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A study of personalized systems of instruction for the community college student in developmental mathematics

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A Study of Personalized Systems of Instruction for the Community College Student in Developmental Mathematics

by
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ABSTRACT

Debra A. Wimer, A Study of Personalized Systems of Instruction for the Community College Student in Developmental Mathematics, 1997, J. Sooy, Mathematics Education

The purpose of this study was to determine if the Urban Challenge Grant program, a modified "Personalized System of Instruction"(PSI) was more effective and efficient than the traditional lecture method of instruction for community college students testing into the lowest level of developmental mathematics. Students were separated into an experimental group (Urban Challenge Grant program) and a control group (traditional lecture method). Each group was given a New Jersey College Basic Skills Placement Test (NJCBSPT) pre-test. The experimental group, after one semester of instruction, was given the post-NJCBSPT. The control group students were given the post-NJCBSPT after 2 semesters of instruction.

It was hypothesized that students taught using a PSI mode of instruction, would be able to advance more quickly and efficiently if each student was allowed to concentrate on his/her own deficiencies. Unlike the traditional lecture method, a student's pace would not be determined by the instructor.

An analysis of t tests performed on the data suggested that while both the control group and the experimental group had significant mathematical skill gain, the control group's scores showed a significantly higher skill gain

than that of the experimental group. One semester of PSI was not as effective as two semesters of the traditional lecture mode of instruction.

MINI-ABSTRACT

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The purpose of this study was to determine if the Urban Challenge Grant program, a "Personalized System of Instruction"(PSI), was more effective and efficient than the traditional lecture method of instruction for community college students testing into the lowest level of developmental mathematics. While both the control group and the experimental group, had significant mathematical skill gain, the control group's scores showed a significantly higher skill gain than the experimental group.

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Acknowledgments

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CHAPTER 1

Introduction to the Study

Introduction

This chapter describes the background, the statement of the problem and the potential value of the study. It explains what prompted the study and lays the foundation to conduct the study. There are various limitations and terms that may be unfamiliar to the reader which will also be explained in this chapter, thereby providing an overview and foundation for the reader of this paper.

Background

The researcher has been involved in community college developmental and remedial mathematics for 13 years at Atlantic Community College, first working as a tutor and for the last 7 years, teaching mathematics part-time. For the purposes of this study, the researcher has been involved in an innovative project through which the use of computer assesment, Individual Education Plans (IEPs) and Computer Assisted Instruction (CAI) allow the students to progress at their own pace. One of the most important aspects of the program is to help the students to identify goals and to help them to attain a path to achieve those goals.

Most of the students involved in this program are first generation students (their parents never went to college), returning to school for a second chance at gaining an education. Counseling is an integral part of the program because the problems of many of these students go far beyond information acquisition. These problems include developing good study skills and overcoming learning problems, even in the face of difficult life styles, personal problems; and unclear, undefined, possibly unattainable goals.

The Urban Challenge Grant, awarded to Atlantic Community College in the Summer of 1996 for a period of one academic year, provided a means of

addressing these problems, by combining today's techology with sound pedagogical principles.

Literature and research on the subject of technologically-driven, individualized instruction becomes outdated as quickly as the technology on which it is based. With new technological programs and systems being introduced in the market everday, it is necessary to determine how to make choices and how to keep up? Unless technology is based on sound pedagogical principles, it will remain the unintegrated, supplemental solution that it is for many educational systems today.

In a discussion on the advantages and disadvantages of PSI (Personalized Systems of Instruction), the following was written, by a researcher studying Keller's Personalized System of Instruction (Ryan, 1974):

> People involved in the frustrating job of teaching are always looking for something that works. There is a danger that people not as knowledgeable about behavior theory principles as they should be will adopt the method wholesale and proceed to implement the technique's prescription regardless of the situational appropriateness. The eventual result is another heavy-handed, mechanical-educational practice that relentlessly satisfies its own needs rather than those of the students.

Twenty years later, we're still struggling with these same problems and ideas. Technology has not provided us with a miraculous cureall, but it has provided us with the means of assessing students' deficiencies and delivering information in a variety of modes; some quite different from traditional lecturing.

It is the purpose of this paper to explore some of the literature and research on PSI and modified PSI systems and to compare and contrast this information with the results of the Urban Challenge Grant project.

Statement of the Problem

It was the purpose of this study to determine if the Urban Challenge Grant was effective in reducing the long series of developmental mathematics classes required of students testing into the lowest level mathematics course, during the Fall 1996 semester.

Significance of the Problem

The significance of this problem is two-fold. The program addresses the issues of the low retention rates of high risk students and the high cost of financial aid for these students. Under the current lecture-based system, it will take at least 4 semesters (2 academic years) for these students to complete their developmental mathematics courses. If the Urban Challenge Grant and programs like it can effectively reduce the time and number of courses that students have to take by concentrating on each student's specific deficiencies, it will provide institutions with an effective and more efficient means of directly helping and also retaining these students.

Limitations of the Study

The study is limited to developmental students, who test into DEVM101 at Atlantic Community College, a community college located in Southern New Jersey.

Due to time limitations, this study includes only data from the first semester of this year-long pilot project. The first semester of the program concluded December 1996. Also, when studying different methods of instruction, the validity of the data would have been stronger if the same instructor had taught both the experimental and control groups.

Assumption

The New Jersey College Basic Skills Placement Test (NJCBSPT) and the Test of Adult Basic Education (TABE) are appropriate measures of a student's mathematical basic skills competency.

Definition of terms

CAI - Computer Assisted Instruction

IEP - Individual Education Plan

NJCBSPT - New Jersey College Basic Skills Placement Test

PSI - Personalized System of Instruction

Urban Challenge Grant – state-funded grant program

Procedures

An experimental study will be preformed, using the pre and post tests of students in the control group (the traditional, group lecture mode of learning) and the experimental group (students enrolled in the Urban Challenge Grant project). Tests will be done to determine goal achievement, based on the post-test scores of the NJCBSPT.

CHAPTER 2

Review of Related Literature and Research

Introduction

This chapter will explore background literature, current literature and research related to Personalized Systems of Instuction, so that the reader might understand the issues surrounding this project. Other programs using individualized methodologies will be compared and contrasted with the Urban Challenge Grant program implemented for the first time at Atlantic Community College in Fall 1996.

PSI: Personalized System of Instruction

One of the classic self-paced programs, "personalized system of instruction" (PSI) developed by Fred Keller in the late 60's, involved 4 steps:

1. Determine material to be covered
2. Divide into self-contained segments
3. Create Evaluation methods
4. Allow students to move from segment to segment at their own pace (Hergenhan, 1993).

With the advent of computers, in the 80's, systems of instruction are now available, pre-packaged to perform these tasks and others. "How effective these systems have been" and "what level and types of human

intervention are necessary for success", are some of the questions addressed here.

PSI as a Method of Instruction

Most literature discussions about PSI begin by comparing PSI to other methods of instruction and discuss its effectiveness. Miller (1991) breaks methods of instruction down into 3 main categories: discussion, lecture and PSI. It is important for teaching professionals to understand the pros and cons of each method, if instructors are to use PSI and the other methods effectively.

Small group discussion and small group problem-solving are often part of PSI programs. According to Miller (1991), the advantages of discussion include development of critical thinking skills, reasoning, promoting equality and respect for other ways of thinking and other points of view. These are advantages that computer programs normally do not and perhaps are not able to address. The disadvantages of small group work are that it is time-consuming and can be easily viewed as "playtime". In order to avoid this, instructors should have clearly stated outcomes for small group discussions.

Probably the oldest and most widely used method of instruction is lecturing. The greatest advantage of the lecture, is the amount of information which can be covered in a short amount of time and imparted to a large group of people at one time. Other advantages for the instructor include that it is usually a more simple preparation and it is "easier to control the flow

and direction of the class." The greatest disadvantages of the lecture method tend to be lower retention rate of material and keeping up with the pace of the class (Miller, 1991).

There is an undeniable motivational factor often present in lectures, that is not found with computer and video technology. If students could learn on their own from video and computer courses, they are out there and available, why don't more students use them and save themselves time and money, rather than taking remedial/developmental courses?

Most sources suggest that PSI is one of the most effective methods of instruction. This is especially true of the " 'Keller Plan,' (named after its founder, who developed the unconventional method in 1968; also known as Personalized System of Instruction)" (Miller, 1991, p. 8). Students, enrolled in PSI sessions, scored at least as high on final examinations and usually higher than students enrolled in lecture sessions.

According to Miller (1991), the following, are factors which could effect the appearance of success of PSI programs: 1) whether students are self-selected or instructor-selected, 2) grades in PSI can reflect, learning less material or spending more time on task, 3) "typical PSI formats have clearly stressed specified testing objectives and repeated testing for mastery."

In an article on the success of computerized mathematics courses, Deloughry (1996) explains that computerized software has allowed mathematics classes at California Polytechnic State University, to grow from 35 to 55, because now that the instructors don't spend most of their time

lecturing, they can spend more time with each student. The department chairman of California Polytechnic, "... stops short of endorsing larger classes or of suggesting that the software can be used without an instructor." An experimental class run without an instructor failed as students' grades dropped and many students dropped out and did not complete the lessons. The teacher's role changes drastically when moving from lecturing to PSI and according to Keller, the instructor becomes more of a information facilitator or manager (Hergenhan, 1991, p. A28).

"Mathematics has been considered to be an ideal subject for individualized instruction as it is a hierarchically ordered field in which concepts generally build on the foundation provided by prior concepts." (Miller, 1991). Individualized instruction emphasizes self-pacing, skill mastery and can include alternative lesson presentations (i.e. video, audio or small group) to appeal to different learning styles (p. 5).

Most individualized instruction programs have learning style and/or study skills assessments. Since there are alternative methods of learning the same material, these assessments help the instructor to determine which technology to assign in an Individual Education Plan (IEP), based on the student's preferred learning style or his current level of study skills.

Related Research

As the information age explodes around us and more information

becomes finger-tip accessible through the internet, with computers being programmed to do more and more tasks for us, the face of learning and education has begun to change and will continue to. Part of this change will involve the ability to individually assess students' educational deficiencies, address those deficiencies and continuously retest to see that the deficiencies have been corrected. Large computerized systems have been developed to perform these tasks. These systems also include management components which track the students and move them from level to level as they satisfy the specified mastery scores.

The Computer Pilot Program was a project that examined 15 integrated learning systems (ILS) with the goal of influencing the attitudes, attendance and performance of students who were at-risk of academic failure in New York City high schools. Evaluators of the program said, "We were particularly impressed by how often and how emphatically students told us they thought the best thing about using computers was that it gave them more control over their own learning" (Swan, 1993, p. 3).

The research done on this project concerned student-teacher interaction. In conclusion, Swan and Mitrani (1993) write, "...we believe that a partnership is developing among the computer, the teacher, and the student in computer-based classrooms." They don't see computers as replacing teachers. "In such classrooms, the computer takes care of assessment, management, and the delivery of content materials. The teacher is responsible for guiding student learning and meeting complex individual or

pedagogical needs. The student is responsible for his or her own learning" (p. 11).

In researching the background on previous studies done, the study that most closely resembled the Atlantic Community College's Urban Challenge Grant, was a project done by Cumberland Campus of Nova Scotia Community College during a literacy project. The similarities between the two programs include the setting, the educational level of the students and the computerized system that was used. The most apparent difference between the two studies, are the goals of the programs. While the literacy project was industry and community-based, the goal of the Urban Challenge Grant students was to complete the first level of developmental courses at Atlantic Community College and retest into a higher level course at the end of the program (Moore, 1993).

The Integrated Learning System that both projects used is Josten's (Invest) program. The reasons that Nova Scotia Community College give for choosing this system, is that, "Many computer programs identify with and deliver to the kinaesthetic and visual learner, but few deliver to the auditory learner. The Jostens program was selected because it would identify with all of the learning styles including auditory learners." One of the goals of the eleven-week project was to compare the gains made by students using the Josten's program and the gains made by students in the traditional classroom setting (Moore, 1993, p. 4).

An Attitudes to Learning Survey was administered to measure student

attitudes about themselves, learning and computer-based instruction. Also, two standardized measures of achievement, the Canadian Adult Ability Test (Level C) CAAT and the Test of Adult Basic Education (Level D) TABE were administered. Using the Josten's system, "students were retrieving lessons and working in twelve different areas" (Moore, 1993, p. 4).

"Standardized testing revealed that positive gains were made in all areas of reading and math" (p. 4). In agreement with much of the other literature on this subject, the most significant gains were made in math. The gains were greater than those of traditional teaching. Moore (1993) states that "gains for more than one and one half years were realized in an eleven week period" (p. 4).

Some highlights of the program are:

1. Attendance remain high at 93%,
2. 73% of the students thought that the Pilot Project should be longer than 11 weeks,
3. 80% felt that they were more highly motivated learners as a result of the program,
4. 73% felt that they were both better and more confident learners,
5. 66% felt the computer program was better than regular classroom learning,
6. 80% indicated that there should have been more time spent with the instructor (Moore, 1993, p.6).

The major advantage of working with systems of this type is that the programs allow "the instructor to pinpoint areas of relative weakness, and to

assign lessons specifically to overcome that weakness." Moore (1993) advises that the instructor should be in the lab to help with instruction and not have to spend a lot of time managing the system. The instructor should receive intensive training on the system before beginning instruction.

In conclusion, Moore expressed that there were many positive features of the Josten's program, "... if used appropriately, [it] would lead to a constructive and successful adjunct to the teaching of adults." At the time that this article was written, Nova Scotia Community College was still using the Josten's program "in conjunction with the traditional teaching style."

PSI programs are another method of presenting material to students. In our efforts to educate students, it is a method worth exploring. Some believe that it is the best method, perhaps to the exclusion of all others. Other educators believe that it has a place within our educational system and that as technology develops better software programs and better whole systems of delivery and management of information, perhaps its niche in education will become clearer and the advantages and shortcomings of PSI will be better understood.

CHAPTER 3

Procedures

Introduction

The purpose of this study is to determine the effectiveness of the Urban Challenge Grant Project, by comparing the NJCBSPT post-test scores of an experimental group of Atlantic Community College (ACC) students with ACC students enrolled in the traditional lecture-based sections of this same level of mathematics.

All students enrolled in mathematics courses at ACC, take the NJCBSPT to ensure placement into the appropriate course. At the end of the second semester of developmental courses, students are given a post-test version of the computational section of the NJCBSPT. There is also an algebraic section which is given to students at the end of their fourth and last semester of the developmental courses.

The Urban Challenge Grant was piloted to address the problem of the lengthy and costly series of developmental classes at ACC, a "2-year" institution. During the Summer and Fall of 1996, 405 students (42.9% of 943 students tested that semester) tested into DEVM051, ACC's lowest level mathematics course. Most students, entering at this level, must take developmental mathematics for 4 semesters, or 2 academic years, before they are able to take their first college-level mathematics course, a requirement for almost all associate degrees and a pre-requisite for many science courses.

Statistical Measures

The Urban Challenge Grant was piloted, with the idea that if ACC can deliver a more individualized program addressing only the areas of an individual student's weaknesses, through the use of computers and PSI programs, the student might be able to progress more quickly and efficiently through the developmental topics. The effectiveness of the program was measured by looking at statistical measures of the difference between the post scores of the two groups of students on the NJCBSPT.

Recruitment for the Urban Challenge Grant program, involved targeting students who tested into both the lowest levels of reading/writing and the lowest level mathematics. Then, most of the recruitment was done via telephone, asking students to change from the traditional mode of learning over to the program and explaining the possible advantages.

The students were also given a TABE test that placed them on the Josten's Invest software at the appropriate level. Students had a lab component built into their schedule and also classroom time, in which they worked with the teacher in small groups, one-on-one with a tutor or by themselves. At the end of the 16-week semester, they took the NJCBSPT post-test, the same test that students in the traditional DBVM052 courses take. The goal was for students to be able to cover two semesters of developmental mathematics in one semester. The post-test scores of the experimental group and the control group (traditional group) were tested to determine how effective the program was in achieving that goal.

Two statistical tests were performed on two samples, using a cluster sampling technique. The cluster from which the samples were chosen were Fall 1996 DEVM052 classes. The control group consisted of students enrolled in these classes. The experimental group consisted of students enrolled in the Urban Challenge Grant Program, a modified individualized instruction program. Both groups were self-selected. Students in either the control group or the experimental group, have exactly the same qualifications and could have randomly been in either of the groups. Students in the experimental and control groups were matched student by student according to their scores on the college basic skills placement test and according to age group. There were 20 students in each group.

The first test, a t-test for dependent samples, was performed to determine if each method individually, was significant for teaching the program objectives. Each group took both a pre- and a post-test form of the college basic skills placement test. Then pre- and post-test scores were compared to measure skill gain.

H_0: NJCBSPT post-test scores are not significantly higher than pre-test scores.

post-tests $\leq$ pre-tests

H_1: post-tests > pre-tests

The second test was a t-test for independent samples to measure significant differences in skill gain between the experimental group and the control group. This test was used to determine if one semester of the intervention techniques used in the Urban Challenge Grant program were as effective as two semesters of the traditional method of instruction as measured by the post-NJCBSPT.

H_o: The post-tests of the experimental group will be equal to or higher than the post-tests of the control group.
experimental post-tests ≥ control post-tests

H_1: experimental post-tests <control post-tests.

CHAPTER 4

Analysis of Data

Introduction

It is the purpose of this study to determine if the Urban Challenge Grant Program is effective in reducing the long series of developmental math classes required of students testing into the lowest level math course at Atlantic Community College, during the Fall '96 semester. This was determined by comparing pre- and post-test scores of students in both the traditional classroom (control group) and the students in the Urban Challenge Grant Program (experimental group).

Data Collection

Table 1 contains the data gathered after the experimental group was matched with control pairs that had homogenous pre-test scores and ages. Table 1 shows the original group sampling. It was not this study's intention to investigate retention rates; however retention rates are an important indication of success. Table 1 shows that exactly 13 students out of each group of 20, completed the semester and took the post-test. Another interesting comparison, is that after removing the 7 students who dropped out from each group, there is little change in the average of the pre-test scores.

Table 1

Pre- and Post-test Scores of the Original Experimental and Control Groups

Experimental Group			Control Group		
Experimental Students	pre	post	Control Students	pre	post
student 20	4	12	student 14	2	*
student 11	5	3	student 11	5	14
student 17	5	*	student 17	5	23
student 2	5	10	student 10	6	27
student 18	5	*	student 2	7	*
student 10	6	*	student 15	7	29
student 4	6	*	student 8	7	18
student 15	7	*	student 12	7	*
student 9	7	8	student 3	7	25
student 16	7	19	student 20	8	24
student 8	9	11	student 9	8	*
student 12	9	*	student 7	8	*
student 1	9	11	student 16	9	28
student 6	9	*	student 1	9	*
student 19	10	12	student 6	10	24
student 3	11	15	student 18	11	*
student 7	11	15	student 19	11	24
student 13	11	13	student 13	11	21
student 14	12	15	student 5	11	20
student 5	13	24	student 4	14	24
avg. score	8.05	8.4		8.15	14.95

* student did not take post-test

Table 2 shows the average pre- and post-test scores of the thirteen students, who completed the course and took the post-test.

Table 2

Pre- and Post-test Scores for Students Completing the Post-test

Experimental Group			Control Group		
Student	pre	post	Student	pre	post
student 20	4	12	student 11	5	14
student 2	5	10	student 17	5	23
student 11	5	3	student 10	6	27
student 9	7	8	student 3	7	25
student 16	7	19	student 8	7	18
student 1	9	11	student 15	7	29
student 8	9	11	student 20	8	24
student 19	10	12	student 16	9	26
student 3	11	15	student 6	10	24
student 7	11	15	student 5	11	20
student 13	11	13	student 13	11	21
student 14	12	15	student 19	11	24
student 5	13	24	student 4	14	24
avg.	8.769	12.92		8.539	23

Table 3 shows the results of a one sample, paired t test that was performed on each group, separately, to compare the pre- and post-test scores of both groups. The results of the experimental group's paired t test are found in Table 3. The results of the control group's paired t test are found in Table 4. Both methods of instruction were found to have significant skill gain.

Table 3

Dependent *t* Test Pre- and Post-test Scores
for the Experimental Group

Experimental Students	pre	post	diff	d^2
student 1	9	11	2	4
student 2	5	10	5	25
student 3	11	15	4	16
student 5	13	24	11	121
student 7	11	15	4	16
student 8	9	11	2	4
student 9	7	8	1	1
student 11	5	3	- 2	4
student 13	11	13	2	4
student 14	12	15	3	9
student 16	7	19	12	144
student 19	10	12	2	4
student 20	4	12	8	64
sum	114	168	54	416
avg. d	4.154			
t-score	3.747*			

* The *t* test is significant at the .05 level.

The null hypothesis, H_o, is rejected. There is strong reason to conclude that the post-tests were significantly higher than the pre-tests and therefore to conclude that significant skill gain was measured for students enrolled in the Urban Challenge Grant, as measured by the NJCBSPT.

Table 4

Dependent *t* test on the Pre- and Post-test Scores for the Control Group

control students	pre	post	diff.	d^2
student 3	7	25	18	324
student 4	14	24	10	100
student 5	11	20	9	81
student 6	10	24	14	196
student 8	7	18	11	121
student 10	6	27	21	441
student 11	5	14	9	81
student 13	11	21	10	100
student 15	7	29	22	484
student 16	9	26	17	289
student 17	6	23	18	324
student 19	11	24	13	169
student 20	8	24	16	256
sum	111	299	188	2966
avg. d	14.462			
t-score	11.487*			

* The *t* test is significant at the .05 level.

There is strong reason to conclude that the post-tests were significantly higher than the pre-tests and therefore to conclude that significant skill gain was measured for students enrolled in the the regular classroom instruction (the control group), as measured by the NJCBSPT.

The second test, a *t* test for independent samples, was used to compare the effectiveness of the two methods of instruction.

H_0: The post-tests of the experimental group will be equal to or higher than the post-tests of the control group.

experimental post-tests ≥ control post-tests

H_1: experimental post-tests <control post-tests.

Table 5

Results of the Independent *t* test performed on the Post-test Scores of the Experimental and Control Groups

	Experimental Group	Control Group
Average post-test score	12.92	23
n	13	13
s^2	26.07	15.67
d.f. = n1+n2-2	23	
t-score	-5.625*	
test stat.	1.319	

* The *t* test is significant at the .05 level.

Since the computed value, -5.625, is less than 1.319, the null hypothesis, H_0, is rejected. The data does not support the hypothesis that the intervention techniques used in the Urban Challenge Grant program were as effective as the traditional lecture method of instruction as measured by the post-NJCBSPT.

CHAPTER 5

Conclusion

Introduction

This study has attempted to determine if two different instructional delivery modes resulted in significant mathematical skill gain, as measured by the NJCBSPT. The second part of the study was to determine if the experimental grant program, funded by the Urban Challenge Grant and using a system of individualized instruction, could, in one semester, be as effective as two semesters of instruction in the regular college classroom.

Summary of the Findings

The analysis of the data suggests that both the experimental and control groups experienced significant skill gain. It also suggests that after the successful completion of the first semester of a two semester sequence and after enrollment in the second semester of the sequence that the control group tested significantly higher than students enrolled in the Urban Challenge Grant Program. It should be noted that the students in the Urban Challenge Grant Program, the experimental group students, had been enrolled in the program for only one semester of individualized instruction which covered the same content as the two semester course. It was interesting to note that the retention rates of both groups were exactly the same and that both groups went from 20 to 13. The data seems to indicate

that having enough time on task and enrollment in the traditional classroom has been more successful than the individualized instruction given in the Urban Challenge Grant Program. Based on the analysis of the data, the program did not achieve the goal, as stated in the study, during the Fall '96 semester.

Recommendations

Many other aspects of the data must be considered before deciding whether this method needs modification or whether it will be too costly at this point. Perhaps the technology is not yet sophisticated enough. Individualized instruction has been available for several decades. The lecture method of instruction has been a more widely-used method of instruction. To determine whether individualized instruction, even in this setting, is feasible a more extensive study than this one, would have to be done. The study would have to include an investigation of all the components of the program separately, as well as an evaluation of how well the components work together. The following are questions, paraphrased from Best and Kahn's (1993) Research in Education text, as components that should be considered in evaluating a program (italicized):

1. *What are the goals and objectives of the program? And what should they be?* This is particularly important in an individualized instruction program. These goals and a student's Individual Education

Plan (IEP) must be clear to both instructor and student. In a program, such as this, an instructor becomes an information manager and an information facilitator.

2. *What results were intended by the program?* The results examined by this study were not the only objectives of this program. A more extensive study could examine all of the intended objectives and whether those objectives were satisfactorily achieved.

3. *What were the value and usefulness of the methods and means used to achieve the results?* In terms of the Urban Challenge Grant Program and the objectives of this study, this would involve an examination of the software and other teaching materials, as well as an examination of teaching and counseling methods.

4. *How well was the program administered and managed?* This study made no effort to examine any aspect of the administration and management of this program. Since it was a grant-funded program, the feasibility of continuing the program will be determined after the second semester is completed and results, such as the ones in this study, can be examined.

Whether the program should be continued and what should be changed will be determined at the end of the program (p. 114).

Many longitudinal studies could be done and could provide valuable information about the long term effects of the Urban Challenge Grant program. For example, after the program's students enroll in the traditional classroom (and how many do?) what do they see as the advantages and disadvantages of each method? The program is currently in its second semester of an academic year pilot.

Individualized instruction programs, since the days of Keller (Ryan, 1974), have been most effective when the goals are clear. Furthermore the instruction is usually based on modules that relate to the testing process. Individualized instruction is normally taught as a mastery learning program. The main criticism of this method is that it doesn't promote critical thinking and problem-solving skills. It tends to promote rote memorization. The problem of the results of the experimental group may have resulted from a deviation from these principles. It is not the intention of this study to determine why the program results were not as effective as the traditional approach, or even if this is an attainable goal.

There were some confounding variables which had they been corrected, would have given much more validity to the data. The same instructor should have taught both methods of instruction. When the instructor is the confounding variable, many other factors are effected. Were the education levels and credentialing of the instructors, the ability to

motivate students and the individual teaching skills of all instructors, comparable?

Another aspect that should be considered in an individualized instruction program is the effectiveness of computer-assisted-instruction. Is CAI appropriate for developmental students and, if so, at what level does it become effective? For instance, if a student can not read and write well, is a computer a good mode of instruction? A supplemental method of instruction is quite different from the computer as the primary method of instruction.

The Urban Challenge Grant Program had many goals indicated in its documentation. This study focused almost exclusively on the mathematical end and did not evaluate other aspects. Clearly though, the program is an attempt to educate students in a more efficient and effective way and, although it was not the intention of this study to do a program evaluation, the results of this study support a recommendation that a formal program evaluation be conducted that would evaluate all of the goals.

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