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# ACQUISITION OF BASIC CONCEPTS BY CHILDREN WITH INTELLECTUAL DISABILITIES USING A COMPUTER-ASSISTED LEARNING APPROACH[1]

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*Summary.*—Computer-assisted learning can be an efficient learning-teaching procedure. Although there is an extensive educational software tradition for this approach, few have better performance than standard drill-and-practice methods. In this work, the specific software "Let's Play With . . ." was designed to teach concepts of colours, shapes, and body position to children with intellectual disabilities. The software structure follows the Gagné instructional design and applied behaviour analysis. The program was carried out with 39 boys and 21 girls who were special education students in the Cadiz School District. Statistically significant differences were found between groups taught with and without the software.

The expansion of computer technology in the last twenty years has allowed design of high quality software which is easy to use and is aimed at improving the learning conditions of students with intellectual disabilities (Crest, 1991; Gardner & Bates, 1991; Rojewski & Schell, 1995; Sepehr & Harris, 1995). Two trends have emerged as important goals, to develop software that makes it easier to learn new topics using computers as a facilitative interface for learning (Shapiro, Tauber, & Traunmuller, 1996) and as a mechanism for improving communication between users and their environment. This is the case of augmentative communication (Vanderheiden & Crest, 1992) or the use of robotics (Howell, Martz, & Stanger, 1996). This paper belongs in the former as its focus is on development and testing of educational software for students with intellectual disabilities.

As educational software has proliferated, many users find assessment difficult (Howell, Heward, & Swassing, 1995). So systematic evaluations of software are useful. Educational software must be adapted to the setting of use, be appropriate to the students' current academic performance, and be suited to specific classroom activities. Most studies of the consequences of using computers in education have had descriptive goals. So more information on implementation and the appropriateness than on effectiveness is available (The Cognition and Technology Group at Vanderbilt, 1993).

The development of projects in which computer technology is used by

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children with intellectual disabilities is difficult as we must consider learning characteristics of children, understand the software, and go beyond the lack of previous work (Crest, 1991). The purpose of this study was to evaluate the effectiveness of "Let's Play With . . ." software, an interactive multimedia program to teach shapes, colours, and concepts about body position to children with intellectual disabilities.

## Method

### *Subjects and Setting*

Three special education schools were selected as representative of the social and cultural status of the Cadiz school district. An trained group was formed of 30 students (20 boys and 10 girls) randomly selected from available children, and a control group ($n=30$; 19 boys and 11 girls) was also randomly selected of children aged from 8 to 16 years (mean age, respectively, were 12 yr., 8 mo. and 13 yr., 0 mo.). Diagnoses made by clinicians was with intellectual disabilities according to the DSM–IV criteria. Mean IQ for the Trained Group was 66.7 (*SD*: 3.7) and for the Control Group was 67.2 (*SD*: 3.4). These schools care for students with intellectual disabilities six hours per day. Students were admitted after exhaustive psychological and medical assessment. The evaluators prescribed an appropriate special education programme, with the aim of teaching basic skills that allow students to adapt to family, social, and work settings. Classrooms in this study included six students and a special education teacher per class. Most sessions were individually administered and were based on a drill-and-practice approach where the teacher was the only adult support.

The computer was placed in a corner behind a folding screen of the children's regular classroom 10 days before the procedure began, so that students got used to its presence.

### *Materials and Software*

The Basic Concepts Assessment Test (Alcalde & Marchena, 1995) is a paper-and-pencil measure administered individually to children, who are required to identify 24 pictures related to shapes, colours, and concepts about body position. There are two forms (A and B), the only difference between the two forms being the pictures used. For both A and B forms Pearson $r$ statistic has indicated measurable internal consistency. Here, Form A was administered as pretreatment and Form B as posttreatment. This test uses different pictures than the software.

"Let's Play With . . ." software (Navarro, Alcalde, Marchena, & Ruiz, 1995) was developed using Authorware 4.0, a multimedia language, which allows integration of sound, video, pictures, and hypertext. "Let's Play With . . ." is based on a stimulus control procedure (Cooper, Heron, & Heward,

1987) that provides a blinking prompt to facilitate learning a target concept. The software uses several activities; in a brief story the protagonist shows the learning activities. For example, a clown dressed in black and white clothing asks the child to color his hat, hair, shirt or shoes. Four colored square boxes (red, yellow, blue, and green) are simultaneously displayed at the bottom of the screen. Students have to pick the correct colored box, answering the questions asked by the program. A match-to-sample procedure includes independent activities, increasing difficulty and required to get to the next activity. Computer activities are presented with several alternative responses (3 to 4 solutions are possible), displayed on the bottom of the screen. Usually these represent opposite concepts, e.g., open vs closed; up vs down.

Audio feedback is delivered after a student's performance. Positive computer sounds are used as reinforcers available after each response; when the student's choice is incorrect, a low frequency "dissonant" sound is provided. When the child does not understand the question, he can click on the sound icon, and the computer repeats the question each time.

Before starting, teachers can select the computer session as a learning (stimulus control) procedure or a play session (without stimulus control). Because the software is designed to be used with several interfaces, the student can use either the touch screen or mouse versions. The session terminates with a display of the student's performance including the number of errors and reaction time.

An Apple Macintosh Quadra-700 with touch screen was used in this research. Both Macintosh and IBM compatible software versions are available.

*Procedure*

The software group received four sessions of computer-assisted learning, of 12 trials each. Four sample questions were administered to ensure the students' understanding. The control group remained in the classroom along with the experimental group. They were not allowed to use the computer. The control group tried to learn the shapes, colours, and concepts about body position with a drill-and-practice procedure presented by the special education teacher in four individual sessions of 30 minutes each.

## Results

The assessment of the software's efficacy was completed by comparisons of (a) number of errors from trained and control group sessions, and (b) the trained and control subjects' scores in pre- and posttreatment scores on the Basic Concepts Assessment Test.

Means ($\pm SD$s) of errors for both groups from the four sessions with the software are presented on Table 1. A Wilcoxon $T$ test with means of errors per session was used. Statistically significant differences were found between

TABLE 1
MEAN ERRORS AND STANDARD DEVIATIONS FOR TRAINED AND CONTROL GROUPS IN FOUR SESSIONS OF TRAINING ON SHAPES, COLORS, AND BODY POSITIONS

| Concept | Session 1 | | Session 2 | | Session 3 | | Session 4 | |
|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Experimental Group | | | | | | | | |
| Colours | 6.2 | .3 | 4.0 | .4 | 2.1 | .4 | .5 | .0* |
| Shapes | 6.9 | .7 | 6.0 | .6 | 4.2 | .3 | 2.9 | .3* |
| Body Positions | 12.5 | 1.0 | 5.9 | .8 | 3.2 | .3 | .7 | .0* |
| Control Group | | | | | | | | |
| Colours | 9.9 | .7 | 11.1 | .9 | 9.5 | .9 | 9.8 | .5 |
| Shapes | 10.1 | .6 | 10.8 | .8 | 9.9 | .4 | 8.9 | .7 |
| Body Positions | 15.5 | 1.1 | 14.4 | .9 | 15.1 | 1.2 | 12.9 | .9 |

*$p < .05$.

the trained and control groups (Colour: $Z = -4.49$, $p < .001$; Body Positions: $Z = -4.39$; Shapes: $Z = -5.74$).

The pre- and posttest scores on the Basic Concepts Assessment Test were also compared (see Table 2). For the trained, but not the control group, Wilcoxon *T* comparisons were statistically significant ($p < .001$); trained group = −2.37, control group = 5.29.

TABLE 2
MEAN ERRORS AND STANDARD DEVIATIONS FOR TRAINED AND CONTROL GROUPS IN PRE- AND POSTTEST SCORES ON THE BASIC CONCEPTS ASSESSMENT TEST

| Group | Pretest | | Posttest | | *Z* |
|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | |
| Experimental | 12 | 1.2 | 1.6 | .02 | −2.37* |
| Control | 12 | 1.5 | 10 | 1.01 | 5.29 |

*$p < .05$.

## DISCUSSION

"Let's Play With . . ." software improved the number of concepts learned by the students in the trained group compared with those in the control group. The control group's mean errors were higher than those of the trained group's. This suggests a lower acquisition of colour, shape, and concepts related to body position, leading to the conclusion that "Let's Play With . . ." software would be useful in teaching these concepts in this specific school population. A deeper analysis of the efficacy of the software suggests a potentially positive outcome of "Let's Play With . . ." in learning/teaching topology and geometric notions (included on shape concepts). It should be stressed here that some of the notions are hard to acquire even by normally developing children. Likewise, the specific peculiarities of the software could be used to reinforce this sort of learning by children with intellectual disabilities.

Effective educational software must ensure that the jump from beginner to expert levels is made gradually. Computers are a powerful tool for processing information, and they have complemented and, sometimes replaced, other instructional resources. But the useful functions of the use of computers must be established with transparent and clear software design, especially for use by children with intellectual disabilities. Like other technology in special education settings "Let's Play With . . ." software can have a motivational effect on student's learning and expand active learning (Recker, 1993; Navarro, Alcalde, Marchena, & Howell, 1997).

Results found using the software "Let's Play With . . ." are encouraging for the current introduction of computer technology into special education settings. Although the spread of the hardware and software use in schools is irregular (Howell & Navarro, 1997), it is hoped that teachers will be able to use this sort of instructional technology more easily in the future. Furthermore, present data give some support for the quality of the software as a "device of the mind" (Sleeman, 1987), which means that it not only generates a specific response from the student, but also a process of mental expansion by generalization to other behaviours when concepts are similar.

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