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ABSTRACT

The basic question investigated in this study was the effect of the Stanford computer-assisted instruction (CAI) drill-and-practice program in elementary arithmetic when used as remedial instruction, on the self-concept and math attitudes of junior high school students. About 75 percent of the sample of 320 students came from Mexican-American backgrounds. A two-group pretest-posttest design was used. The subjects could not be randomly assigned to treatment and control groups because the CAI program had been operating for several years in the school. The conclusions of this study are: the CAI program promoted realistic attitudes toward math; CAI may be an efficient, effective form of remedial instruction; CAI did not prove dehumanizing, and no across-the-board negative attitudes resulted from the program; there is no best way of presenting educational material to all students. (Author)

STANFORD CENTER
FOR RESEARCH AND DEVELOPMENT
IN TEACHING

Research and Development Memorandum No. 89

THE EFFECTS OF COMPUTER-ASSISTED INSTRUCTION ON STUDENT SELF-CONCEPT, LOCUS OF CONTROL, AND LEVEL OF ASPIRATION

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Introductory Statement

The Center is concerned with the shortcomings of teaching in American schools: the ineffectiveness of many American teachers in promoting achievement of higher cognitive objectives, in engaging their students in the tasks of school learning, and, especially, in serving the needs of students from low-income areas. Of equal concern is the inadequacy of American schools as environments fostering the teachers' own motivations, skills, and professionalism.

The Center employs the resources of the behavioral sciences--theoretical and methodological--in seeking and applying knowledge basic to achievement of its objectives. Analysis of the Center's problem area has resulted in three programs: Teaching Effectiveness, Teaching Students from Low-Income Areas, and the Environment for Teaching. Drawing primarily upon psychology and sociology, and also upon economics, political science, and anthropology, the Center has formulated integrated programs of research, development, demonstration, and dissemination in these three areas. In the Program on Teaching Effectiveness, the strategy is to develop a Model Teacher Training System integrating components that dependably enhance teaching skill. In the program on Environment for Teaching, the strategy is to develop patterns of school organization and teacher evaluation that will help teachers function more professionally, at higher levels of morale and commitment. In the program on Teaching Students from Low-Income Areas, the strategy is to develop materials and procedures for engaging and motivating such students and their teachers.

Contents

Abstract

The basic question investigated in this study was the effect of the Stanford CAI drill-and-practice program in elementary arithmetic, when used as remedial instruction, on the self-concept and math attitudes of junior high school students. About 75 percent of the sample of 320 students came from Mexican-American backgrounds. A two-group pretest-posttest design was used. The subjects could not be randomly assigned to treatment and control groups because the CAI program had been operating for several years in the school. The conclusions of this study are: (a) this CAI program promoted realistic attitudes toward math; (b) CAI may be an efficient, effective form of remedial instruction; (c) CAI did not prove dehumanizing, and no across-the-board negative attitudes resulted from the program; (d) there is no one best way of presenting educational material to all students.

THE EFFECTS OF COMPUTER-ASSISTED INSTRUCTION ON STUDENT SELF-CONCEPT, LOCUS OF CONTROL, AND LEVEL OF ASPIRATION

Ian D. Smith and Robert D. Hess

Introduction

Two sources of inspiration directed this research. The first was Coleman's (1966) finding that the attitude variables he measured had a close relation to school achievement. The second was the emergence of computer-assisted instruction (CAI) as a method of increasing achievement in selected school subjects (Atkinson, 1968; Hansen, 1969; Hilgard, 1968; Suppes, Jerman,& Brian, 1968). It was reasoned that if CAI does increase school achievement, and if school achievement is related to student attitudes such as self-concept, locus of control, and level of aspiration, then perhaps CAI could contribute to positive changes in these attitudes.

Coleman measured self-concept, sense of control over the environment, and interest in learning. He found that these attitudes contributed more to variation in school achievement than did eight home background variables. Their influence on student performance was more direct, and it operated in both directions. Success in schoolwork led to an improved conception of one's ability, and a "high self-concept" led to greater achievement in school. The significance of the Coleman finding prompted this investigation of the influence of CAI on the same attitudes.

Definition of the Research Problem

We examined the impact of a particular CAI program--the Stanford math drill-and-practice program--on self-concept and feeling about locus of control.[1] The Stanford CAI program in elementary arithmetic has been operating for seven years under the direction of Patrick Suppes. In 1970, more than 7,000 students across the United States were taking daily supplementary math lessons based on the program. Early in 1970, a "strands" approach to structuring the program was adopted. A strand is a series of

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[1]A detailed description of the Stanford CAI program appears in Jerman (1971).

problems involving the same operation (e.g., addition). The operations were ordered according to their difficulty. Each lesson included problems from several strands. Students usually attempted between 20 and 30 problems presented by a teletypewriter that linked the schools with a computer at Stanford. Ten minutes was allowed for each lesson.

The CAI program is highly individualized: each student receives problems that are based on his past performance. If he answers 70 percent of the problems correctly, he can progress one grade level in a school year. Thus, the program was designed to provide immediate reinforcement for each student's answers, and high scores on his CAI math lessons.

The basic purpose of this investigation was to discover what effect the CAI program would have when used as remedial instruction. Would successful experiences provided by CAI lessons change the attitudes of students who experienced chronic failure in math when taught in the conventional classroom? Three attitude variables were chosen as the dependent variables: self-concept, locus of control, and level of aspiration.[2]

The following six questions guided this investigation:

1. Do the self-concepts of low-achieving CAI students become more favorable from pretest to posttest?
2. Do their feelings about locus of control shift in the direction of personal control?
3. Are their initial levels of aspiration realistic?
4. Do their aspiration levels become more realistic after an extended CAI experience?
5. Are there further effects on self-concept, locus of control, and level of aspiration after one year's contact with CAI?
6. Are their conceptions of their mathematical abilities related in any way to achievement in the CAI math program?

Design

A two-group pretest-posttest design was used in the study. The dependent variables, as mentioned, were self-concept, sense of locus of control, and level of aspiration. The independent variable, or treatment, was the CAI math drill-and-practice program. This was not a strictly experimental investigation, inasmuch as the CAI program had been operating for three years in the school selected for the study, and the investigator could not allocate the subjects randomly to experimental and control groups. Instead, he had to fit the study to an ongoing CAI program that was entering its fourth year of operation.

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[2] A review of this research may be found in Smith (1971).

The overall design was as follows:

Treatment Groups	Test	Expected Findings
Students new to CAI math Students with one year's CAI experience	Pretest-posttest comparisons on self-concept, locus of control, and level of aspiration	Substantial changes from pretest to posttest in new group; pretest differences between new and one-year group

Control Group	Test	Expected Findings
Students not referred to CAI, but from same math classes, where possible	Pretest-posttest comparisons on self-concept and locus of control	No systematic changes from pretest to posttest

Subjects

The sample consisted of 320 students from a junior high school (7th, 8th, and 9th grades) in the San Francisco Bay Area that draws its students from a low-income population. Approximately 75 percent of the sample came from Mexican-American backgrounds. The students were performing two to three years below grade level on the arithmetic section of the Stanford Achievement Test.

The CAI program had been used at this school for three years to provide remedial instruction in skills such as addition, multiplication, fractions, and applications of the distributive law. The total number of students who could receive computer-assisted instruction was limited by the availability of teletype equipment. The school had four teletypes, which were linked with the Stanford Computation Center by a telephone line. In the year this study was made, math teachers were encouraged to have all members of their classes take part in the CAI program, whereas in previous years, only students with an obvious need for such remedial instruction were allotted spaces in the program. In six math classes all class members were allotted spaces in the program. In six other math classes, students were assigned to CAI on the recommendation of their teachers.

The treatment (CAI) group consisted of all the students assigned to the computer math program. This group numbered 159, of which 132 were having their first contact with CAI. The other 27 students were beginning their second successive year in the program. Students in the control (Non-CAI) group were selected, as far as possible, from the same math classes as the CAI students in order to minimize the influence of any one math teacher on either group, but the new procedure of assigning entire classes to the CAI program required the addition of two classes consisting entirely of Non-CAI students. Since both of these classes were taught by teachers who also taught CAI students, any differential teacher effect on the dependent variables was expected to be slight.

Because the allocation of students to the treatment and control groups was beyond the control of the investigator, any positive findings must be interpreted cautiously. Furthermore, because the initial equivalence of the two groups of students on a number of possibly relevant variables (e.g., math ability, IQ) could not be assured, differences between the two groups at the end of a period of exposure to CAI could not be ascribed to the influence of CAI alone. For these reasons this study cannot be described as a truly experimental investigation; rather, it is a field study of an ongoing program. Any promising findings would have to be checked in an experimental setting if unequivocal treatment effects were to be claimed.

TABLE 1

Number of CAI and Non-CAI Students
(classified by grade and sex)

	CAI group				Non-CAI group			
	Grade			Total	Grade			Total
	7	8	9		7	8	9	
Male	39	52	11	102	35	33	13	81
Female	33	17	7	57	35	41	4	80
Total	72	69	18	159	70	74	17	161

Table 1 shows the characteristics of the sample broken down by CAI/Non-CAI, sex, and grade. Male CAI students outnumbered females by a ratio of almost two to one; the Non-CAI group was split evenly. The reason for the disproportionate number of boys selected for the CAI program was not investigated.

The Instruments

The Sears Self-Concept Inventory. One questionnaire designed to measure aspects of a student's self-concept is the Sears Self-Concept Inventory. This rating scale, developed by Pauline S. Sears (1964), appears in Appendix A as the Self-Rating Instrument. Each student who used the instrument was instructed to compare himself with other students his age on items like "understanding something new." Because of the limited time available in this study, several of the concept areas were dropped from the questionnaire. The pretest general self-concept scores had an internal consistency coefficient of .91, and the math self-concept scale had an equally high reliability coefficient of .93.

The general self-concept areas included physical ability, attractive appearance, convergent mental ability, social relations with the same sex, social vitues, and school subjects. Four items were selected to measure each of these six areas; eight others were chosen to measure math self-concept. Table 2 presents the alpha coefficients showing the internal consistency levels for each of the seven areas. These coefficients indicate moderate to high consistency between the items on all of the seven. However, the intercorrelations between them were also moderate, suggesting a good deal of overlap among the various areas of a student's self-concept.

TABLE 2

Internal Consistency Coefficients for Three Attitude Inventories
(N = 320)

Instrument	Coeffient
Sears Self-Concept Inventory	
Physical ability	.81
Attractive appearance	.72
Convergent mental ability	.67
Social relations	.73
Social virtues	.68
School subjects	.59
Math	.93
Coopersmith Self-Esteem Inventory	
General self-esteem	.64
Math self-esteem	.49
Crandall Locus of Control Instrument + Coleman Items	
Positively expressed math items	.29
Negatively expressed math items	.35
Coleman items	.46

The profile of the pretest item means on the six general scales and the math scale for the total sample is depicted in Figure 1. Five of the seven means were below 3 ("better than most"), the middle response on the 5-point scale. That is, when a student compared himself with his peers, on five out of seven scales the average response was between "O.K." and "better than most." All seven scale distributions were positively skewed, placing the majority of students at the low end of the scale.

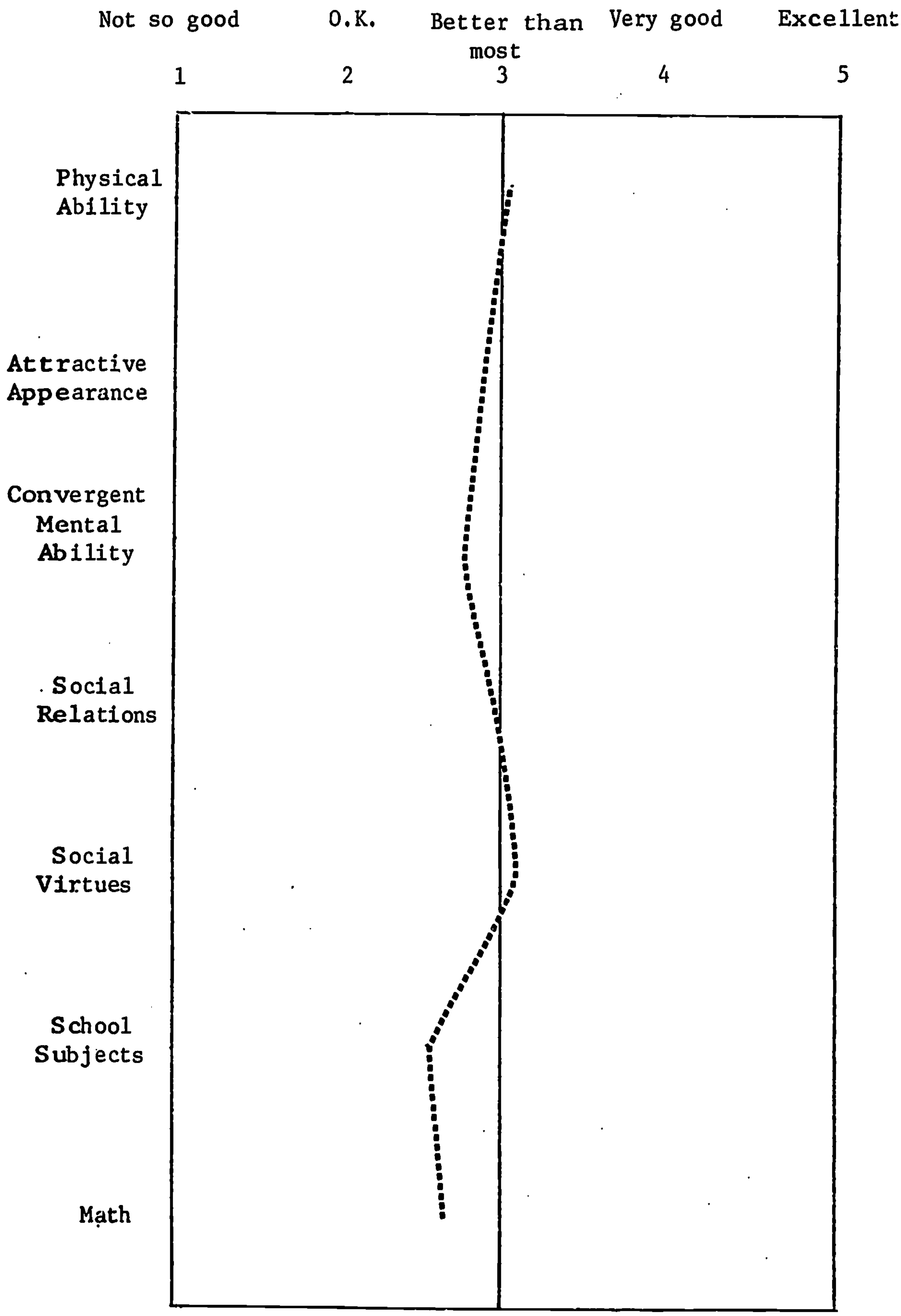

Fig. 1. Profile of pretest item mean scores on seven self-concept scales.

On the pretest, the seven scales were ranked from highest to lowest preference as follows: social virtues, physical ability, social relations with same sex, attractive appearance, convergent mental ability, math, and school subjects. The students reacted most positively to items like "listening to what others are saying," and least positively to items such as "being interested in science," "learning about things that scientists do." Although the score differences were small, a pattern in the self-ratings did emerge. The top four scales measure social-emotional self-concept; and the three lowest scales measure cognitive self-concept. The students, most of them from Mexican-American families, consistently ranked themselves higher in the social-emotional areas of self-concept than in cognitive self-concept. This finding confirms previous research on the self-concepts of Mexican-American children (Carter, 1970; Coleman, 1966; Penna-Firme, 1969).

Coopersmith Self-Esteem Inventory. The instrument designated the Self-Description Inventory on the pretest form is a modification of Coopersmith's Self-Esteem Inventory (1959), which was developed for use with 5th and 6th graders. The items on this rating scale were halved from the original 50 to 25. Each item required the student to agree or disagree with a particular statement, as illustrated in Appendix A. A student was asked to respond to certain statements, such as "I'm pretty happy," in terms of how he usually felt. Two points were assigned to each response that indicated high self-esteem, and one point to each low self-esteem response. Six math items were selected, together with 19 general self-esteem items. The internal consistency coefficients are presented in Table 2. They were .64 and .49 for general and math self-esteem, respectively. The correlation between the two scales was .32, which indicates that the math scale is not independent of the general scale.

The pretest mean on general self-esteem for the total sample of 320 students was 31.95, with a range of possible scores from 19 to 38. The average math self-esteem score was 9.53, (range 6-12). The mean on math self-esteem was just over halfway between the minimum and maximum scores, whereas the mean on general self-esteem was approximately two-thirds of the distance away from the minimum score. This comparison suggests that the general self-esteem of these students was relatively higher than their self-esteem in math. Here, again, the general self-esteem scale measured self-esteem in the social and emotional areas, as opposed to the cognitive emphasis of the math scale.

Crandall Locus of Control Instrument. This instrument, entitled Math Choices Scale in Appendix A, was constructed to measure student feelings of control over the reinforcements they received in math. The student responded to statements like the following: "When you get a good grade on a math test, it is because, A. You studied for the test; B. The test was easy." Two kinds of response were offered, as well as a no-response alternative. An external response (2 points) placed the blame or credit for the student's actions on someone or something other than himself, whereas an internal response (1 point) indicated that the student accepted the

consequences of his own actions. The instrument consisted of two scales: one with five positively expressed items and one with five negatively expressed items.

Table 2 shows the internal consistency coefficients obtained in the pretest. The two coefficients, although modest, approximated the value of .60 reported by Crandall et al. (1965) for the original locus of control instrument, when the length of the instruments was controlled. The items within each scale are somewhat heterogeneous.

Coleman Control Items. The third locus-of-control scale used in this study[3] was composed of the three control items constructed by Coleman (1966). Items on this scale were designed to measure student feelings of "control over their environment." Each student was asked to indicate "agree" (3 points), "disagree" (1 point), or "not sure" (2 points), on items such as "Good luck is more important than hard work for success." The internal consistency coefficient on this three-item scale was .46, a moderate level considering the small number of items in the scale.

The mean pretest scores on the two math locus-of-control scales showed that the students were, in general, internally oriented toward math. That is, they accepted responsibility for both their successes and their failures in math. Means of 6.64 and 6.82 were obtained for the positive (success) and negative (failure) locus-of-control scales for the total sample. The range of possible scores was between 5 and 10 points. The distribution of scores on both scales was positively skewed; a majority of students scored toward the internal-control end of the scale.

The correlation between the two scales was zero (see Table 3). A student's score on the positive locus-of-control scale was a poor predictor of his score on the negative scale. In other words, students who gave themselves credit for their math successes did not blame themselves for their failures. A response bias may have contributed to this lack of correlation. There were two response choices, one for an internal response and the other for an external response. The first choice on the positive scale was an internal response, whereas the first choice on the negative scale always represented an external response.

The three Coleman control items were more general than the two math locus-of-control scales. A general feeling of control over one's environment was indicated by a high score, whereas a low score on this scale indicated a feeling of little control. A mean pretest score of 6.59 was obtained for the total sample (range, 3 to 9). This mean was slightly past the neutral point, toward a feeling of control, although many students did feel they had little control over what happened to them.

[3]These three scales were used in this study, despite their modest levels of internal consistency, because a high level of reliability is unnecessary for analyses based on mean scores.

TABLE 3

Pretest and Posttest Correlation Matrices for Seven Attitude Scales and Two Achievement Variables for the CAI Group
(N = 115)

Pretest

Attitude Scales	1	2	3	4	5	6	7	8	9
1 General Self-Concept		.53**	.26**	.02	.03	-.08	-.01	.03	.09
2 Math Self-Concept			.18	.22*	-.20*	.07	.01	.12	.12
3 General Self-Esteem				.32**	-.07	.11	.12	.18	.02
4 Math Self-Esteem					-.27**	.11	.07	-.04	.03
5 Pos. Locus of Control						.00	-.03	-.09	-.14
6 Neg. Locus of Control							.03	.02	-.01
7 Coleman Control Items								.19*	.21*
8 CAI Math Gde. Equiv.									.41**
9 CAI Math Score									

Posttest

Attitude Scales	1	2	3	4	5	6	7	8	9
1 General Self-Concept		.65**	.36**	.09	-.23*	.07	-.12	.15	-.01
2 Math Self-Concept			.13	.29**	-.20*	-.02	-.14	.25**	.02
3 General Self-Esteem				.20*	-.04	.15	.09	.20*	.15
4 Math Self-Esteem					-.19*	.11	-.06	.01	.12
5 Pos. Locus of Control						.15	-.09	.05	.00
6 Neg. Locus of Control							-.13	-.19*	-.15
7 Coleman Control Items								.25**	.12
8 CAI Math Gde. Equiv.									.36**
9 CAI Math Score									

* = .05 level of significance
** = .01

Table 3 presents the pretest and posttest correlation matrices of all the dependent variables for the CAI group. Table 3 reveals the generally modest level of association between the variables. The strengths of the relationships were attenuated by unreliability within the scales. The two scales with the highest level of internal consistency, general and math self-concept, also had the highest correlation. This finding does not detract from the construct validity of either scale, however. It merely indicates that the level of intercorrelation of any two variables was limited by their internal consistency. The two general self-concept scales were modestly correlated, as were the math self-concept scales. The level of association was slightly higher in the posttest than in the pretest.

Two measures of CAI math achievement were obtained. The first was each student's average percent-correct score in the CAI lessons. This score was taken during the third week of the program and again in the ninth week. The second measure was the grade equivalent score of each student. These two scores were not independent of each other, since the grade equivalent was based on the problems answered correctly on each lesson. It represented a weighted sum of a student's level of competence in 15 areas of elementary arithmetic. The two measures of math achievement were correlated .41 in the pretest and .36 in the posttest. Both coefficients were significant at the .01 level (see Table 3).

A comparison of math self-concept and math percent-correct scores was made for both the pretest and posttest. A negligible relation was found. The correlations were .12 and .02 for the pretest and posttest respectively. The means and the regression slopes were not significantly different. An explanation for the lack of association between math self-concept and math percent-correct scores may be that the CAI program was designed to facilitate high percent-correct scores. Most students received high scores on all the lessons, which were composed of problems geared to their individual level of competence. Thus, students who were doing well on the program might receive scores that were no higher than the scores of students not doing so well. Percent-correct, then, was not an accurate indicator of math achievement.

Findings

The major findings of this study were as follows:

1. The posttest self-concept scores of the CAI group were less predictable from their pretest self-concept scores than were those of the Non-CAI group. This pattern of change from pretest to posttest was not reflected by changes in mean scores. No differences were found between the pretest and posttest mean scores of the CAI group on any of the self-concept scales. There was no general increase in self-concept. Rather, some students revised their self-concept upward, others downward.

2. A similar pattern of findings was recorded for the locus-of-control scales. On two of the three scales the posttest scores of the

CAI group were less predictable from their pretest scores than were those of the Non-CAI group (i.e., regression slopes for CAI and Non-CAI groups were significantly different). These trends were not reflected by changes in the mean scores.

3. The initial aspiration levels of CAI students were found to be realistic. Their aspiration scores were closely related, in terms of means and correlation coefficients, to their actual performance. Six weeks later the same phenomenon was observed.

4. The pattern of results for students who were taking CAI math for their second successive year was very similar to that obtained for beginning CAI students.

5. Only a modest relationship was found between self-concept and achievement in the CAI program after nine weeks. Problems with measuring math achievement indicate that no weight can be placed on this finding.

It cannot be concluded unequivocally that these findings were a consequence of CAI since the students were not randomly allocated to the treatment and control groups. Rather, they were selected for the CAI program if their math teachers (1) expressed interest in the program, and (2) recommended that they be assigned to it. Even though every attempt was made to match the students on math achievement and self-concept by choosing Non-CAI students from the same math classes, the CAI group did have a significantly lower pretest math self-concept than the Non-CAI group. The same could be said for math achievement, although standardized test scores that would have made it possible to verify this belief were not available for all students. Therefore the pattern of findings for the CAI group may have differed from that for the Non-CAI group simply because the groups were drawn from two different populations.

Generalizability of Results

The generalizability of these findings is limited by four factors. The first two involve the special nature of the sample of students who were participating in the CAI program. First, these students were performing two to three years below grade level in arithmetic and were using the CAI lessons as remedial work. The same pattern of findings might not occur for student populations with average or higher-than-average math achievement. Second, 75 percent of the CAI students were Mexican-Americans, who, Coleman (1966) found, had attitudes that were systematically different from those of other ethnic groups. The findings of this study then cannot be generalized, without qualification, to Caucasian or Black students.

Third, only one CAI program was investigated: the Stanford math drill-and-practice program. Other forms of programmed instruction are available, as well as tutorial and dialogue presentations. The drill-and-practice program is generally regarded as one of the simplest forms of CAI. Other, more sophisticated uses of CAI may produce a substantially different set of results.

Fourth, this study used self-report attitude measures. There are other methods of attitude measurement, such as the interview and the behavior-rating methods, neither of which was used. Therefore, these findings cannot be generalized to all forms of attitude measurement, nor can they be generalized from the attitude domain to behavioral referents of these attitudes. In the present study, specific changes in attitudes toward math were found, with some transfer to more general attitudes about self-concept and locus of control. No widespread attitude change was apparent, however, nor was the impact of these specific changes on student behavior revealed.

Implications for Education

The findings of this study have several implications for education and educational research.

First, this CAI program promoted realistic attitudes toward math, an important finding for a low-achieving population that is inclined to set its expectations at an unrealistically high or low level. An educator who values the formation of attitudes that are realistic appraisals of the student's ability in math should consider carefully the feasibility of implementing a CAI program. The unique features of CAI that achieve these results are not yet clearly determined. One may be the feedback the student receives after answering each problem. Another may be the effect of prescribing problems for each student individually on the basis of his past performance. The student may be motivated to continue working on the math problems because they are neither too easy nor too difficult, but pitched at a moderate degree of complexity for him. Further, the problems provide him with objective information on which to base his attitudes toward math.

Second, CAI may be an efficient and effective form of remedial instruction. Not only does CAI facilitate realistic student attitudes, but it reduces fear of failure by individualizing the content and pace of instruction. The student's present level of performance in a variety of math problems is quickly located, and he is paced according to his progress on these problems. Previous research (Hess et al., 1970) has suggested that the absence of subjective evaluations is another advantage of CAI over classroom instruction. The computer bases its evaluations strictly on performance, not on the personal characteristics of a student or his social relationship with the teacher.

The cost of a remedial specialist versus the cost of a computer-aided remedial program should be taken into account in determining the relative efficiency of the two methods. The current trend is toward increasing personnel costs and decreasing computer technology costs, but this trend does not imply the eventual elimination of the classroom teacher. CAI is not yet sophisticated enough to be able to handle student questions. Nevertheless, financial cutbacks in education usually mean less money for special programs, such as remedial instruction. If an elementary math or reading CAI program is proved to be an efficient form of remedial instruction, then the need for remedial specialists could be considerably reduced.

Third, there were no across-the-board decreases in student attitudes from pretest to posttest. In other words, students assigned to the CAI program did not experience diminished confidence, less realistic aspiration levels, or even feelings or less control over the environment. This finding contradicts the many articles, usually found in the popular press, reporting the dehumanizing influence of computer technology. Very few of these articles support their claims with hard data. The finding obtained in this study certainly does not support the "dehumanization thesis." On the contrary, overwhelming enthusiasm for the CAI program on the part of beginning as well as second-year participants was observed. They welcomed the change from the classroom routine, were prompt in attendance, and expressed disappointment whenever the computer was "down".

The program designers do add a personal touch by ending each lesson with the statement, "Goodbye, John. Please tear off on the dotted line." The students were perfectly aware the machine did not know them personally, but many expressed surprise when, for the first time, it completed the identification process by typing their last name. The computer aide was often asked by new students, "How does it know my name?" This lack of personal encounter between computer and student may well be an advantage, particularly for students who are having difficulty with school tasks. There is no embarrassment in working simple arithmetic problems that are presented by a machine, whereas this can be a humiliating situation when a human teacher is involved. For the sample studied, the advantages of receiving problems from a machine offset any disadvantages resulting from the impersonal nature of the interaction.

There is one final implication for educational research. In this study we found what thousands of others engaged in educational research have found--no differences between the mean scores of the experimental group and the mean scores of the control group on the dependent variables. This is not to say that there were no treatment effects. These effects showed up in the regression analyses, not in simplistic comparisons between means. The implication is that there is no single "best way" of presenting educational treatments. The research on aptitude-treatment interactions (e.g., Cronbach & Snow, 1969), has confirmed the view that one method may effectively promote a desired outcome for some students, but not for others. Educational researchers can materially assist the classroom teacher by investigating many alternative educational approaches and then furnishing the teacher with evidence of their effectiveness for students of varying aptitudes and abilities. The teacher will then be able to implement these methods to meet the needs of individual students. Computer-assisted instruction is one of many alternatives that meet the objective of individualizing the educational program.

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Appendix A

Three Attitude Questionnaires

SELF-RATING INSTRUMENT

Name:______________________________ Grade:______ Sex: Male___ Female___
(Please Print)

Some boys and girls have thought about the things they do and decided that the items on these pages were helpful in thinking about themselves. This is a chance for you to look at yourself and decide what your strong points are and what your weak points are. This is not a test; we expect to have different answers -- so be sure your answers show how you think about yourself. Your answers are private and will be kept in confidence.

Read each item and then answer the question: Compared with other students my age how do I rate now?

Find the line under whatever heading indicates your answer. (The words at the top show what the lines in each column stand for.) Mark an X on that line.

	Excellent	Very good	Better than most	OK	Not so good
1. Being good at sports	____	____	____	____	____
2. Understanding something new	____	____	____	____	____
3. Make friends easily with my own sex	____	____	____	____	____
4. Solving math problems	____	____	____	____	____
5. Having brains to get a good job	____	____	____	____	____
6. Being able to read well	____	____	____	____	____
7. Being a good size and build for my age	____	____	____	____	____
8. Remembering what I've learned	____	____	____	____	____
9. Letting others have their own way sometimes	____	____	____	____	____

	Excellent	Very good	Better than most	OK	Not so good
10. Being interested in math; learning about different kinds of math problems	____	____	____	____	____
11. Having nice clothes	____	____	____	____	____
12. Learning math rapidly	____	____	____	____	____
13. Being good at things that require physical skill	____	____	____	____	____
14. Being a good student	____	____	____	____	____
15. Being a leader--one to get things started with my own sex	____	____	____	____	____
16. Listening to what others are saying	____	____	____	____	____
17. Remembering what I've learned in math	____	____	____	____	____
18. Being interested in science; learning about things that scientists do	____	____	____	____	____
19. Being attractive, good looking	____	____	____	____	____
20. Being a good student in math	____	____	____	____	____
21. Making other people feel good	____	____	____	____	____
22. Being able to do well in math problems	____	____	____	____	____
23. Being active in social activities with my own sex	____	____	____	____	____
24. Writing creative stories and poems	____	____	____	____	____

	Excellent	Very good	Better than most	OK	Not so good
25. Being a good athlete	____	____	____	____	____
26. Knowing how to do math problems	____	____	____	____	____
27. Being about the right height	____	____	____	____	____
28. Enjoying games and sports	____	____	____	____	____
29. Getting along with others	____	____	____	____	____
30. Having plenty of friends among my own sex	____	____	____	____	____
31. Learning more about math	____	____	____	____	____
32. Having good handwriting even when I'm hurried	____	____	____	____	____

MATH CHOICES SCALE

Name:____________________________ Grade:______ Sex: Male___ Female___
(Please Print)

When you have read each sentence, draw a circle around the A or the B, next to the reason you agree with.

For example, look at this sentence: If your parents say you're acting silly, it is because

A of something you did.
or
B they feel cranky.

You should draw a circle around the A or the B. Do that now.

There are no right or wrong answers.

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1. If your grade in math is better than usual, it is because

   A you tried harder.

   B someone helped you.

2. If the math teacher says to you, "Try to do better," it is because

   A he wants you to try harder.

   B your work wasn't as good as usual.

3. If your parents say your math grades are good, it is because

   A your math work is good.

   B your parents are feeling good.

4. If you forget what the math teacher tells you to do, it is because

   A the math teacher didn't say it clearly.

   B you didn't try very hard to remember.

5. When you get a good grade on a math test, it is because

   A you studied for the test.

   B the test was easy.

6. When you can't remember how to solve a math problem, it is because

A the math problem was a bad example.

B you couldn't solve the math problem.

7. If your math is easy to learn, it is because

A you listened carefully.

B the teacher taught it well.

8. When multiplication problems are hard to work, it is because

A the problems were too hard.

B you didn't study the problems enough.

9. If you finish a math problem quickly, it is because

A you worked carefully at the problem.

B the problem wasn't very hard.

10. When your math work is very hard to understand, it is because

A the math teacher didn't give you enough help.

B you didn't listen to what the math teacher said.

11. Good luck is more important than hard work for success.

A agree

B not sure

C disagree

12. Every time I try to get ahead, something or somebody stops me.

A agree

B not sure

C disagree

13. People like me don't have much of a chance to be successful in life.

A agree

B not sure

C disagree

SELF-DESCRIPTION INVENTORY

Name:______________________________ Grade:______ Sex: Male___ Female___
(Please Print)

Please mark each statement in the following way:

If the statement describes how you usually feel, put a check (✓) in the column, "Agree."

If the statment does not describe how you usually feel, put a check (✓) in the column, "Disagree."

There are no right or wrong answers. Please do not spend more than a few seconds on each statement.

	Agree	Disagree
1. I spend a lot of time daydreaming..............	_____	_____
2. I'm pretty sure of myself......................	_____	_____
3. I often wish I were someone else................	_____	_____
4. I'm easy to like...............................	_____	_____
5. I often feel upset in a math class..............	_____	_____
6. My parents and I have a lot of fun together.....	_____	_____
7. I really don't like being a boy (girl)..........	_____	_____
8. I like to be called on in a math class..........	_____	_____
9. I often feel ashamed of myself..................	_____	_____
10. Kids don't pick on me very often................	_____	_____
11. I'm not doing as well in math as I'd like to....	_____	_____
12. I can make up my mind without too much trouble..	_____	_____
13. I am not a lot of fun to be with................	_____	_____
14. I'm as nice looking as most people..............	_____	_____
15. I'm doing the best math work that I can.........	_____	_____

		Agree	Disagree
16.	I'm happy with the way I look..................	_____	_____
17.	I'm often sorry for the things I do............	_____	_____
18.	I'm popular with kids my own age...............	_____	_____
19.	My parents usually consider my feelings.........	_____	_____
20.	I'm proud of my math work......................	_____	_____
21.	I give in very easily..........................	_____	_____
22.	Kids usually follow my ideas...................	_____	_____
23.	I'm pretty happy...............................	_____	_____
24.	My math teacher thinks I'm a good student.......	_____	_____
25.	I usually make up my mind and stick to it.......	_____	_____