

CHANGES IN CHILDREN'S CREATIVITY IN LOGO ENVIRONMENTS

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ABSTRACT

This presentation summarizes the authors' experience in studying changes in children's creativity as a result of LOGO-based learning in different educational context. Two empirical investigations (in-school and out-of-school settings) are carried out to examine the relationships between changes in children's creative thinking abilities (measured by Torrance Tests of Creative Thinking) and characteristics of children's work with computers. The results lead to the conclusion that experimentally proved creative potential of the computer-based education needs appropriate environment and instructional strategies in order to be fully materialized in the real-life educational processes.

Keywords:

Creativity, LOGO programming, LEGO-LOGO activities, real-life educational context.

Aside our proper research interest in creativity, we firmly believe that creativity is an important aspect of human learning and living. Many of society's needs change drastically and the objectives of education, the concepts of teaching, methods of instruction and criteria for evaluating instruction must also change. There was a time when we thought that a person could learn some things at school and this learning would last him/her for the rest of his/her life. Today's schools are being asked to produce men and women who can think, who can adapt to change and who can find more adequate solutions to impelling world problems. Man of the future will have to behave creatively and today's educational technologies have to help today's students to meet the challenge.

Information Technology in Education and Creativity

Creativity is very often claimed to be a positive outcome of the computer-based education. Specialists in computers uniformly agree, that such an instructional innovation is expected to enhance children's creativity, but there are only few researches in the field: Clements (1986; 1991); Blumen (1991); Sakamoto, Zhao and Sakamoto (1991). Controversial findings are reported also (Bruce, 1989; Sakamoto, Zhao and Sakamoto, 1991) and the need for further research in this field is emphasized (Bruce, 1989; Clements, 1991).

According to Bruce (1989), the analysis of the effects of the use of information technology in education on creativity "...should be done in terms of all relevant sets of variables: the kind of technology involved, the educational strategy in which it is embedded, the functions it serves in the particular educational strategy, and the aspects of creativity involved or affected" (Bruce, 1989, p.249).

Difficulties are related mainly with the fact that there is no widely accepted theory of creativity; the field of creativity research is characterized by a rather peaceful co-existence of different approaches and models. Several conceptions have been proposed, which although very similar, differ by the answers they are giving to two principal questions: 1) how the individual's creative potential is being conceptualized (and, respectively, what kind of measurement instruments have been developed?); and, 2) is the individual's creative potential susceptible to educational influences?

Our research work is based on Torrance's (1979) conception of creativity as a natural problem-solving process which is similar in all fields and is highly teachable. We use also Torrance Tests of Creative Thinking (as did Clements, 1986; 1991; and Blumen, 1991) as a creativity measure. The Verbal and Figural batteries consist of open-ended tasks which require kinds of thinking, analogous to the thinking involved in recognized creative achievements and which measure individual differences in creative thinking abilities.

This presentation summarizes the authors' experience in studying changes in children's creativity as a result of LOGO-based learning in different settings. The main results of our studies seem to be in raising questions rather than answering them. Data analyses draw attention to the characteristics of the educational context which probably affect the impact of computers in education on children's cognitive development.

Study 1

In 1990/1991 we were engaged with an empirical investigation of the development of the creative thinking abilities in the context of learning programming in a regular classroom setting. Subjects of the study were 31 sixth-graders (19 boys and 12 girls) who studied Informatics-LOGO for a second school year. The

previous year they had LOGO-lessons twice a week or 72 hours per year. The 1990/1991 school year they had LOGO-lessons once a week or 36 hours total. The data were gathered at the beginning and at the end of the 1990/1991 school year in order to determine 1) eventual changes in students' creative thinking abilities and) if and how these changes are related to several characteristics of students' work with computers.

Verbal and Figural Forms A of the Torrance Tests of Creative Thinking served as a creativity indicators in both pre- and posttestings. Information about students' involvement with computer work was gathered from their Informatics teacher by a 3-point Likert-type scale for measuring children's interest in and experience with computers. Academic achievements in Informatics were considered as well.

Data analyses show that:

1. The group as a whole shows statistically significant positive gains in all verbal and all nonverbal measures of creative thinking abilities at the end of the school year.

2. Students who are more interested in computers, and those who are better in Informatics tend to be less fluent ($p < .05$) and less flexible ($p < .05$) in the verbal production of unusual ideas. Pupils with higher academic achievements in Informatics and who demonstrate higher interest in computers tend to give less imaginative and abstract titles to their pictures ($p < .05$) in the Figural Form (they prefer just to label their drawings). Deep involvement with computers seems to influence negatively the richness of the verbal expression of ideas. This fact is probably related to the specific features of the effective communication with the computer which stress on neatness, preciseness, unambiguousness of the language and on short language forms.

3. Experience with and interest in computers and achievement in Informatics present the highest positive correlations, although not significant, with figural originality (number of unusual, unique ideas) and elaboration (number of details, used to elaborate the pictures). Such a result is consonant to data, reported by Clements (1986), who studied the effects of LOGO computer programming and CAI on first- and third- grade children's creativity and found out that LOGO group outscored the others on originality and elaboration in their responses to figural creative tasks.

Study 2

The second study we carried out focused upon studying the same problem in a new educational context, differing from the school setting by the way in which the information processing functions of the computer have been incorporated into the learning process.

In 1992 we initiated a study aimed at investigating the presumed advantages of the out-of-school computer use in developing creativity. We chose a rather rare pedagogical situation: the sessions of the LEGO-LOGO Club in Sofia. The whole group visiting the Club was observed. The sample consisted of 20 children from about the same age group as in the previous study. In 1991 they had had 30 hours of LEGO-based activities without the use of computer. During the year 1992, they had 30 LEGO-LOGO lessons using the Bulgarian version of LEGO-LOGO language, developed by COMSED Ltd. Children were tested with the same instruments in February 1992, at the beginning of the course and were retested at its end in May, 1992.

The LEGO-LOGO Club represents a rather different learning con-

text when compared to the regular classroom setting. The participation depends on children's willingness and interest in it only. Children work in smaller groups and the session organization is informal. No marks are given to the children, nor any other formal assessment is available. The fact that they choose themselves to follow this course and the variety of the instructional tools provide a base for individualized, flexible and independent learning. The children have the freedom to design models, appropriated to their preferences and aesthetic taste, to elaborate them and to test themselves their efficacy. The instructors (two young women) are not regular school teachers, but mathematicians who are working in COMSED Ltd. and have received appropriate LEGO-training in Denmark. Their role consist mainly in organizing children's interactions and in supporting their problem-solving activities.

That is why we expect this learning context to be more favorable to children's creative behavior and more stimulating for their creative achievements.

Data analyses show that:

1. The group as a whole demonstrated a) statistically significant ($p < .005$) positive gains in figural fluency and originality; b) positive but non significant gain in resistance to premature closure (the ability to resist to the natural psychological urge to close the incompleteness by the simplest, easiest solution); c) decrease, although nonsignificant in titles' abstractness (the degree to which the titles given by the children to their pictures are going beyond what can be seen) and elaboration. Blumen (1991) used the same experimental design (in addition with a control group) to investigate the effects of computer programming with LOGO on 7-11 years old children's figural creativity and found major differences in fluency and originality too. It is quite difficult to suggest a satisfying explanation for the observed decrease in some creativity measures. Creativity is multifaced as well as multidetermined phenomenon which development is a result of different and sometimes opposite influences.

2. Some evidences were obtained which support our expectancies that the educational context of the LEGO-LOGO Club provides more favorable background for realizing the positive influence of the computer use on children's creativity. Abstractness of Titles and Elaboration are the creativity indicators which are most susceptible to differences in children's work with computers. Given the overall negative trends in their development, the impact of intensive children's work with computer over the above mentioned creativity indicators emerges as a compensatory effect:

a) the decrease in titles' imaginativeness and abstractness is more pronounced ($p < .05$) in the group having small experience with computer and in the group exhibiting moderate interest in computers; for the children with rich computer experience and great interest in computer work pre-post differences in the scores on Abstractness of Titles are nonsignificant;

b) the decrease in the degree of elaboration of the responses to the figural creative tasks is more pronounced in the group having moderate interest in computers while in the group having great interest in it the differences between the two testings are nonsignificant. The restricted size of the sample (which had not been experimentally manipulated) limited however not only the scope of the statistical computing, but reduce as well the degree of significance and generalization of the data obtained. That is why we can interpret the results as no more than a tendency and further extensive research work in this field is needed.

3. Experimenters' observations show that children's behavior during the LEGO-LOGO sessions exhibits a lot of creativity relevant

attitudes (self-directed search for different solutions; mutually supportive activity within the group; persistence in the work; very high level of internal motivation) which had not been typical for the regular classroom setting. It seems useful that further investigations of the computer's impact on children's creativity rely heavily on behaviorally-grounded creativity indicators.

Significant sex differences were found in the both studies. In the first study 72% of the pupils who are seen as very much interested in computers and 74% of those who have variety of experience with computers are boys; 73% of the pupils who receive highest marks in Informatics are boys too. At the same time girls outscored boys on all verbal and on most of the nonverbal creativity indicators. This discrepancy makes quite logical the negative relationship between changes in creativity and the characteristics of computer use.

Girls are minority (N=3) in the LEGO-LOGO Club too. Boys are more likely than girls to perceive computers, Informatics and different type of constructor-tools as a valuable field for expressing one's potential and receiving acknowledgement. It might be that our cultural stereotypes don't consider computers to be very much a "female" business. Similar sex differences are reported by Sakamoto, Zhao and Sakamoto (1991) for a sample of over 700 Japanese 4th - 6th graders. *

Conclusions

How can we integrate the results we obtained with the accumulated data concerning the impact of computer-based education on children's creativity?

Both Clements (1986; 1991) and Blumen (1991) investigate the influence of LOGO programming on children's creativity in well controlled experimental conditions. They both report positive outcomes which confirm that LOGO environments might be a positive factor in children's creative development.

When *real-life educational context* is considered, the results are not so conclusive. Mitterer and Rose-Krasnor (1986) revealed few changes in problem solving skills which could be attributed to the LOGO instruction (cited in Bruce, 1989). Sakamoto, Zhao and Sakamoto (1991) found out that computer use experience in school (programming) enhances children's creative initiativeness and inquiry abilities, but computer use at home (games) does not always enhance initiativeness and, on the other hand, decrease children's inquiry abilities. Therefore, *the advantages of the computer-based instruction, which have been experimentally proved, are not automatically materialized in real-life educational processes* - additional efforts are needed to put them into practice.

Considering our proper results from this point of view, we direct our attention towards those factors/variables in the Bulgarian educational context which might be responsible for the ineffective computer use in- and out-of-school. One of the most important is the overall shortage of computer resources available to children at home and at school. Our results are probably predetermined by the restricted computer experience of the Bulgarian children. Both further enrichment of the educational context by the means of new information technologies and the implementation of appropriate instructional strategies are needed to provide children's creative growth.

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