DOCUMENT RESUME

ED 361 378 TM 020 473

AUTHOR Telese, James A.
TITLE Effects of Alternative Assessment from the Student's View.
SPONS AGENCY Department of Education, Washington, DC.
PUB DATE Apr 93
CONTRACT R117E10152
NOTE 33p.; Paper presented at the Annual Meeting of the American Educational Research Association (Atlanta, GA, April 12-16, 1993).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Age Differences; Analysis of Variance; Class Activities; Cooperative Learning; *Educational Assessment; Educational Change; *Elementary School Students; Elementary Secondary Education; *Mathematics; Nontraditional Education; Racial Differences; Scores; *Secondary School Students; Sex Differences; *Student Attitudes; Student Participation; Teaching Methods
IDENTIFIERS *Alternative Assessment; Repeated Measures Design; Student Surveys

ABSTRACT

Student perceptions of changes in the mode of instruction used by teachers who use alternative assessment techniques and changes in student attitudes and beliefs about mathematics after experiencing alternative assessment were studied. Eighteen teachers surveyed their elementary school and secondary school students three times during the school year to measure attitudes about mathematics and participation in classroom activities. At time 1, there were 387 students, with 384 students at time 2 and 137 students at time 3. An attitude score and traditional and non-traditional classroom activity scores were the dependent variables in a repeated measures analysis of variance (ANOVA). Traditional activities were things such as watching the teacher and textbook problems. Non-traditional activities included working in groups and having students make up their own problems. Gender, ethnicity, and ability were blocking variables in a two-way ANOVA. For attitude, there were significant main effects for teacher, time of observation, and ability. Attitudes improved over the year, as did non-traditional activities. There were significant main effects for all groups except ability. Girls, African Americans, Hispanics, and students in the lower and upper grades reported more involvement in classroom activities than did boys, Anglo Americans, and seventh and eighth graders. Five tables and seven figures illustrate the findings. The student survey is also included. (Contains 16 references.) (SLD)

Effects of Alternative Assessment from the Student's View

James A. Telese
Texas A&M University

Symposium paper presented at the annual meeting of the American Educational Research Association, Atlanta, GA, April 15, 1993.

This work was funded by the United States Department of Education under grant number R117E10152. Any opinions, findings, and conclusions or recommendations expressed in this paper are those of the author and do not necessarily reflect the views of the U. S. Department of Education

Abstract

Teachers administered surveys to their students three times during the school year. The questionnaire contained 10 items related to attitudes about mathematics, and 15 items related to their participation in various classroom activities. An attitude score and two classroom activity scores (Traditional, Non-traditional) were used as dependent variables in repeated measures ANOVAs. The traditional activity score consisted of student ratings on how often they did things such as watching the teacher and doing textbook problems. The non-traditional score was constructed from items such as working in groups and making up their own problems. Two-way ANOVAs were performed on these scores, using gender, ethnicity, and ability as blocking variables. Analyses of attitude scores revealed significant main effects for the teacher ($F = 18.57$, $p < 0.001$), time of observation ($F = 6.85$, $p < 0.001$), and student ability ($F = 16.39$, $p < 0.001$). Attitudes improved over the year; interaction of time with grade level showed that the younger students, 4th-6th graders, had the higher attitude scores, followed by the 9th-11th grade students. Average and high-ability students had higher attitudes than low-ability students. Non-traditional activities increased significantly over the year ($F = 16.48$, $p < 0.001$). There were significant main ($p < 0.01$) effects for all groups except ability. Girls, African-Americans, Hispanics, and students in the lower and upper grades reported significantly more involvement in classroom activities than boys, Anglos, and 7th-8th grade students. Grade by gender interaction showed equally low involvement by 7th-8th grade girls and boys, but higher levels for girls in the other grades.

The affective domain in mathematics education has been studied and reviewed by several researchers including Kulm (1980), Reyes (1984), Schoenfeld (1985), Fenema (1989), and McLeod and Adams (1989). Moreover, various organizations are concerned with the affective domain. Organizations calling for greater emphasis in facilitating improvement of beliefs and attitudes towards mathematics include the National Council for Teachers of Mathematics (NCTM), and the National Research Council (NRC). The NCTM's1989 publication, *Curriculum and Evaluation Standards for School Mathematics*, contained standards which emphasized the need for students to value mathematics and for mathematics educators to enhance student confidence in mathematics. On a wider spectrum, the National Research Council's (1989) publication, *Everybody Counts*, suggested the need to change the general public's beliefs and attitudes about mathematics (McLeod, 1992).

It appears that beliefs and attitudes towards mathematics develop during one's school years and persist throughout adulthood. Adults are willing to accept poor performance in mathematics, and both adults and children proclaim their ignorance of mathematics without embarrassment (McLeod, 1992). Hence, if the affective factors are improved in children, then it is likely that the improvement will persist to adulthood.

The affective domain has been divided into three categories (Schoenfeld, 1992). The first category includes student beliefs about self, about mathematics, about mathematics teaching, and about the social context. The second category includes student attitudes such as a dislike for certain topics, enjoying or dreading problem solving, or a preference for a particular presentation style. The third category includes student emotions which includes feelings of joy or frustration when doing mathematics and aesthetic responses to mathematics (McLeod, 1992). Student beliefs about themselves and mathematics play an important role in developing positive responses to mathematics. These beliefs, attitudes, and emotions encountered while learning mathematics have an impact on positive and negative attitudes to mathematics in general or towards certain aspects of mathematics. Schoenfeld (1985) and Silver (1985) found that students believed that problems could be solved quickly or not at all and that only geniuses could be creative in mathematics. Other beliefs reported by McLeod (1992) included ideas that learning is competitive and mathematics is based on rules. Underhill (1988) reported that student beliefs, within the dimensions of mathematics, as rule oriented, and mathematics is taught by transmitting knowledge to the students. Fenema and Peterson (1985) found connections between one's beliefs and autonomous learning behavior, and the impact of one's beliefs on higher-order thinking in mathematics.

Students may develop their affective beliefs and attitudes through varied social settings or situational experiences (D'Andrade, 1981). The classroom falls into the category of a social setting. Classroom interactions have an integral role in forging students' beliefs and attitudes towards mathematics. Schoenfeld (1992) stated that "students abstract their beliefs about formal mathematics--their sense of the discipline--in large measure from their experiences in the classroom" (p. 359). Similarly, students' behavior, during problem solving, is shaped by their beliefs and attitudes towards mathematics (Schoenfeld, 1992). Moreover, negative beliefs and attitudes weaken students' ability to solve non-routine problems (Schoenfeld,1985; Silver,1985). Also, the limited view that mathematics is basically a skill-oriented subject leads to anxiety about mathematics which interferes with higher-order thinking skills. Therefore, the classroom experiences encountered by students are influential in creating positive or negative consequences within the affective domain.

Classroom Activities

Classroom experiences effect not only the cognitive factors, but also the attitudes, and beliefs about the content. There are various modes of instruction which tend to foster student involvement in mathematics (Farrell & Farmer, 1989). They include such teaching modes as question and answer, discussion, and laboratory/performance (Farrell & Farmer, 1989). At times, they are used separately or in conjunction with each other. Question and answer is a widely used mode of instruction (Farrell & Farmer, 1988). This mode involves the Socratic approach to teaching. The questions posed are designed to initiate higher-order thinking. This provides feedback to the teacher concerning student understanding which can be used to modify instructional goals during instruction. A second method similar to the question and answer mode, the discussion mode incorporates a well planned student to student talk with occasional verbal intervention by the teacher (Farrell & Farmer, 1988). Here, students talk and sort out various aspects of a topic.

The students must use reasoning skills to analyze comments from other students in order to make conclusions or conjectures. The teacher acts as a facilitator, guiding the discussion, providing feedback to individuals or groups of students, giving verbal and nonverbal praise for creativity, thoughtfulness, and efficiency (Farrell & Farmer, 1988). The third mode of instruction is the laboratory/ performance mode. This is a mode which can be useful for both instruction and as a means for gathering assessment information. The students are actively involved in learning while manipulating equipment or materials to collect data. This mode allows students the opportunities to employ higher-order thinking through observation, stating generalizations, and testing conjectures. The laboratory/performance mode is excellent for group activities and group assessment. Students from all skill levels benefit from experiencing hands-on activities (Farrell & Farmer, 1988).

Furthermore, the classroom contains many variables that may affect students' beliefs and attitudes. For example, students may register a positive attitude and belief score on a questionnaire, even though they may dislike mathematics, because they may view the teacher in a favorable light, which can raise the overall attitude and belief score (Kulm, 1980). Likewise, students' attitude and beliefs may be effected because of the strong emphasis placed on testing and grading in the mathematics classroom. Moreover, changes in assessment techniques may produce anxiety in students due to experiencing the shift from customary methods to alternative assessment methods. As indicated, several researchers have examined student affective factors; yet, there are few researchers who have associated alternative assessment in mathematics with student attitudes and beliefs towards mathematics. In order to study the type and extent of impact on students, the following questions were a focus of the investigation:

1. To what extent will students perceive changes in the modes of instruction used by teachers who use alternative assessment techniques?

2. To what extent will there be a change in students' beliefs, and attitudes towards mathematics after experiencing alternative assessment techniques and non-routine questions in the classroom?

Methodology

Participating teachers administered a survey at three intervals during the project, early in the school year, at the middle and toward the end of the school year. The survey consisted of 25 statements (see Appendix) using a five-point Likert scale. Statements 1 - 10 dealt with attitudes and beliefs towards mathematics. To insure validity of the student questionaire, items 1 - 10 parallel the questions dealing with students' perceptions of mathematics administered on the National Assessment of Educational Progress (Dossey, Mullis, Lindquist, & Chambers, 1988). Statements 11 - 25 describe teaching activities. Within questions 1 - 10, statements 1, 3, 4, 5, 6, and 7 were belief items and statements 2, 8, 9, and 10 were attitude items. These questions comprised the attitudes and beliefs category for this study. Statements 11 - 25 were statements concerning "traditional" and "non-traditional" teaching activities which were designed to reflect possible changes in the classroom as a result of alternative assessment and related activities.

The Traditional Teaching Activities (TACT) scale contained items that described the stereotypical mathematics classroom illustrated by Romberg (1992): the teacher lectures, talks about the previous days homework, presents examples of the new content, and provides time for student practice on problems which are from the textbook. The Non-traditional Teaching Activities (NACT) scale includes activities which extend and go beyond the stereotypical approaches such as classroom discussions, students working in cooperative groups, using mathematical games to learn content, doing mathematical projects, and using technology for learning mathematical content. The TACT scale includes items 11, 12, 15, 16, 18, 19, 21, and 25. The NACT scale consists of items 13, 14, 17, 20, 22, 23, 24, and 25. Note that items 15, 18, 21, and 25 are included on both scales, since they can be interpreted as describing types of activities that are relevant to each scale. The teacher's names and schools, along with the number of students who responded to each questionnaire are listed in Table 1.

Table 1

List of participating teachers.

Teacher	Grade/ Course	Number of students at Observation		
		1	2	3
Dorothy Aiken Moody High School Moody, TX	Algebra I	15	13	13

Dorothy Albrecht La Grange High School La Grange, TX	Algebra I	23	23	-
Olivia Allen Langham Creek High School Houston, TX	Algebra I	30	30	19
Ernestine Betchan Rockdale Elementary Rockdale, TX	Fourth Grade	22	21	22
Gloria Bosworth Briargate Elementary Sugar Land, TX	Fourth Grade	19	15	-
Rebecca L. Burghardt Oakwood Middle School College Station, TX	Fifth Grade	25	25	-
Vykye Cox Mission Glen Elementary Houston, TX	Fourth Grade	20	19	-
Beth Douglas Langham Creek High School Houston, TX	Informal Geom.	20	16	15
Deborah Godfrey W.D. Spinger Elem. School Calvert, TX	Fourth Grade	21	22	19
Virginia Heilman Rock Paririe Elementary College Station, TX	Fourth Grade	22	23	-
Frances Herron Langham Creek High School Houston, Tx	Algebra I	26	22	18

Katie Newberg Montgomery High School Montgomery, TX	Geometry	16	21	-
Christine Ogden Allen Academy Bryan, TX	Seventh and Eigth Grade	11	12	12
Barbara Raines Lake Travis Middle School Austin, TX	Sixth Grade	29	33	-
Scott Samuelson Lamar Ninth Grade Campus Bryan, TX	Geometry	33	34	-
Diane Scott Briargate Elementary Sugar Land, TX	Fourth Grade	21	20	-
Carol Skaff Stewart Elementary Huntsville, TX	Fifth Grade	18	19	19
Cyndy Zoch La Grange High School La Grange, TX	Algebra I	16	16	-
Total		387	384	137

During the course of the school year, some teachers had students who entered and withdrew due to schedule changes, leaving the district, new to the district, or any combination of the above. These are possible explanations for the variability among the number of students surveyed by each teacher. Another source of variation in the number surveyed is from absences on the day the survey was administered. The low return rate of the third survey was a result of two factors. One, some teachers administered the second survey relatively late in the year, so they did not administer it a third time, and two, other teachers were caught in a time crisis near the end of the school year and were unable to schedule the third survey.

Data Analysis

Student response sheets were coded by the teacher to protect anonymity. Scores were analyzed using a repeated measures ANOVA, with the time of administration as the independent variable. The attitude score and two classroom activity scores (Traditional, Non-traditional) were used as dependent variables. Two-way ANOVAs were selected for analysis of these scores, using gender, ethnicity, and ability as blocking variables. The responses to items 1, 4, and 6 on the Attitude and Beliefs scale were reversed, due to their negative statement in relation to the Likert scale, then the ten items were added to obtain a single score for each student. A higher value reflects a more positive attitude. Items for the TACT and NACT scales were summed to obtain the two scores related to classroom activities. On these scales, the higher the score, the more often a student perceived the activities taking place.

The total score for the attitude-belief, and the teaching activities scales is determined from the five point Likert system, with each containing ten items for a total of 50. A listing of the means and standard deviations for students' scores on the beliefs and attitude, the TACT, and the NACT scales for each of the three observations are listed in Table 2. Mean scores are also provided by gender, grade level, and ethnicity.

Table 2. Means and Standard Deviations from Student Survey Instrument: Overall, Gender, Grade and Ethnicity

	Series 1		Series 2		Series 3	
	N	Mean	N	Mean	N	Mean
Overall						
Attitude	379	33.09 (5.03)	368	33.73 (4.96)	196	34.31 (4.76)
TACT	374	30.39 (4.48)	363	30.63 (4.01)	190	29.97 (4.30)
NACT	371	34.44 (6.05)	363	36.13 (5.71)	187	36.51 (5.90)
Gender						
Males						
Attitudes	186	33.16 (4.75)	171	34.38 (4.36)	82	34.59 (4.62)
TACT	185	29.96 (4.59)	169	30.34 (3.89)	78	29.92 (4.57)
NACT	184	34.24 (6.33)	169	35.73 (5.41)	78	35.41 (5.37)
Females						
Attitude	188	32.84 (5.32)	180	33.02 (5.44)	97	34.05 (5.41)
TACT	184	30.84 (4.37)	177	30.77 (4.11)	96	30.82 (4.04)
NACT	182	34.67 (5.84)	177	36.33 (5.98)	94	37.31 (6.44)
Grade						
4, 5, 6						
Attitude	199	35.23 (3.86)	194	35.53 (4.31)	118	35.59 (3.96)

TACT	198	29.82 (4.53)	190	30.36 (3.95)	114	29.82 (4.31)
NACT	195	35.16	190	36.43	111	35.57
7, 8						
Attitude	14	29.36 (5.92)	15	29.73 (6.24)	15	27.06 (4.48)
TACT	13	29.77 (4.15)	15	29.40 (3.80)	14	29.21 (4.02)
NACT	13	31.92 (4.86)	15	32.13 (5.50)	14	33.00 (3.23)
9, 10, 11						
Attitude	166	30.63 (5.00)	159	31.89 (4.71)	63	33.63 (4.57)
TACT	163	31.12 (4.36)	158	31.08 (4.06)	62	30.42 (4.36)
NACT	163	33.79 (5.67)	158	36.15 (5.61)	62	39.02 (5.79)
Ethnicity						
African-American						
Attitude	52	33.57 (5.01)	50	33.58 (4.83)	37	35.05 (4.24)
TACT	51	30.84 (4.39)	47	32.28 (3.10)	34	31.76 (3.07)
NACT	51	35.35 (6.13)	47	36.89 (6.14)	34	38.53 (6.10)
Asian						
Attitude	11	32.09 (5.26)	11	33.45 (5.56)	3	33.67 (5.69)
TACT	11	29.00 (4.31)	11	30.54 (4.18)	3	30.00 (4.36)
NACT	11	32.36 (5.73)	11	35.00 (5.04)	3	37.33 (6.81)

Caucasian						
Attitude	256	32.62	242	33.36	106	33.94
		(5.06)		(5.14)		(5.35)
TACT	253	29.97	240	29.96	104	29.23
		(4.32)		(3.91)		(4.64)
NACT	253	33.63	240	35.64	104	35.70
		(5.49)		(5.39)		(5.67)
Hispanic						
Attitude	36	33.08	31	35.32	17	33.82
		(4.77)		(4.13)		(3.91)
TACT	35	30.91	31	30.67	17	31.12
		(4.85)		(4.25)		(4.64)
NACT	35	35.89	31	36.29	17	36.18
		(6.11)		(5.81)		(6.90)

The SAS system was used to perform analyses of variance on the attitude and classroom activity scores. Complete ANOVA tables showing the results of these analyses are in the Appendix. Sources of variation were considered to be the following: teachers, gender, grade level, the time of observation (series), ability, and ethnicity. It was of special interest to determine whether grade, gender, and ethnicity had any effect on student attitudes, and their perceptions of TACT and NACT. The interactions that were analyzed, include: gender-series, grade level-series, series-ethnicity, teacher-series, gender-grade, gender-ability, teacher-gender, and gender-ethnicity. The level of significance was set for an alpha of 0.05.

Analyses of attitude-beleif scores revealed significant main effects for teacher ($F = 18.57$, $p < 0.001$), series ($F = 16.85$, $p < .001$), student ability ($F = 16.39$, $p < 0.001$), and ethnicity

(F = 2.67, $p < 0.05$). Attitudes improved over the year; the interaction with series and grade level showed that the 4th-6th graders had the higher attitude-belief score, followed by 9th-10th graders, and 7th-8th graders whose attitude score decreased during the last half of the year (see Figure 1).

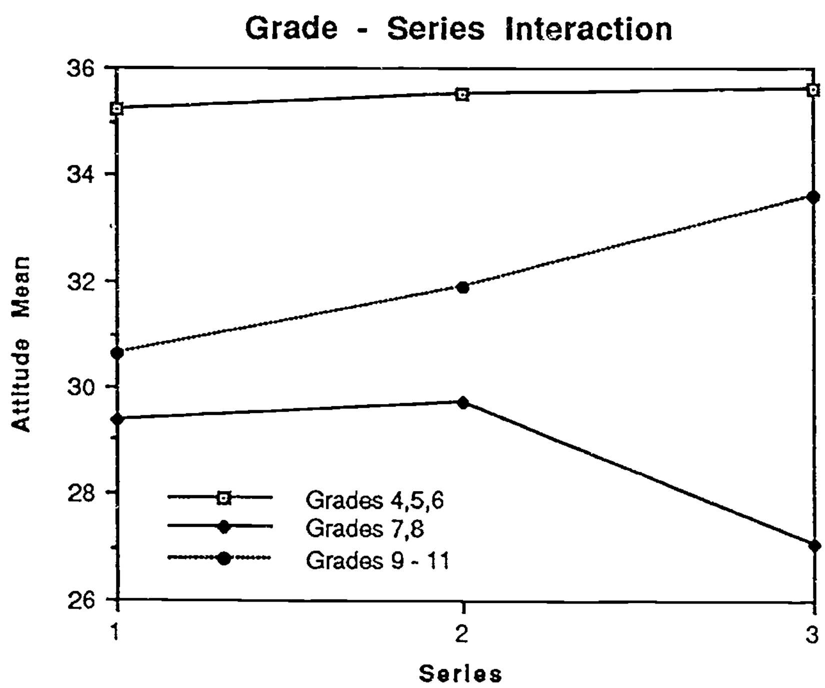

Figure 1. Grade by series interaction for attitudes

Interactions also revealed that 4th to 6th grade students had better attitude-belief score than 9th to 11th graders, with 7th and 8th graders having the lowest attitude-belief score. Asian and African-American girls had better attitudes-beliefs towards mathematics than Asian and African-American boys, while Caucasian boys had better attitudes than Caucasian girls. Hispanic boys' and girls' attitudes were the same (see Figures 2-3).

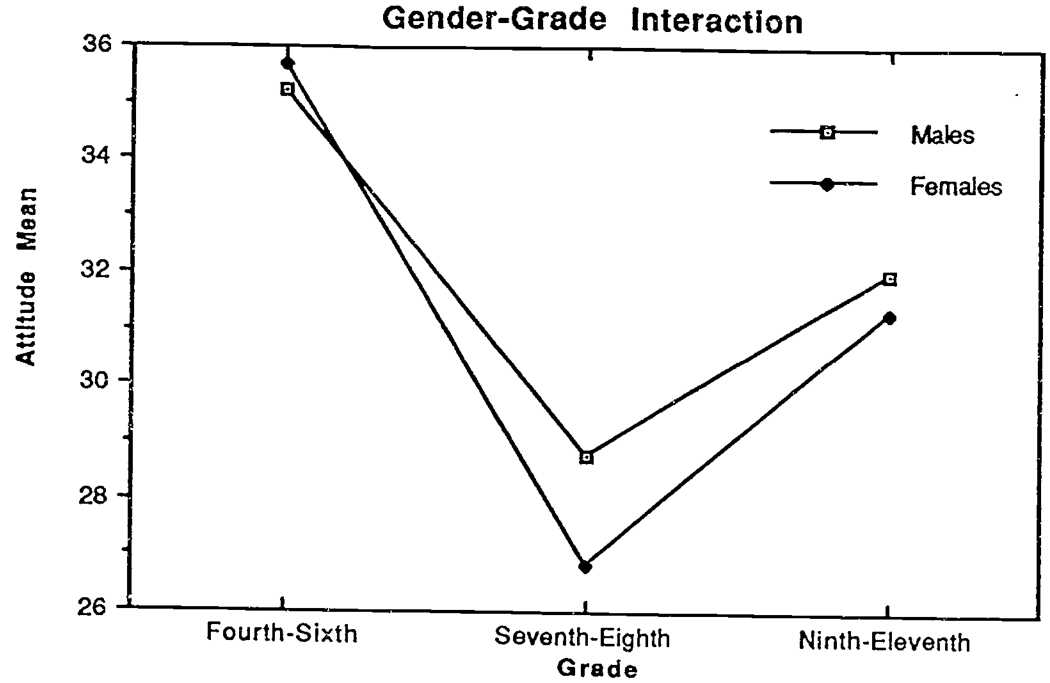

Figure 2. Gender-grade interaction for attitude.

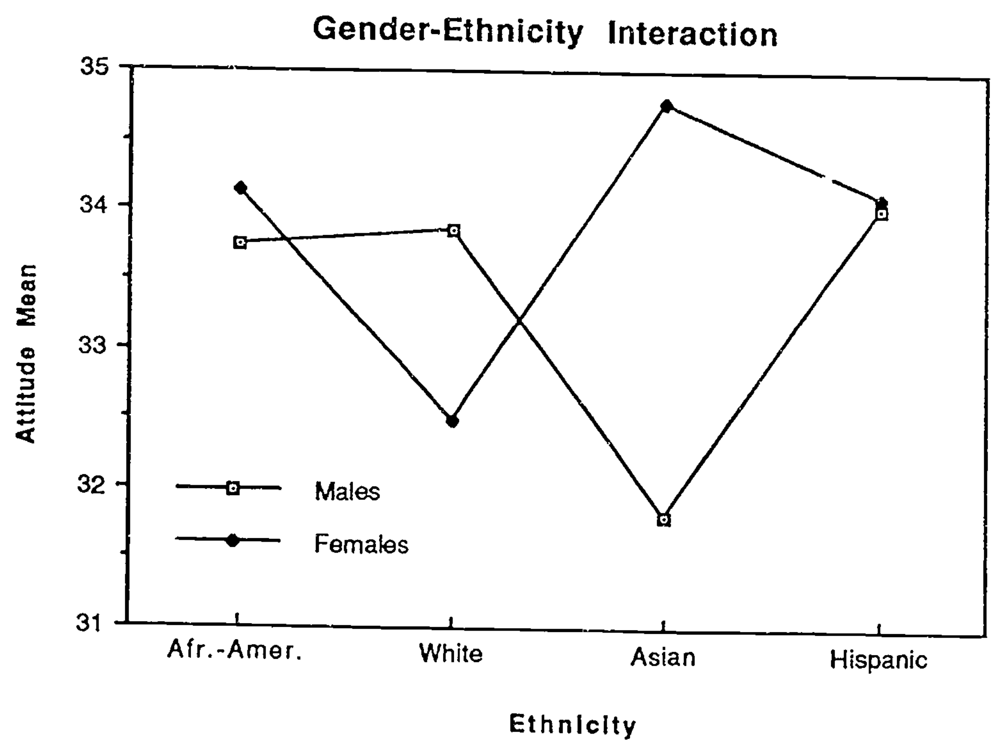

Figure 3. Gender-ethnicity interaction for attitude.

Analyses of traditional activity scores revealed significant main effects for teacher ($F = 10.44$, $p < 0.001$) and gender ($F = 5.24$, $p < .05$). Interactions were found for teacher by series, gender by grade, and gender by ability (see Figures 4 and 5).

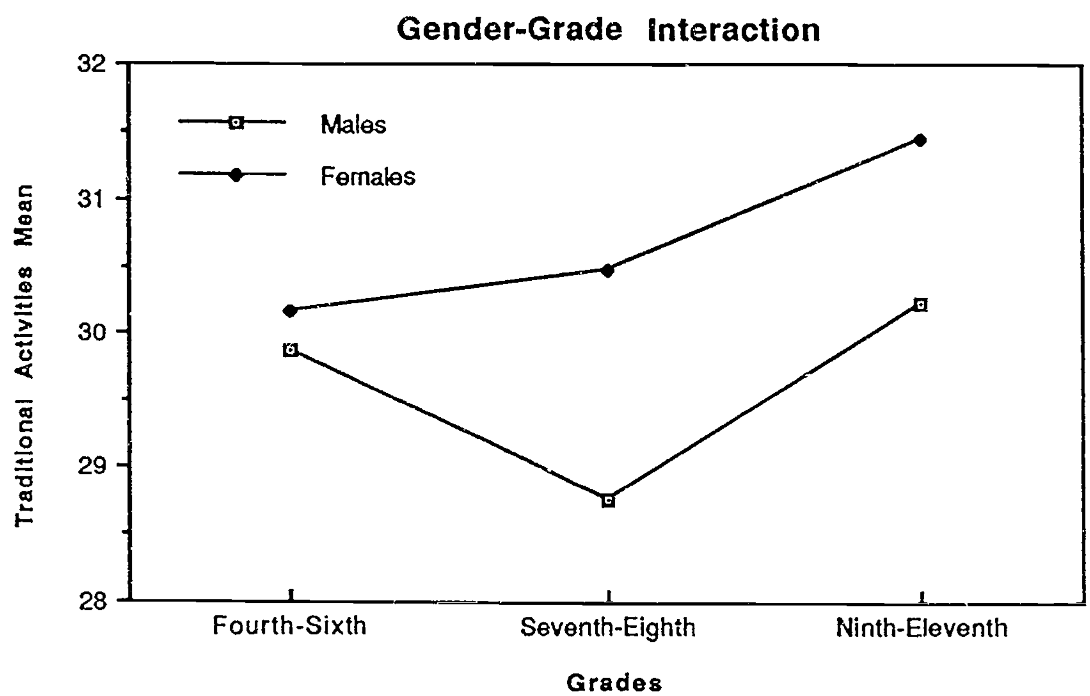

Figure 4. Gender-grade interaction for traditional activities.

Fourth to sixth grade boys and girls reported similar levels of traditional activities, while girls in the middle and upper grades reported more traditional activities than boys. Overall, girls reported more traditional activities. The average ability students reported the higher level of traditional activities, and the higher ability students reported a lower amount of traditional work.

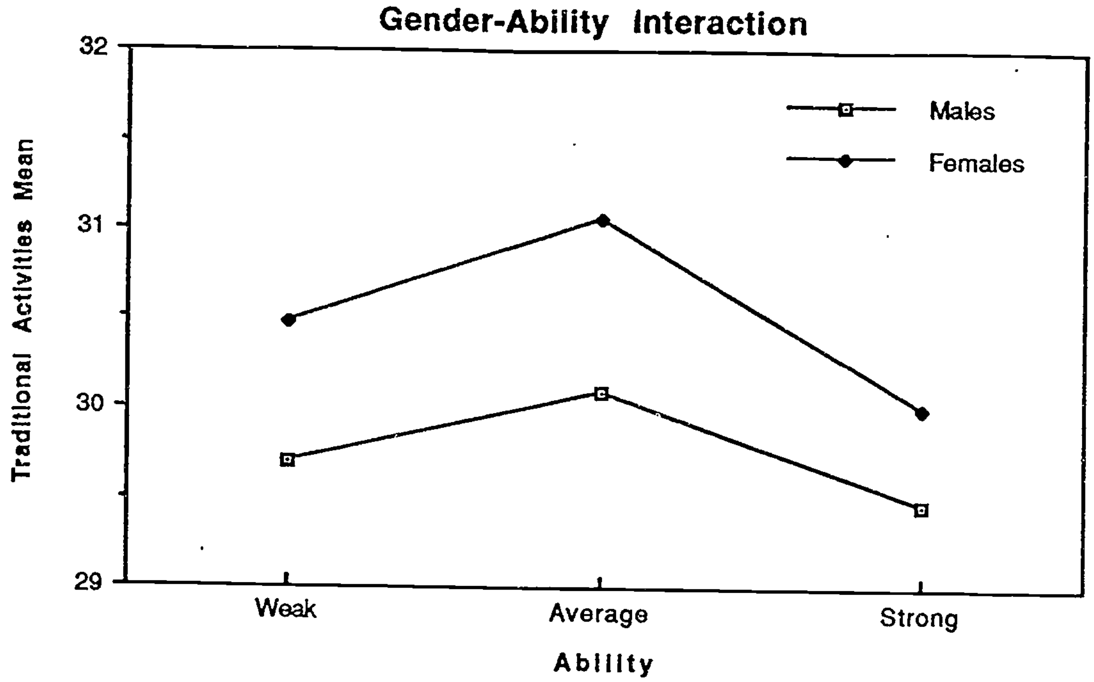

Figure 5. Gender-ability interaction for traditional activities.

Analyses of non-traditional activities indicated significant main effects for all factors except ability: teacher ($F = 5.70$, $p < 0.001$), gender ($F = 7.82$, $p < 0.01$), grade level ($F = 5.88$, $p < 0.05$), series (16.48, $p < 0.001$), and ethnicity ($F = 3.01$, $p < 0.05$). Girls, African-Americans, Hispanics, and students in the lower and upper grades reported significantly more involvement than boys, Anglos, and 7th-8th grade students. Interactions for NACT (F were found for gender by ethnicity and teacher by series (see Figures 6 and 7).

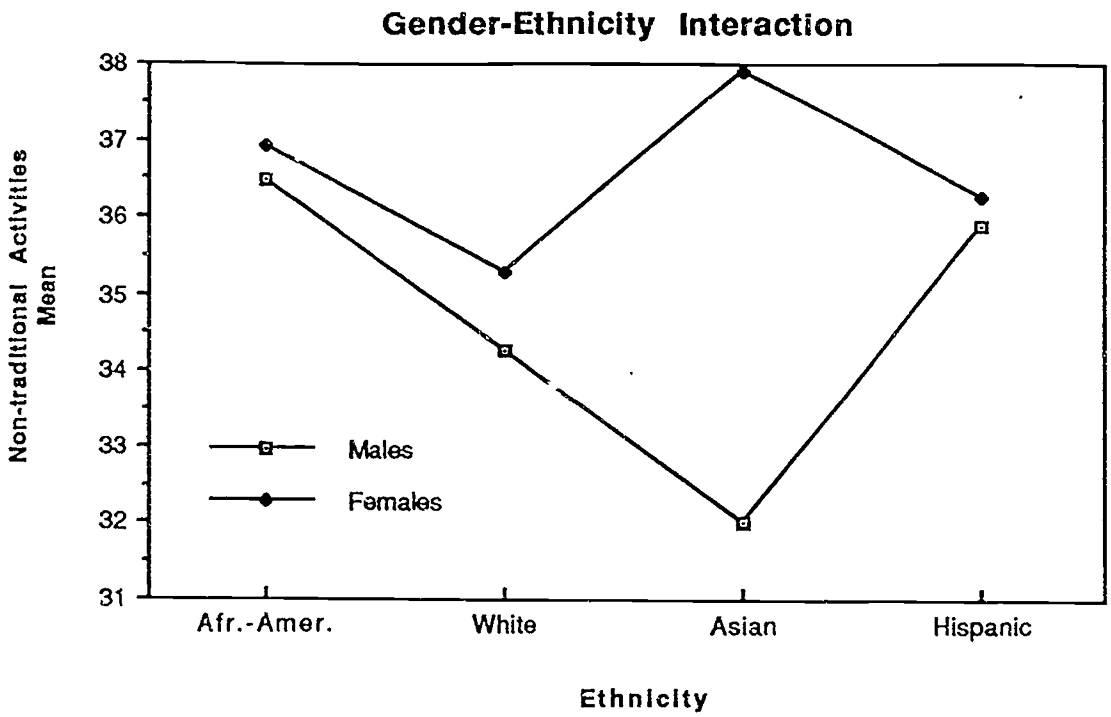

Figure 6 Gender-ethnicity interaction for non-traditional activities.

The teacher-series interaction (see Figure 7) indicated that students perceived changes in their teachers' instructional strategies from traditional activities to non-traditional activities. The interaction is due to these scores increasing and decreasing differently at each observation. Overall, the teachers began the year with more tradtional activites than non-traditional activities as perceived by the students. The students noticed more non-tradtional activities occuring as the school year progressed. For some teachers, there was an increase at each observation. For others, there were decreases, especially at the final observation; this may be due the standardized testing which often occurs near the end of the school year. Every teacher did not improve at the same rate. Students of some teachers saw more change than students of other teachers, for example, students of teacher 1 recorded, at the beginning of the school year, a 31.8, and toward the end of the school year they recorded a 36.9, while the students of teacher 18 perceived very little change from survey one to survey three. These students recorded a 32.3, 33.0, and 33.7 on surveys one, two, and three respectively. This indicates that students are sensitive to changes in teaching behavior, and teachers tend to alter their teaching strategies toward non-tradtional methods when alternative assessment techniques are used to gauge students' mathematical abilties.

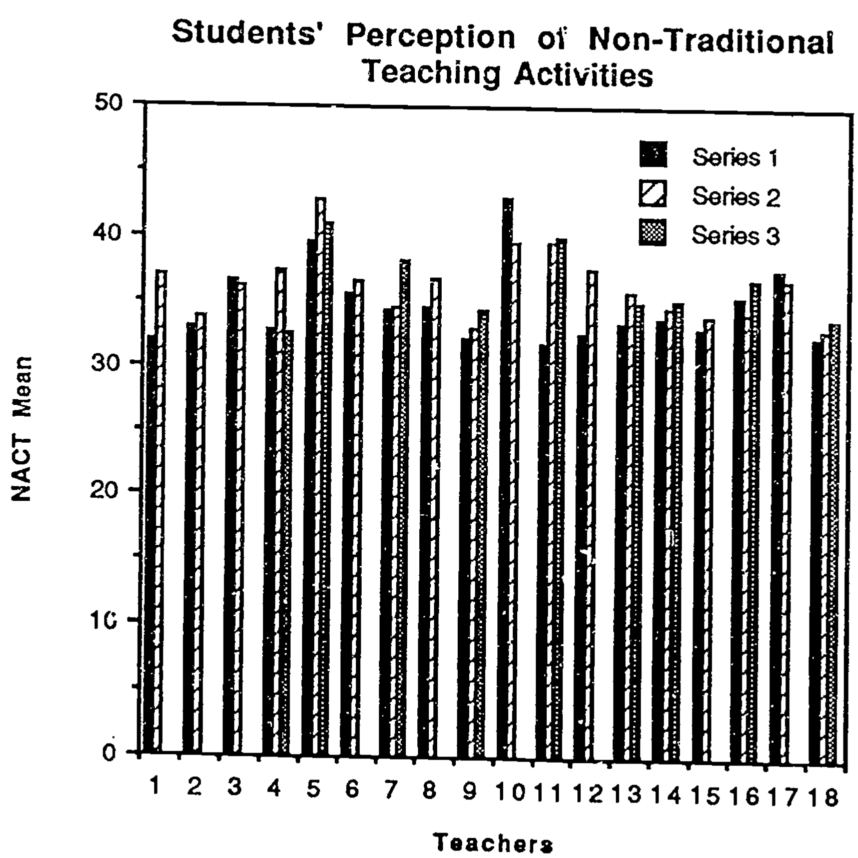

Figure 7 Teacher-series interaction for non-traditional activities.

Discussion

The overall attitude means showed improvements from survey one to survey three. The students indicated that when teachers employed alternative assessment items, aligned with instructional practices, they developed a positive attitude towards mathematics. The students revealed that their teachers used more non-traditional teaching activities than traditional teaching activities which contributed to the overall improvement in their attitudes.

In agreement with other research studies of gender differences in mathematics, it was determined that female students tend to have a poorer attitude towards mathematics than male students. Yet, the female students perceived a greater change in the teaching activities. The female students' mean attitude difference from survey one to survey three was 1.21 points, compared with the male students' mean difference of 1.43 points. Both the female and male students indicated an increase in the non-traditional teaching activities from survey one to survey two, but the female students revealed a greater change than did the male students; the degree of change for the female students was 2.64 points, while the males' degree of change was 1.17. This difference indicated that female students did not view the events in the mathematics classes in the same light as did males. Generally, female students tend to feel ignored, receive less encouragement, and have lower achievement in mathematics. However, since the Innovative Mathematics Assessment Project (IMAP) data showed that the use of non-traditional teaching methods in the classroom occurred, female students perceived greater involvement through non-traditional teaching activities.

Moreover, the female students' attitudes towards mathematics improved. The use of alternative assessment techniques, aligned with instruction, contributed to the involvement of female students and improved their attitudes towards mathematics. Consequently, their enhanced attitudes may generate more interest in mathematics, and may lead to these students choosing mathematics-related careers.

Results for the various grade levels were interesting, in particular, at the high school level. The high school group showed a 5.23 point increase in attitude score from survey one to survey three. This was a surprising finding; it was expected that this group would show a decrease in attitude score, since the high school group, experienced more of the traditional teaching methods, the expectation was that they would resist the change to non-traditional teaching practices. Yet, they showed the greater improvement in attitude score compared to the elementary and middle grade students.

Moreover, students at the elementary level, grades four, five, and six, showed a slight improvement in attitudes and a minor increase in the non-traditional teaching activities. This may be due to the idea that in elementary school, students experience more hands-on activities, group work, and communicate mathematics as part of their normal activities. The seventh and eighth grade classes showed a slight improvement in attitude and in the non-traditional teaching activities from survey one to survey two. The third survey revealed a lower attitude. This may be due to their age and expectations that school is just about finished for the year. This group saw an increase in non-traditional teaching activities. Apparently, the non-traditional activities had little effect on thier attitudes. As a cautionary note, generalizing this finding is restricted because of the small sample size.

Results of the various ethnic groups indicated positive changes in attitudes and they, too, saw more non-traditional activities from survey one to survey three. It is interesting to note that the African-American students maintained a higher attitude score when compared to Asian students, Caucasian students, and Hispanic students. However, the scores are very close. For example, African-Americans students at survey one had a mean attitude score of 33.57, Asian students had a mean score of 32.09, Caucasian students had a score of 32.62, and Hispanic students had a mean of 33.08. This trend occurred at survey three as well: African-American students' attitude mean score was 35.05, Asian students' mean score was 33.67, Caucasian students' mean was 33.94, and Hispanic students' mean was 33.82. Therefore, it appears that using alternative assessment techniques, aligned with instructional practices, improves students' attitudes towards mathematics, regardless of ethnic background or gender.

In summary, the results from the student surveys indicated that when teachers are exposed to alternative assessment techniques, they will align their teaching activities to coincide with the assessment techniques. As a positive consequence of the alignment of instruction with alternative assessment techniques, Students, whether male or female, regardless of ethnic background, developed desirable attitudes towards mathematics instruction.

Also, students tended to become more involved in mathematical discourse when experiencing non-traditional teaching activities. High school students view the teaching changes as more significant than the lower grade level students. An implication of the findings may be that the use of alternative assessment techniques creates a non-threatening atmosphere which may encourage all students to participate and to use higher-order thinking skills in mathematical discourse.

References

D'Andrade, R. G. (1981). The cultural part of cognition. *Cognitive Science*, 5, 179 - 195.

Dossey, J. A., Mullis, I. V. S., Lindquist, M. M., & Chambers, D. L. (1986). *The mathematics report card: Are we measuring up?* (Report No. 17-M-01, pp. 92 - 105). Princeton, NJ: Educational Testing Service.

Farrel, M. A., and Farmer, W. A. (1988). *Secondary mathematics instruction: An integrated approach.* Providence, Rhode Island: Janson Publications, Inc.

Fenema, E. (1989). The study of affect and mathematics: A proposed generic model for research. In D. B. McLeod & V. M. Adams (Eds.), *Affect and mathematical problem solving: A new perspective* (pp. 205 - 216). New York: Springer-Verlag.

Fenema, E. and Peterson, P. (1985). Autonomous learning behavior: A possible explanation of gender related differences in mathematics. In L. C. Wilkinson & C. Marret (Eds.), *Gender influences in classroom interaction* (pp. 17 - 35). Orlando: Academic Press.

Kulm, G. (1980). Research on mathematics attitudes. In R. J. Shumway (Ed.), *Research in mathematics education* (pp. 356-387). Reston, Virginia: National Council of Teachers of Mathematics.

McLeod, D. B. and Adams, V. M. (Eds.). (1989). *Affect and mathematical problem solving: A new perspective.* New York: Springer-Verlag.

McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 575 - 597). New York: Macmillan Publishing Co.

National Council of Teachers of Mathematics, (1989). *Curriculum and evaluation standards for school mathematics.* Reston, Virginia: Author.

National Research Council, (1989). *Everybody counts: A report to the nation on the future of mathematics education.* Washington, D. C. : National Academy Press.

Reyes, L. H. (1984). Affective variables and mathematics education. *Elementary School Journal*, 84, 558 - 581.

Romberg, T. A. (1992). Assessing mathematics competence and achievement. In A. Tom (Ed.), *Toward a new science of educational testing and assessment.* Albany: State University of New York Press.

Schoenfeld, A. H. (1985). *Mathematical problem solving.* Orlando: Academic Press.

Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 334-370). New York: Macmillan Publishing Company.

Silver, E. A. (1985). Research on teaching mathematical problem solving: Some underrepresented themes and needed directions. In E. A. Silver (Ed.), *Teaching and learning mathematical problem solving: Multiple research perspectives* (pp. 247 - 266). Hillsdale, NJ: Lawrence Erlbaum.

Underhill, R. (1989). Mathematics learning beliefs: A review. *Focus on Learning Problems in Mathematics*, 10, 55 -69.

Appendix

Summary ANOVA tables for interactions of the dependent variables: Student Attitude, Traditional Teaching Activities, and Non-traditional Teaching Activities

Table 3

ANOVA for Student Attitude

Source of Variation	Degrees of Freedom	Sum of Squares	F value
Model	90	8014.95	4.97**
Error	753	13494.21	
Total	843	21509.15	
Teacher	16	5325.88	18.57 **
Gender	1	2.42	0.14
Grade Level	1	10.70	0.60
Series	2	245.59	6.85**
Ability	2	587.35	16.39**
Ethnicity	3	143.56	2.67
Gender * Series	2	50.81	1.42
Gender * Grade	2	166.16	4.64**
Gender * Ethnicity	3	170.20	3.17*

*p < 0.05

**p < 0.01

Table 4

ANOVA for Tradtional Teaching Activities

Source of Variation	Degrees of Freedom	Sum of Squares	F value
Model	90	4130.45	3.18**
Error	738	10651.90	
Total	828	14782.34	
Teacher	16	2410.48	10.44**
Gender	1	75.60	5.24*
Grade Level	1	35.20	2.44
Series	2	35.73	1.24
Ability	2	28.94	1.00
Ethnicity	3	54.33	1.25
Gender * Grade	2	163.13	5.65**
Gender * Ability	3	47.20	3.27*

*$p < 0.05$

**$p < 0.01$

Table 5

ANOVA for Non-tradtional Teaching Activities

Source of Variation	Degrees of Freedom	Sum of Squares	F value
Model	90	7031.69	2.81**
Error	738	20528.63	
Total	828	27559.73	
Teacher	16	2537.72	5.70**
Gender	1	217.62	7.82**
Grade Level	1	163.56	5.88*
Series	2	917.11	16.48**
Ability	2	73.20	1.32
Ethnicity	3	251.59	3.01*
Gender * Ethnicity	3	233.64	2.80*

*p < 0.05

**p < 0.01

Texas A&M Innovative Math Assessment Project

STUDENT SURVEY

Student ID______________________ Teacher__________________________

Mark the choice that best describes your feeling or opinion abouteach statement.

	Disagree		Rating		Agree
1. Learning math is mostly memorizing.	1	2	3	4	5
2. Math is interesting.	1	2	3	4	5
3. Guessing is OK to use in solving a math problem.	1	2	3	4	5
4. There is always a rule to follow in solving math problems.	1	2	3	4	5
5. New discoveries are seldom made in math.	1	2	3	4	5
6. Math is mostly about symbols rather than ideas.	1	2	3	4	5
7. In math, knowing why an answer is correct is important.	1	2	3	4	5
8. Math is useful in everyday life.	1	2	3	4	5
9. I would like to have a job that uses math.	1	2	3	4	5
10. Math is fun.	1	2	3	4	5

Mark the choice that best describes **how often you** do each of these things in your math class.

	How Often				
	Never				A Lot
11. Do math problems from the textbook.	1	2	3	4	5
12. Work alone at my desk on math problems.	1	2	3	4	5
13. Use a computer to work on math problems.	1	2	3	4	5
14. Work on math problems with a group of classmates.	1	2	3	4	5
15. Show all of my work on a test or quiz.	1	2	3	4	5
16. Do math practice worksheets.	1	2	3	4	5
17. Play math games.	1	2	3	4	5
18. Have class discussions about math problems.	1	2	3	4	5
19. Watch the teacher work problems on the board.	1	2	3	4	5
20. Do math projects	1	2	3	4	5
21. Take math tests and quizzes.	1	2	3	4	5
22. Talk to the teacher about how I am doing in math.	1	2	3	4	5
23. Make up my own math problems to solve.	1	2	3	4	5
24. Use calculators to solve math problems.	1	2	3	4	5
25. Students explain how they solve math problems.	1	2	3	4	5