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ABSTRACT

In 1985 The Texas Higher Education Coordinating Board (THECB) conducted an extensive investigation of student academic readiness for Texas' institutions of higher education. From the study it was learned that 30% of the students were unable to read, write or compute at desired performance levels. The state's response was the Texas Academic Skills Program (TASP). One important part of TASP is a pre-college enrollment test. According to THECB: "The TASP has become an essential part of quality assurance efforts in Texas higher education. "It guarantees that all students entering public colleges and universities in Texas have an opportunity to develop the academic skills necessary for success" (Boylan, 1997). After many years of research it is commonly accepted under-prepared college bound students face great difficulties in achieving the knowledge and skills needed for mathematics when conventional teaching methods are used. However, it is also widely accepted that conventional methods that are supported with instructional software significantly increases depth of learning while reducing time needed for learning. Yet, a caution is needed. Software that includes integrated text, sound, and computer animation maximizes students' learning. Mayer and Anderson (1991,1992) and Mayer and Sims (1994) clearly showed the value of computer animation and "oral narration" or traditional/conventional methods are most effective when they occur concurrently. This paper will explain how the mathematics performance of College bound students was enhanced by computer assisted instruction (CAI) with conventional instruction. (Author)

ENHANCING THE MATHEMATICS PERFORMANCE OF COLLEGE BOUND STUDENTS COMBINING COMPUTER ANIMATION WITH TEXT AND NARRATION

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Abstract

In 1985 The Texas Higher Education Coordinating Board (THECB) conducted an extensive investigation of student academic readiness for Texas' institutions of higher education. From the study it was learned that 30% of the students were unable to read, write or compute at desired performance levels. The state's response was the Texas Academic Skills Program (TASP). One important part of TASP is a pre-college enrollment test. According to THECB: "*The TASP has become an essential part of quality assurance efforts in Texas higher education. 'It guarantees that all students entering public colleges and universities in Texas have an opportunity to develop the academic skills necessary for success'* (Boylan, 1997)." After many years of research it is commonly accepted under-prepared college bound students face great difficulties in achieving the knowledge and skills needed for mathematics when conventional teaching methods are used. However, it is also widely accepted that conventional methods that are supported with instructional software significantly increases depth of learning while reducing time needed for learning. Yet, a caution is needed. Software that includes integrated text, sound, and computer animation maximizes students' learning. Mayer and Anderson (1991,1992) and Mayer and Sims (1994) clearly showed the value of computer animation and "oral narration" or traditional/conventional methods are most effective when they occur concurrently. This paper will explain how the mathematics performance of College bound students was enhanced by computer assisted instruction (CAI) with conventional instruction.

Introduction:

In 1985 the Texas Higher Education Coordination Board (THECB), appointed an investigative committee to determine the college preparedness of students entering state institutions of higher education. Briefly, the 1986 report alerted the state to a 30% deficit in students' ability to read, write, and/or compute at the levels needed to perform effectively in college. It was the committee' s belief that the lack of these skills, not the lack of students' abilities, was a major hindrance for students' success rates in higher education.

Following the release of the report, THECB adopted the committee's recommendations for a statewide test to determine student readiness for college courses. The state legislature accepted THECB's recommendations and in 1987 sections 51.306 of the Texas education code (Vernon's civil Statues, 1987) was enacted. The Texas legislature developed the Texas academic skills program (TASP) in 1987 as an assessment and academic assistance program for students entering Texas public institutions for higher education.

The Texas Academic skills Program (TASP) has been in place since 1989 and is now the prominent piece in the state's

quality assurance efforts for public higher education. TASP gives all students entering public colleges and universities in Texas an opportunity to identify and strengthen any weaknesses in academic skills before attempting college level course work and by so doing increase the students' likelihood for academic success. Students who fail one or more parts of the TASP test are required, by law, to participate in continuous developmental study or remediation until all sections of the test are passed.

The National Center for Developmental Education (NCDE), under contact to the Texas Higher Education Coordinating Board (THECB) conducted an extensive review of the Texas Academic Skills Program (TASP) from April through September 1996. The results of the NCDE study shows that each year 43.1% of Texas students in public higher education pass the three section of the TASP test. The test measures students' knowledge and skills in reading, mathematics, and writing.

The report further revealed a 53.4% statewide passage rate in mathematics. The remaining 46.6% are required to enroll in developmental courses in mathematics. It takes some of these students one or more years to develop and/or remediate the deficiencies in their mathematical skills. Many of these students

become discouraged by the continuous need to enroll for non-credit mathematics courses. The state's response to this problem was to have each institution design and develop a program of study that would provide efficient and effective alternative teaching/learning methods.

One option, currently used by several universities, is mediated computer instruction. Mediated instruction is fully self contained. That is the application requires the use of text book, provides instant instructional feedback, branches according to the demonstrated need of students, and maintains an extensive database of practice and teaching problems. All of the above is provided in addition to highly useful administrative records. Nonetheless, for all its value, there is value added when the highly interactive and multimedia based software is routinely folded into traditional class rooms that are narration driven.

In describing computer technology as the fourth revolution in education, the Carnegie Commission on Higher Education (1980) elevated the computer to the same status as the invention of the creation of writing, the printing press, and the development of formal schooling. As early as 1969, the Committee on the Undergraduate Program in Mathematics (CUPM) recommended

that the use of computers be incorporated with conventional teaching when and wherever feasible across the Mathematics curriculum. The National Research Council (1989) strongly suggested computer support for introductory courses by saying such courses "Must be taught in the manner that reflects the era in which we live, making full use of computers as an integral tool for instruction and for mathematics. It seems the question is not whether to use computers in mathematics education, but how to increase the use of technology in Mathematics education.

Dual-code theory provides theoretical support of the use of verbal – text - and nonverbal – animation - codes in lesson presentations. Studies performed by Anderson (1991,1992) and Mayer and Sims (1994) confirmed the dual-code theory. Their studies reveal that computer animation and oral narration are most effective when they occur concurrently. In a relatively short period, computer technology has changed the way teaching and learning is done. Studies revealed that computer assisted instruction has raised students achievement in a variety of settings, particularly those involving developmental students: "Sophisticated and independent learners might not need computer help, but for under prepared students and weaker learners

computers might make a real difference" (Kulik & Kulik, 1991). Clearly, computers can help many students, but "they can be of particular use in helping under achievers, specially minority underachievers' (Friedman, 1991; Lawson (1989),). Perhaps the difference is due to some of the following characteristics used to describe computers such as:

- Non threatening
- Infinitely patient
- Able to give immediate feed back.
- Non judgmental
- Tireless
- Able to proceed at student's pace
- Unbiased
- Ubiquitous, and therefore accessible to nearly everyone.

Text and narration v computer animation:

The most accepted method in mathematics education is lecturing: However, lecturing is also widely accepted as the least productive method for teaching. Most mathematicians know that mathematics can not be learned by watching problems being solved. Mathematics is learned when the student actively practices solving problems. Concepts must be understood, but skill learning takes place when the student interacts with the problem in a

concrete way. Therefore, the computer provides an environment in which abstract concepts can be given concreteness through the use of simulation and virtual reality. That is, the computer with its multimedia strengths can give the student virtual manipulative even when such manipulatives would be impractical in the real world.

Hypothesis:

Working from the question "Can a student's competency level be improved by a course that combines individual instruction in an class room as well as computer animated instruction?" The following null hypothesis evolved: Computer assisted instruction with text and oral narration will not enhance the mathematics performance of college bound students.

Method of Analysis:

Two cohorts of college bound students in 2000 and 2001 were used as study participants. Cohort one n=134 (year 2000) and cohort two n=173 (year 2001). Students were enrolled in a pre-college Summer Academy whose curriculum was focused on providing transition to college academic, personal and social

support, knowledge, and skills during an 8-weeks intensive summer program. The academy was open to all incoming TASP responsible first-year students admitted to the University.

The Summer Academy was designed to help program participants remove TASP responsibility by successfully retaking the TASP test in the areas of weakness. Three academic classes were offered: Mathematics, English/Reading, and study skills. This strategy allowed students without TASP responsibility to move directly into college-level course work at the beginning of the fall session.

Mathematics classes were scheduled four days a week for a total of ten (10) hours per week. The ten hours were distributed across a daily time arrangement consisting of one hour and fifteen minutes of teacher led content instruction within a conventional class strategy consisting of text and narration. This instruction was broadened by one hour and fifteen minutes of computer animated instruction further supplemented with human tutoring when needed. Tutors were employed upper class undergraduate students. To facilitate the entire process and to monitor procedures and equipment, classroom teachers were also available. Teachers,

unlike tutors, worked a full instructional day comparable to one worked by public school teachers.

Table A: Description of Student Population

Descriptors	Year 2000	Year 2001
Age	16-19	16-19
Male	39%	40.5%
Female	61%	59.5%
African American	94%	84.4%
Other ethnic group	6%	15.6%

Mathematics :

The primary goal of the mathematics component was to ensure that students had the necessary mathematical preparation for success in college-level mathematics courses, particularly college algebra. A secondary goal was to assist students in mastering the skills to pass the mathematics section of the TASP test.

Students enrolled in the mathematics classes were also enrolled in other classes. The following table displays how that breakdown occurred.

Table B: Number of Students Taking PreTASP and TASP

	YEAR 2000		YEAR 2001	
TEST	**PreTASP**	**TASP**	**PreTASP**	**TASP**
Reading	134	111	122	136
Mathematics	134	111	124	136
Writing	134	111	115	129

The evaluation plan was to assess the effectiveness of the Summer Academy by comparing the pre and Posttest scores in addition to examining the TASP test passage rate. In order to evaluate the level to which TASP scores were raised, analysis were conducted on the following:

1. TASP passing rate in Mathematics.
2. TASP percentile change of scores were examined.
3. TASP change scores within quartiles were examined to determine quartile movement.
4. The following performance criteria were set for quartile movement:
   - Seventy percent of the students who score in the first quartile in PreTASP will advance to the second quartile on the Post TASP.
   - Seventy percent of those who score in the second quartile on PreTASP will advance to the third quartile on the Post TASP.
   - Seventy percent of those who score in the third and fourth quartile in PreTASP will pass the TASP test.

5. Comparison table with graphs were performed to visually examine the result (see figures 1, 2, and 3).

6. Gender Difference in TASP score was observed.

7. Standard deviation and T-test were done to conclude the result .

Table C the TASP profiles the passage rates for all academic sections. The mathematics pass rate was 46% in 2000 and 53.7 % in 2001. This is a significant Improvement for Summer Academy students.

Table C: Student TASP Test Profile

	2000 n = 125		2001 n = 136	
	Number	**Percent**	**Number**	**Percent**
Pass One Section	40	32%	22	16.2%
Pass Two Sections	40	32%	40	29.4%
Pass All (3) Sections	21	17%	31	22.8%
Failed all Sections	24	19%	43	31.6%
Cumulative	125	100%	136	100%
Reading	64	51%	64	47.1%
Mathematics	58	46%	73	53.1%
Writing	62	49%	73	53.7%

In the table D the Pre and Post TASP quartile movement is shown. A careful study of this table will aid in understanding that the quartile movement from pre to Post TASP test is very encouraging. The performance criteria is nearly achieved, which is seventy percent of the quartile movement from each quartile to the next upper quartile.

Table D: Table for Quartile Change in TASP Math Scores

YEAR	2000			2001		
Quartile	Pre test N=134	Posttest N = 111	Quartile movement from pre to Posttest	Pre test N= 124	Posttest N=129	Quartile movement from Pre to Posttest
4th Quartile 76%-100%	2.24% n= 3	4.5% n = 5	4th Q to TASP pass 105% n =3	1.6% n = 2	39.5% n = 51	100%
3rd Quartile 51%-75%	15.67% n= 21	31.5% n= 35	4th Q 31.8% n = 5	12.9% n = 16	56.6% n= 73%	4th Q 91.7% n= 11 3rdQ 8.3% n = 1
2nd Quartile 26%-50%	55.22% n = 74	51.4% n = 57	3rd Q 51.2% n=19	65.3% n=81	3.1% n= 4	4th Q 42% n= 21 3rd Q 56% n = 28
1st Quartile 0%-25%	26.7% n=36	12.6% n = 1`4	2nd Q 67% n = 23	20.2% n = 25	0.8% n= 1	4thQ,15% n = 3 3rd Q 85% n = 17

The TASP Score shows that there is no significant gender difference in performance. Minor but non-significant trends indicate that female students consistently show more improvement from pre to posttest for all components. Female student also showed slightly higher pass rate in reading and writing , but male students showed higher pass rate in Mathematics. The lack of significant gender differences in TASP performance is good in programmatic efforts and can be applied uniformly and need not include different strategies for each gender.

The last table presents the general statistics of pre and post TASP scores for the year 2000 and 2001.The Table-E contains the mean, standard deviation, and the T- test for comparing the improvement of TASP scores in the Summer Academy .

Table E: Table for Statistics

STATISTICS	2000			2001		
	MEAN	STANDARD DEVIATION	T– TEST	MEAN	STANDARD DEVIATION	T- TEST
Pre TASP	37.56	16.86	5.55	35.71	11.89	4.86
TASP	221	13.76		224	18.29	

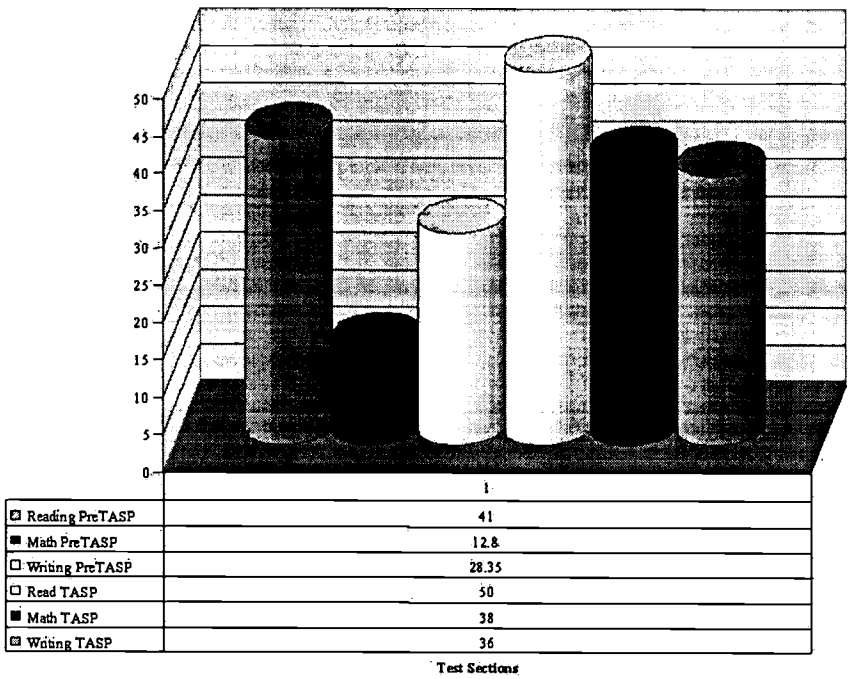
Student " t "Test Analysis for Pre and Posttest of 2000 and 2001 Scores

The result of the pre and posttesting of the Summer Academy students was used to determine if there was improvement between the two independent samples and if so, was the improvement significant. The "t" of 5.55 for 2000 is greater than 2.576 (from T-distribution table) and the "t" 4.86 for 2001 is greater than 2.576 (from T-distribution table). The probability of selecting from two populations with different mean and different standard deviation is within 5%: Therefore, a conclusion is drawn that asserts the significance of the results and causes the rejection of the hypothesis.

Conclusion :

The most significant aspect of Texas Southern University, Summer Academy experience was that it produced considerable gains in TASP performance. Average Percentile movement in Math was37.5%. Further more, analysis of quartile improvement in scores also confirmed substantial gains. The performance goals set were 70% movement from the initial quartile to the next for those in the 1^{st} and 2^{nd} quartiles, Actual improvement exceeded these performance goal for each of the subject areas. The academic preparedness of Summer Academy students must also be taken

into account, The vast majority of students , i.e., from 73% to 95% have score below on one or more sections of their TASP tests. While Summer Academy experience produces admirable gains in TASP scores. The passage rate of the students ,who are not severely handicapped range from 45.5% to 80%.The Summer Academy faculty generally appreciate the effort for the students and for Texas Southern. The advantage of Summer is in giving students a head start on TASP and a head start on the college experience. The result of "t" test is significant. **There fore the null hypothesis that the computer animated instructions with text and oral narration will not enhance the mathematics performance of college bound students is rejected.** Instructions in the remedial classes for under prepared students help to improve their mathematics performance.



Summer Academy 2000

Figure 1: PreTASP and TASP Scores 2000

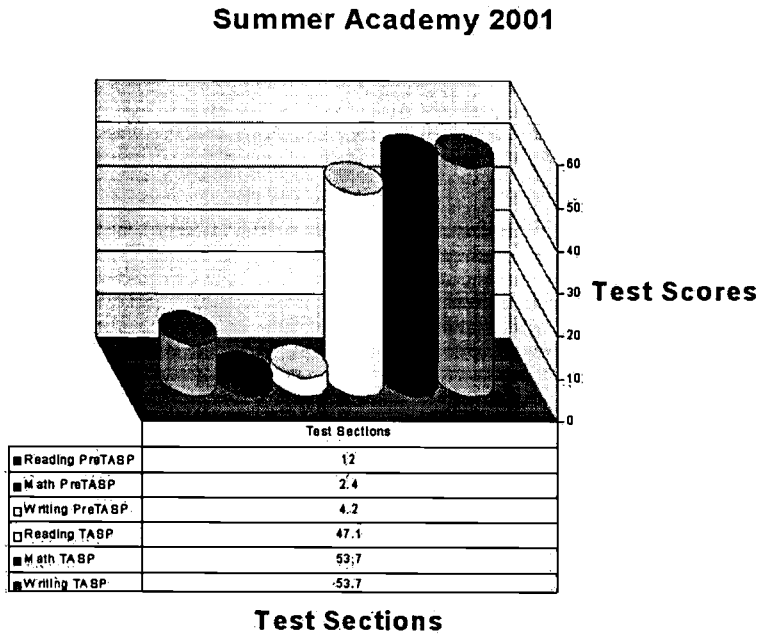


Figure 2: PreTASP and TASP Scores 2001Figure 3: PreTASP and TASP Comparison for Years 2000 and 2001

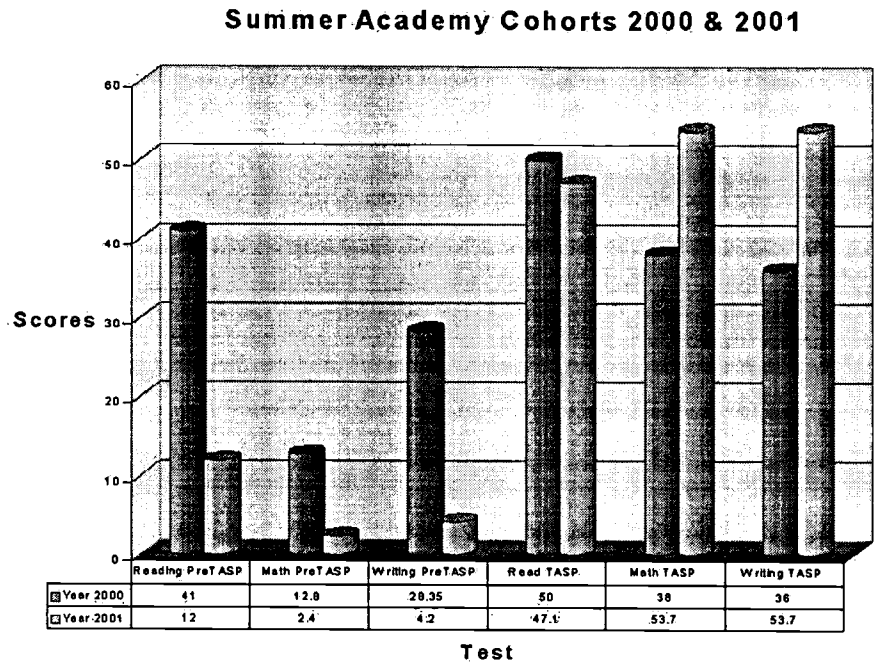


Figure 3: PreTASP and TASP scores for the year 2000 and 2001

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