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ABSTRACT

The Mathematics Teacher Development Program was an effort to develop the skills of classroom teachers in the use of handheld calculators and microcomputer systems. It was sponsored by the National Science Foundation and Loyola University, and it consisted of an academic portion and an intense 3-week, full-time summer session. The focus of this paper is a study done during the 1980 summer portion of the program. During this time, the teachers received training in both computer science and computer problem solving in mathematics. The purpose of the study was to assess the effectiveness of this instruction on cognitive and affective objectives associated with computer literacy. Thirty-three teachers were used as subjects. All teachers were female and were placed in two different instructional tracks. Eleven completed track 1, and 22 completed track 2. Track 1 teachers were taught various topics in discrete mathematics, while those on track 2 were instructed in aspects of linear algebra and matrix theory. The investigation focused on 15 days of intensive summer instruction that involved microcomputers. Results indicated that the summer program had a positive effect on the computer literacy of teachers. (Author/MP)

The Effect of Computer Instruction on Computer Literacy in a Mathematics Teacher Development Program

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Abstract

The Mathematics Teacher Development Program was an effort to develop the skills of classroom teachers in the use of handheld calculators and microcomputer systems. It was sponsored by the National Science Foundation and Loyola Universtiy, and it consisted of an academic portion and an intense three week, full-time summer session. This paper focuses on a study done during the 1980 summer portion of the program. During this time, the teachers received training in both computer science and computer problem solving in mathematics. The purpose of the study was to assess the effectiveness of this instruction on cognitive and affective objectives that are characteristic of being computer literate.

The Effect of Computer Instruction on Computer Literacy in a Mathematics Teacher Development Program

The need for a more "computer literate" elementary or secondary school mathematics teacher was evident before 1976 (Lykos, 1974). By then, handheld calculators had found their way into several levels of education. Microcomputer systems were leaving the kit/machine language stage and becoming plug-in/BASIC oriented. Thus, microcomputing was starting to enter education. However, it was felt that most classroom mathematics teachers had not developed their own skills on these computing devices. As a result, the Department of Mathematical Sciences submitted a proposal to the National Science Foundation for support of a Mathematics Teacher Development Program. A grant was awarded for 1977-78 and again for 1978-79 and 1979-80.

The Mathematics Teacher Development Program was a two-track project that combined an academic year portion with an intense three week, full-time summer session. Track 1 consisted of teachers with under 18 hours of college mathematics who were teaching in grades 5 through 9. Track 2 consisted of teachers with 18 or more hours of college mathematics who were teaching in high school. During the academic year classes were held on Saturday mornings for three hours. Track 1 teachers were taught various topics in discrete mathematics while Track 2 teachers were taught topics in linear algebra and matrix theory. For one hour each group received instruction which integrated the subject matter being presented and the use of the handheld calculator as a computational tool. During the summer portion of the program, each track received training in computer science and computer problem solving in mathematics.

This paper focuses on a study done during the 1980 summer portion of the Mathematics Teacher Development Program. An outline of the topics covered in these courses is presented in Table 1. The purpose of the study was to assess the effectiveness of this intense 15 day period on certain cognitive and affective objectives that are characteristic of being computer literate.

There are some 54 different objectives that might be used in characterizing computer literacy (Johnson et al, 1980). In designing our experiment, we selected 12 cognitive and three affective objectives which we felt could be used to evaluate the teachers. A list of these objectives is presented in Table 2. Because of the structure of the Mathematics Teacher Development Program, a pretest/posttest instrument was used to rather data. To observe the 12 cognitive objectives, we used a 28 item true/false and multiple choice achievment test. A 12 item semantic differential using "computer science" as a stimulus was used to measure attitudes. Three groups of four pairs of adjectives were concatenated to provide feedback on the three affective objectives of understanding, evaluation, and confidence.

A total of 36 teachers started the course; there were 13 in Track 1 and 23 in Track 2. Since two teachers withdrew in Track 1 and one teacher withdrew in Track 2, only 33 teachers participated in the complete study. All the teachers were female.

During the summer portion of the Mathematics Teacher Development Program, classes were held six hours a day for 15 days with each day being a self-contained module. Both tracks had their day divided into two three hour blocks with the mathematical computer problem solving being taught to Track 1 in the morning and Track 2 in the afternoon. Topics in computer science were taught to Track 2 in the morning and Track 1 in the afternoon. Each three hour block was divided into a one hour lecture, a twenty minute study and review session, a twenty minute quiz, and a supervised lab period of an hour and twenty minutes for "hands-on" activity. The computer hardware consisted of three TRS-80 and four APPLE microcomputer systems. Although there are differences in each of the computer's BASIC, we defined a subset of the language that could be used on both systems

(McLean et al, 1979). A text (Golden, 1975) provided the teachers with a reinforcement tool for computer programming and a wealth of problems at different mathematical levels..

In analyzing the data generated by the achievement test, we considered both tracks as one group and compared the signed differences of the paired data (percentage of teachers agreeing with the school solution). The mean difference was 16.83 (S.D.=15.08). A view of the pretest/posttest data is presented in Table 3. Our null hypothesis was that the course had no effect on the 12 objectives and our alternative hypothesis was that the course actually increased the teachers' computer literacy. The results indicated that the course was statistically significant, $t(11)=3.87$, $p<.05$.

There were two other questions that we wanted to investigate. First, did the teachers of Track 2 possess more computer awareness before the course than the teachers of Track 1? Secondly, did the teachers of Track 2 achieve higher scores after the course than the teachers of Track 1? In order to answer the first question, we did a pretest analysis of the achievement test data comparing the signed differences of Track 2 and Track 1. The mean difference was 7.92 (S.D.=12.12). We were able to reject the hypothesis that there was no difference between the two groups of teachers in favor of the hypothesis that the Track

2 teachers possessed more computer awareness before the course than the Track 1 teachers, $t(11)=2.26$, $p<.05$. On the other hand, we could not reject the second hypothesis that there was no difference in the scores after the course. The mean difference of the posttest analysis was 6.08 (S.D.=17.16) with a resulting $t(11)=1.28$, $p<.05$.

In our analysis of the semantic differential, we again began by considering both tracks as a single group. The null hypothesis was that the attitudes toward computer science would not change during the course, whereas the alternative was that the teachers would demonstrate more favorable attitudes. Using the Wilcoxon Matched-Pairs Signed-Rank Test, we rejected the null hypothesis in favor of the alternative at the .005 level of significance. The data from each track was considered separately only to reveal that with Track 1, the null hypothesis could not be rejected at the .05 level of significance. However, the null hypothesis was rejected for Track 2 at that level.

To determine if there existed a significant difference in the attitudes between the two tracks before and after the course, we studied the data using the Mann-Whitney U-Test. The null hypothesis was that there was no difference between the attitudes of the two groups, while the alternative maintained that Track 2 had more favorable attitudes than Track 1. Since we lacked randomness in our sampling, it became critical that we observe no difference between the two tracks before the course. This was indeed the case as we were not able to reject the null hypothesis, not even at the .1 level of significance. In the posttest analysis, we rejected the null hypothesis in favor of the alternative at the .05 level of significance.

Overall the summer portion of the Mathematics Teacher Development Program had a positive effect on the computer literacy of the teachers. Although the Track 2 teachers did show more of an awareness of computers than the Track 1 teachers before the courses, the 15 day program put both groups on the same improved cognitive level. Furthermore, the courses produced a greater change in attitudes among the teachers in Track 2 than in Track 1.

Table 1

Outline of Computer Science (CS)

Mathematical Computer Problem Solving (MCPS)

<u>Day 1</u>

CS: The computer, what can it do? What does it do? Demonstrations.

MCPS: Pretest. Demonstration of drill and practice, tutorial, and simulation software.

<u>Day 2</u>

CS: The computer as a BASIC calculator (PRINT).

MCPS: Comparing the computer with the handheld calculator.

<u>Day 3</u>

CS: Built in functions and memory (ABS, EXP, RND, etc.).

MCPS: Where are the sine and square root keys?

<u>Day 4</u>

CS: Algorithms and their representations (END).

MCPS: Adapting problem solving procedures to the computer.

<u>Day 5</u>

CS: More on algorithms and their representations.

MCPS: Flowcharting problems having a sequence structure.

<u>Day 6</u>

CS: Input and output in a program (INPUT, READ, TAB).

MCPS: Flowcharting problems having a selection structure.

Day 7

CS: Decisions and branching (IF...THEN..., GOTO).

MCPS: Flowcharting problems having a loop structure.

Day 8

CS: Strings and how to use them. Substrings and concatenation.

MCPS: Converting sequence flowcharts into BASIC. Doing a program trace.

Day 9

CS: Looping techniques -- loops of known and unknown duration (FOR...NEXT...).

MCPS: Converting selection flowcharts into BASIC. Doing a program trace.

Day 10

CS: String functions (LEN, VAL, STR$, LEFT$, MID$, RIGHT$).

MCPS: Converting loop flowcharts into BASIC. Doing a program trace.

Day 11

CS: Subroutines (GOSUB).

MCPS: Writing drill and practice programs in mathematics.

Day 12

CS: Arrays (DIM).

MCPS: Writing tutorial programs in mathematics.

Day 13

CS: Computer graphics.

MCPS: Learning about "sets" again.

Day 14

CS: Real-time control programs.

MCPS: Sorting algorithms for items in a "set".

Day 15

CS: The role of the computer in elementary and secondary education -- a technical view.

MCPS: Posttest. Where to from here? Sources of educational help.

Table 2

Cognitive Objectives

Hardware

1. Identify the major components of a computer.

2. Identify the basic operations of a computer system.

3. Recognize the rapid growth of computer hardware since 1940.

4. Determine that the basic components function as an interconnected system under the control of a stored program developed by a person.

5. Compare computer processing and storage capabilities to the human brain.

Software

6. Recognize the definition of a flowchart.

7. Follow and give correct output for a simple flowchart.

8. Given a simple program, explain what it accomplishes.

9: Recognize that a computer needs instructions to operate.

10. Recognizes that a computer gets instructions from a program written in a programming language.

Impact on Society

11. Recognize that most "privacy problems are characteristic

of large information files whether or not they are computerized.

12. Recognize that computerization both personalizes and impersonalizes procedures in fields like education.

Affective Objectives

Understanding

1. Does not feel confused, mystified, or intimidated by a computer experience.

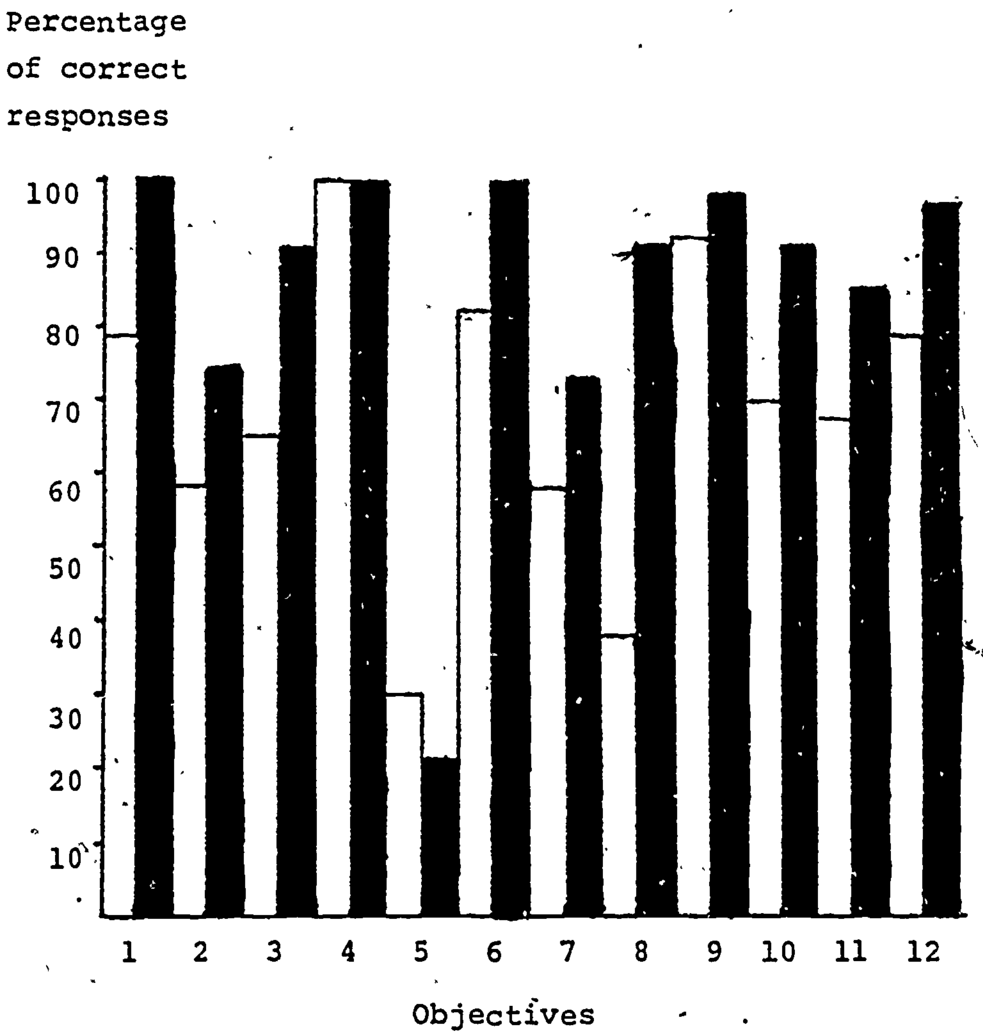
Evaluation

2. Considers computer experience valuable.

Confidence

3. Feels confident about ability to use computers.

Table 3



Pretest data are the white bars and posttest data are the black bars.

References

Golden, N. Computer Programming in the BASIC Language, New York: Harcourt Brace Jovanovich, 1975.

Johnson, D., Anderson, R., Hansen, T., and Klassen, D. Computer Literacy -- What is it? The Mathematics Teacher , 1980, 73, 91-96.

Lykos, P. The Computer Illiteracy Problem: A Partial Solution. American Mathematical Monthly, 1974, 81(4), 393-398.

McLean, R., Lopez, A., Schmit, J., and Griffin, D. Master BASIC Command List. Recreational Computing, 1979, 8, 51-53.