 weeks). The short training with the computer, in the first study, showed generally positive results. Those children who scored high at pre-test also learned more from the training. In the second study, the significant learning gains the students demonstrated also were found to be visible one month after training

According to Chera and Wood (2003) study, where CAI programme was used to promote phonological awareness in children beginning to read, the intervention group showed significantly higher increases in phonological awareness than the control group did. On the other hand there were no significant benefits observed for word reading. The intervention group received ten, 10-minute sessions with the programme over 4 weeks, while the control group completed normal activities. In order to ensure a strict evaluation for the quantitative outcomes of the intervention, the control group (15 children) had the same age, gender and level of letter sound knowledge at the time of the pre-test as the 15 children of the intervention group. The results suggested that the combination system of presenting both whole word and segment speech feedback simultaneously may not be very effective, probably because less attention was being paid to the words as whole units and therefore being learnt in that way.

In their research, Moxley et al. (1997) examined computer use in developing writing ability in 3-year-olds. The sample included 12 children and lasted through two school years, during which they used a CAI programme for their language lessons. Progress in spelling and story writing were the indications sought for the development of writing. Although some children remained longer than others at the pre-reading stage, the class as a whole showed steady improvement in spelling and story-writing in the first year, continuing on into the second.

The main outcome of the research was to provide a database demonstrating how much a child's writing may be improved using a CAI programme, beginning at the age of 3, until 4 years of age. Thus, Vygotsky's proposal (1935/1978) for transferring writing skills education to preschoolers is justified, since it is more feasible in our day due to widespread computer use.

The effectiveness of using a CAI programme was examined in Carlson and White research (1998) in teaching the notion of right and left side. Thirty-two preschool students took part. The researchers first estimated their knowledge of right and left, asking them to identify familiar objects placed either to the right or left of an initial object. The children were from a middle socio-economic level, aged from 5½ to 6 years and 7 months. They were divided into two groups: the experimental, to which the CAI was applied, and the control group learning right-left in the traditional manner. Both groups had the same teacher and had no previous instruction in the notions. A pre-test was executed to establish the children's academic level. The experimental group took part in the programme for 10 minutes over 2 weeks. The results, both of the same group's pre- and post-test, as well as between the two different groups (experimental and control) were subsequently compared in order to determine the effect of the programme.

The results showed a positive impact by the programme, and the experimental group had improved the understanding of the notion of right-left in relation to the control group. The research confirmed the positive use of computers as a tool for learning in a manner that arouses interest in children. The sample was, however, restricted and the children had access to computers at home (middle socio-economic level), which may possibly have affected the research results.

In his research review on the relation between computer use in the classroom and constructivist teaching, Brown (1996) considered that the computer may be used in three principal categories: (a) as a book (b) as a mean for learning words and (c) as a tool for graphics. Comparison between teaching by computer and constructivist teaching showed different results. The use of computers as books does not conflict with a constructivist teaching method and thought processes because children are unable to modify the information and merely provide the correct answer. Computerised teaching is useful for certain children in the development of post-cognitive skills and not at the initial stage of acquiring such knowledge. Use of computers as means of learning words is the most competitive, compared to constructivist teaching, because it permits children to form words on their own, based on their level of competence, to interact amongst themselves and to exchange thoughts and experiences. Computer use as a tool for graphics can help children particularly in learning geometry. However, the value of computer use in the classroom depends on the type and quality of each CAI programme, as well as the teacher's competence in handling the CAI programme. While

the computer and its use in class could not be the answer to everything in education, it might become an implement for cognitive development in preschool children.

Other researchers besides Brown have emphasised the significance of developmentally appropriate CAI programmes for the instruction in preschool. Escobedo and Bhargava's (1991) research demonstrated that young children showed greater interest in the use of a graphics programme when their commands were required. The children wished to explore and create their own graphic symbols, irrespective of sex and age, when the graphics were developmentally appropriate ones.

In the same way, Hangland (1992) found that children feel happier and more creative with a computer when it has developmentally appropriate CAI programmes, compared to CAI programmes, which do not allow control by the children themselves. In fact, this type of programme diminished the children's creativity by 50% and made them passive users of software.

Kulik (1994) in his research review on CAI with children from preschool through higher education confirmed the positive effect of computer in learning process. Students who used CAI scored higher on the achievement test, learned in less time, and were more likely to develop positive attitudes.

Most of the previous studies dealt primarily with the various effects of computers on young children, and with the advantages, disadvantages and potentials of computer learning environments for preschoolers, while the roles of the adults in preschool computer learning environments were generally overlooked, according to Klein, Nir-Gal, and Darom (2000). These researchers made an attempt to use mediated learning theory in order to identify basic characteristics of adult–child mediation in a computer learning environment. Subjects were 150 preschool students, 79 boys and 71 girls, ranging in age between 5 and 6 years. The types of adult interaction considered were: (1) mediation: provision of mediation, including behaviours such as focusing, affecting, expanding, encouraging, and regulation of behaviour; (2) accompaniment: responding to children's questions; and (3) no assistance. The results of this study revealed that children interacting with adults who were trained to mediate in a computer environment, scored significantly higher than other children on measures of abstract thinking, planning, vocabulary, and visual-motor coordination, and on measures of responsiveness, including measures of reflective thinking. Furthermore there were no differences in performance of children who worked in a computer environment with an adult available to answer their questions; and others who received technical assistance only.

In their research Passig and Levin (1999) made an attempt to examine the differences of satisfaction with multimedia computer assisted instruction (MCAI) learning interfaces between boys and girls. Subjects were 90 preschool children, 46 boys and 44 girls. The research findings revealed significant gender differences in time on task and in intrinsic satisfaction with MCAI learning interfaces. Boys emphasized control over the computer and preferred high-action programs while girls responded to writing, colors, drawing, help, and calm games. On the other hand, according to the findings of Wilson-Gillespie's (2004) research, there were not systematic gender differences between the preschool girls and boys with regard to their behaviour during Lego-Logo time.

DISCUSSION

Despite the small sample size and short time period, there was some evidence by reviewing the above research projects that supported the positive influence of computer usage as a learning tool for children at preschool as compared to traditional teaching of skills. Significant differences were detected in learning direction (right-left) in the Carlson and White (1998) study where the two teaching methods (by CAI and traditional) had statistically significant differences between them, confirming the positive use of computers as a tool of learning. In the same way, Kulik (1994) found that students who used CAI scored higher on achievement tests, learned in less time, and were more likely to develop positive attitudes.

The contribution of computer use to the acquisition of spelling and reading (Din & Calao, 2001), and writing abilities (Moxley et al., 1997) was also very significant. There was greater improvement in phonological composition (word creation and recognition) with use of a CAI programme, rather than by traditional teaching methods (Reitsma & Wesseling, 1998). In these studies, no differences were found in the development of mathematical notions by computer use as opposed to traditional methods and this was explained by the lack of maturity in children of this age at being able to develop mathematical thinking (Shute & Miksad, 1997). On the other hand

results from Elliot and Hull's intervention research (1997) revealed significantly higher scores on the Test of Mathematical Ability for preschool students who used CAI based activities. Similarly, Fletcher-Flinn and Gravatt (1995) reported that CAI was more effective than traditional instruction for a wide range of skills in math, science, art, reading, and writing.

The duration of computer-acquired knowledge is another area of interest. Reitsma and Wesseling (1998) found lasting evidence of development in word production and in recognition of their groupings by computer use, even some months following the implementation of the intervention programme. Immigrant preschool students in the Netherlands benefited from the computer supported vocabulary program and these significant learning gains were found still to be visible 1 month after training. Those children who preformed higher in the pre-test or who performed more exercises on the computer scored significantly higher (Segers & Verhoeven, 2002).

The use of animated multimedia books resulted in gains in general phonological awareness and in awareness of letter sounds and word onsets in children beginning to read while there were no significant benefits for word reading (Chera & Wood, 2003).

Passig and Levin (1999) pointed out the gender differences in learning interest from different designs of MCAI interfaces. Their findings indicated the existence of different attitude between boys and girls toward different issues: boys showed more interest in the game activities while girls had more interest in the visual aspects of the game.

Another important discovery in Shute and Miksal (1997) research was the increased attention span of children while learning with the use of computer.

Klein, Nir-Gal, and Darom (2000) focused on the adult- child mediation in a computer learning environment. The results indicated significantly higher achievements for preschool students who interacted with adults who were trained as mediators within the computer environment.

Additionally, use of computers as books did not make a difference for children's learning process, which is to say, it is not yet in a position to replace the equivalent manuals. Differences were found, however in its use for word recognition and its employment as a tool for graphics, aiding in the comprehension of basic geometrical concepts (Brown, 1996).

Furthermore, what the teacher should constantly bear in mind, according to Escobedo and Bhargava (1991), Haugland (1992) and Brown (1996) is that the use of CAI programmes in education must be developmentally appropriate to the child; otherwise the results of such use in achieving the learning objectives will not be the expected ones.

CONCLUSIONS

As established by the above review, computer use has been applied experimentally at the preschool level on a wide scope of skills and knowledge acquisition. Results demonstrated a significant contribution of computer use in the classroom as a learning tool. Such use, however, should keep pace with the development of children at preschool age. The CAI programmes applied should be developmentally appropriate to achieving specific learning goals; a learning tool of any type would have little effect if the objectives and plans of the lessons and means of teaching are not developmentally appropriate.

Teachers and students should also keep in mind that teaching through computers is an interactive process and, consequently, has a positive effect on learning. It is well known that children learn faster in an interactively functioning learning environment. This is probably the most important advantage of computer use in the teaching process against traditional teaching.

Moreover, the use of computers as a teaching tool allows children to learn at their own individual pace. Upon achieving one level of knowledge they can proceed to the next, which is not the case in traditional teaching.

Also one should bear in mind the small size of research samples, which will have affected the results of the intervention programmes.

Evidently, the possibility of increasing children's attention spans is a matter that deserves concern given the 'thorn' presented by the lack of attention in children in everyday life, both in managing preschool classes and elsewhere. If the computer lengthens their attention span, then its broader use should be recommended.

The respective teacher's capabilities to handle such technology as a teaching tool have been a very important factor. It is essential that educators should be trained in the ability to apply new technologies and to interact with the students during the learning process. Attending training programmes and keeping an open mind are the keys to a teacher's success.

Additional research should be done on the effectiveness of CAI in promoting early academic skills in preschoolers. As the reviews of this study are

still preliminary, more detailed guidelines for applying CAI programmes in practice have yet to be published. Preschool students need the opportunity to apply their new skills in a variety of tasks for generalization. In summary, the use of CAI programmes can be an effective tool for the teacher: a tool which can be used to enhance learning academic skills, promote maintenance of skills, and reinforce learning through additional practice on a motivating medium.

Finally in order to maximize the benefits of computer use in education, all the educators should keep in their minds this question: ''Can we use technology to teach the same old stuff in the same way or can we capitalize on the benefits of technology by using integrated computer activities to increase achievement?'' (Clements & Sarama, 2002, pp. 340–343).

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