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ABSTRACT

The objectives of this study were to develop, implement, and evaluate the year long project, Microcomputer Adaptive Testing High-Risk Urban Students (MATH-R-US). The project produced diagnostic software to meet the following criteria: (1) help students obtain high school mathematics credit needed for graduation; (2) motivate students to learn mathematics; (3) account for erratic student attendance; and (4) use computer adaptive testing as an integral part of the program. The project was used for an entire school year by a class in an urban high school with an at-risk predominantly black population and a high rate of absenteeism. The tests, which accept generative responses rather than multiple choice answers, were administered once a week in the school's computer lab. The results of each test were saved and practice sheets, with answer keys, were generated for the missed objectives. The program was evaluated to improve implementation and furnish descriptive data to the classroom teachers and school administrators. It was found that the program generated intense student competition to see who could get the most hamburger graphics--which appeared on the screen when students completed a test with 100% accuracy--in an hour. Both males and female students expressed positive attitudes about the course components, but female responses reflected more confidence in their own abilities. Computer math test scores indicated a consistent improvement on retesting of a topic, with 23 perfect scores on 43 retests. A discussion of the implications of this study concludes the paper. (2 tables, 22 references) (BBM)

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A Study of Black At-Risk Urban Youth Using Computer Assisted Testing

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Author Notes

This paper is part of the study "CAI and At-Risk Minority Urban High School Students." The full text of the study will soon appear in the Journal of Research on Computing in Education.

A Study of Black At-Risk Urban Youth Using Computer Assisted Testing

Objectives

The objectives of this study were to develop, implement and evaluate the year long project, Microcomputer Adaptive Testing High-Risk Urban Students (MATH-R-US). The project produced diagnostic software to meet the following criteria: (a) help students obtain high school mathematics credit needed for graduation, (b) motivate students to learn mathematics, (c) account for erratic student attendance, and (d) use computer adaptive testing as an integral part of the program.

Theoretical Framework

The theoretical framework of this study was based on the literature concerning: (a) computer adaptive testing of computational skills, (b) assessment as part of instruction, and (c) computer assisted instruction/testing with high risk students. Computer adaptive testing has been recognized as an effective means of assessing student performance of computational skills (Attisha & Yazdani, 1983; Janke & Pilkey, 1985; McDonald, Beal & Ayers, 1987/1988; Signer, 1982; & Travis. 1984). The advantages of computer assisted testing include: (a) flexibility of administration time, (b) efficiency, (c) test security, (d) clerical processing power, and (e) reduction in test construction time (Lippey, 1973; Reckase, 1986; Signer, 1982).

Recommendations support the need for the continual integration of assessment into classroom instruction (Bright, 1988; Bunderson, Inouye & Olsen, 1988; Fisher, Berliner, Filbey, Marliave, Cahen and Dishaw, 1980; & The National Council of Teachers of Mathematics, 1989). Moreover, the use of diagnostic data by teachers has been positively correlated with student achievement (Bright, 1987; Lamon & Bright, 1987).

Evaluation studies of computer use in programs for students in danger of dropping out of high school are few (Polin, 1989). Guerrero and Swan (1988) investigated the efficacy of computer assisted instruction (CAI) with older, at-risk students in New York City. The researchers reported improvement in student attitudes and pride in their work. Johnson & Mihal (1973) found that black elementary students improved their performance with computerized tests. They hypothesized that anxiety increases when tests are administered by individuals representing more advantaged populations.

Project Description

The topics of the MATH-R-US diagnostic programs and accompanying practice sheets are: (a) numeration, (b) whole numbers, (c) fractions, (d) decimals, (e) percent , and (f) measurement. They were written to test every required high school general mathematics objective as described in the city's curriculum guide. The project was used for an entire school year by a class in an urban high school. The school serves an at-risk predominantly black population with a high rate of absenteeism.

The tests accept generative responses, rather than multiple choice answers. If a student's answer is correct, the next objective is tested. If an answer is incorrect, a second question on that objective is presented. If that too is incorrect, than that objective is considered missed. Upon completion of the test, results are shown on a computer monitor, saved on a disk for later retrieval, and reproduced by a printer. Practice sheets, with answer keys, can then generated for the missed objectives.

The diagnostic tests were administered once a week in the school's computer lab. During the other daily class meetings, students worked on the computer generated practice sheets. Students typically would be working on different objectives.

Methods

Evaluation was not conducted to fulfill external funding requirements. Instead, its purpose was to improve implementation and furnish descriptive data to the classroom teacher and school administrators. In this respect, evaluation was applied according to the definition of Stake (1967) which is to describe inputs, processes, and outcomes.

The program's author observed the computer sessions to record both teacher and student suggestions. Recommendations were incorporated into the programs and tested at the next weekly computer class. Weekly computer test results were kept by the teacher. For each student he noted when a test was taken, which objectives were missed, and the objective that was last attempted on the test. The teacher decided which tests to give to each student and whether or not they should be repeated. These records were used to assess the students' achievement in mathematics.

A graduate student attended all the computer sessions to record on and off task behaviors. To ascertain student attitude toward their instruction, an attitude survey was administered at the end of the year. The attitude instrument was based on the Attitude Toward Instructional Setting Survey developed by Suydam (1974). All items are scored on a five point Likert scale (strongly agree, agree, neutral, disagree and strongly disagree).

Data Source

The students were part of a special program in an urban high school serving predominantly black youth. They were targeted as the most at-risk of dropping out before high school graduation. They had a history of high absenteeism and academic setbacks.

Close to thirty students comprised the targeted group. However, the actual group member changed sharply throughout the year because of: (a) erratic attendance, (b) students dropping out of school, (c) students transferring to other schools, and (d) new students being admitted to the class. For this reason, it was not feasible to apply comparative testing procedures.

Results

One finding of the study was intense student generated competition. When students completed a test with 100% accuracy, a graphic of a hamburger appeared on the screen. The students turned this feature into a contest. Upon entering the computer lab, they raced to see who could get the most hamburgers in that hour. Another observation was the absence of off task behaviors. As a result of the student competition for hamburger pictures, students infrequently (less than 5% of observed computer class time) engaged in off task behavior.

An examination of the attitude data was conducted to look for aggregate responses and to determine if there were differences according to gender. Only students who attended at least two consecutive months of classes completed the survey. Fifteen students met this criteria. Although both males and females responded positively to the components surveyed overall, an inspection of the responses disclosed differences by gender. Results showed that the males tended to distribute their responses across the five responses, while the females clustered their responses at the extremes.

Means for each item were computed by gender. In order to compare the means for each statement, many of the survey items were reworded for positive phrasing. Mean scores ranging from 1 to 1.49 were interpreted to denote strongly agree; 1.50 to 2.49 agree; 2.50 to 3.49 undecided; 3.50 to 4.49 disagree; and 4.50 to 5.00 strongly disagree. Attitude survey responses that reflected personal concerns (fear of operating the computer, receiving attention, and opinion of the teacher) were more positive and stronger among the females. This was also true for items that described the classroom environment as conducive to learning. Table 1 contains a list of the attitude statements that were rated differently by the nine males and six females. While both males and females expressed positive attitudes about the course components, it is interesting that the female responses reflected more confidence in one's own abilities.

An observation that occurred with increasing frequency was student insistence that answers were correct, when the computer indicated otherwise. As a result, the students were very eager to prove themselves to their teacher. This observation was surprising since students, especially low achieving students, are not inclined to review examples they are told are incorrectly solved.

Achievement in mathematics was studied by examining student performance on the diagnostic tests during the year. The unstable student population demanded that this assessment look at individual student performance on repeated tests. The data in Table 5 reports test results for students who took the same topic test more than once. Only 17 of 48 students met this criterion. While many other students took several computer tests, they did not attend often enough to have engaged in the same test more than once.

An inspection of the computer math test scores indicated a consistent improvement on retesting of a topic, with a 25% average increase over an earlier test. Of the 43 retests, only 3 did not show an improvement. The 23 perfect scores are noteworthy, in light of the difficulty of many of the test items. Table 2 lists the more difficult objectives for the topic tests.

Educational Implications

This study supports the findings of Becker (1988) and Guerrero and Swan (1988). At-risk high school minority students can profit from computer assisted instruction with increased motivation, self-confidence, and self-discipline. Even though the students were being asked to solve 100% of the topic objectives with 100% accuracy (without guessing), they did not feel that too much work was required for the course.

It is noteworthy that the girls were more definitive and self-assured than the boys. Girls have historically been described as more computer anxious than boys. Nevertheless, unlike the boys, the girls were undivided in their agreement that they were confident they could operate the computer. They viewed the computer as having a positive effect on their learning and expressed a sense of active enjoyment. These results are considerably different from those of Campbell and Perry (1988). Their results found more minority stereotyping of computers as a male domain. The majority of students in the Campbell and Perry study had completed a computer course. In contrast, those in this study were at-risk students who used the computer as a tool rather than as the object of instruction. An explanation of the results of this project raises the possibility that older at-risk, black girls are not as computer anxious as girls have been reported.

The high risk black high school girls in this study seemed to exhibit higher self-confidence toward computers than that found in other studies that examined gender. Recognizing that generalizations from small samples are dangerous, the results of this investigation solely suggest that research is needed to investigate computer and mathematics anxiety of black teenage girls. Specificly, studies should examine the mathematics and computer anxiety of black, at-risk, high school girls, when the computer is used as a tool, rather than as the object of instruction.

Previous research has found a positive correlation of computer access and use with general school achievement (Becker (1987); Blaschke (1986); Gannon (1986); Krulik & Krulik (1987). More recently, the availability of computers in middle- and upper-income homes has exacerbated the school equity/access problem for the black at-risk student. In light of the results of this project and the equity issue, technology affirmative action seems necessary so that low achievers will have more opportunities, rather than fewer, to raise their levels of achievement.

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Table 1

Varying Mean Responses to the Attitude Survey by Gender

ATTITUDE CATEGORY	ATTITUDE STATEMENT	MEAN RATING M	F
Computer Confidence	I was afraid I couldn't operate the computer.	D	SD
Computer Value	I feel the computer was a waste of time.	D	SD
	Using the computer was boring.	U	D
Confidence could do the work.	Too much work was required for this class.	D	SD
	The slow worker didn't have a chance in this class.	U	D
	If a student did not learn in this class, it was his/her own fault.	U	D
Feel Important	Using the computer made me feel that I am important.	U	D
Computer de-personalizes instruction.	No one paid any attention to me when we used the computer.	D	SD
Enjoyed Computer	Time seemed to fly when we used the computers.	U	A

SA = Strongly Agree; A = Agree; U = Undecided; D = Disagree; SD = Strongly

Table 2

Descriptors of Difficult Test Items

TOPIC	OBJECTIVE
Numeration	Estimating the square root to nearest tenth
Fractions	Finding a fractional part in a word problem Adding unlike denominators Subtracting unlike denominators Dividing mixed numbers Solving ratio and proportion problems
Percent	Finding percent when the percent is a decimal Finding percent in a word problem Finding a number when the percent is known Finding percent of discount, given original and sale prices Finding the cost given the percent of discount
Measurement	Doing two-step conversions, within a system Applying knowledge of measurement to word problems