Culturally Relevant Word Problems in Second Grade: What are the effects?

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Abstract

In this study researchers investigated the effects of the use culturally relevant word problems on second graders' mathematics achievement. The participating elementary schools were in one of three groups: control, word problems, or culturally relevant word problems. A pre- and post-test design measured the effectiveness of the interventions. The two intervention schools taught problem solving for 15 minutes twice a week. The culturally relevant word problem group used modified problems based upon a home survey while the word problem group used textbook problems. Findings from this study suggest further research investigating the use of culturally relevant problem solving instruction is warranted.

Introduction

"Mathematics educators cannot afford to be isolated from research related to culture and learning and to culturally relevant teaching. Educators need to integrate: students' informal knowledge and their culture and experiences, critical mathematical thinking, and critical approaches to knowledge in general" (Gutstein, Lipman, Hernandez & de los Reyes, 1997, p. 734). Gutstein is correct but the question remains: what are the most effective methods for achieving this type of instruction?

Problem solving is one logical avenue in which mathematics educators can achieve the integration of culture into mathematics instruction that Gutstein mentions. Problem solving has been a focus of mathematics research for decades and considered a foundation of mathematics education (NCTM, 1989, 2000). Extensive evidence supports the premise that problem solving is beneficial to student achievement in mathematics (Carpenter, Ansell, Franke, Fennema, & Weisbeck, 1993; Carpenter, Fennema, & Franke, 1998; Carpenter, Fennema, Franke, Levi, & Empson, 2000). Evidence also indicates that using culturally relevant problem solving instruction can improve student achievement (Brenner, 1998; Likpa & Adams, 2004; Lopez & Sullivan, 1991; Gutstein, et al., 1997; Villasenor & Kepner, 1993). Yet, there remains a need to empirically examine whether culturally relevant instruction affects mathematics achievement for young children.

Research on the use of culturally relevant instruction is relatively limited but vitally necessary given the number of articles existing which promotes its use. While several foundational articles exist supporting the use of culturally relevant problem solving instruction to improve student achievement (Brenner, 1998; Likpa & Adams, 2004; Lopez & Sullivan, 1991; Gutstein, et al., 1997; Villasenor & Kepner, 1993) more is required. There remains a need to empirically examine the effects of culturally relevant mathematics instruction and related achievement targeting students at various grades and mathematical abilities. The authors of this article will discuss such research and findings involving the use of culturally responsive word problems with groups of second grade students in a northern Utah community.

Culturally Relevant Instruction

Studies of culturally relevant instruction employ various methods of infusing culture into mathematics instruction. One study used a native fish rack to teach geometric concepts (Lipka & Adams, 2004). A second study examined the effects of using elements of the African culture in geometry instruction (Moses-Snipes, 2005). Another study used Carpenter's Cognitively Guided

Instruction (1999) and students' Hawaiian culture in problem solving instruction to examine how the combination of both types of instruction affected math achievement of kindergarteners (Brenner, 1998). All of these studies examined a specific culture and related cultural connections with mathematics instruction.

Another approach has been the use of a personalization of in mathematics instruction. In 1991, Lopez and Sullivan found that Hispanic middle school boys performed better when they receive "personalized treatment". For personalized treatment story problems, "referents were replaced with the familiar items students provided in the biographical inventory" (Lopez & Sullivan, 1991, p. 96). Prior to the middle school personalization study, Davis-Dorsey, Ross, & Morrison (1991) examined the effects of rewording and personalizing word problems for second and fifth graders. This study used a biographical questionnaire to acquire personal information about students, which was then incorporated into mathematics problems used in classrooms. Personalization in this study meant changing names and supplementing standard textbook problems with information from student biographical questionnaires.

While studies on the use of culture in mathematics instruction are limited in number, their impact appears sufficiently promising to suggest additional required research. Furthering the idea of how to infuse culture into mathematics instruction, the study looked at more general inclusion of culture in mathematics instruction. Using Asher's definition of culture which included place as an essential component, this study included a various cultures that were found in the participating classrooms. Considering the culture of the students in this study were of a northern Utah community, place played an important role in these children's lives. The main research question asked in this study was: Is there a positive effect on second graders' textbook math test scores when using culturally relevant problems in problem solving instruction?

Ethnomathematics

It is imperative that ethnomathematics is discussed when conducting a study that examines culture and mathematics. “Ethnomathematics is used to express the relationship between culture and mathematics” (D’Ambrosio, 2001, 308). The ethnomathematics connection in this study refers to math as practiced in many American public schools in relation to the use of traditional textbook story problems found in the curriculum. D’Ambrosio (2001) reminds us that “Much of today’s curriculum is so disconnected from the child’s reality that it is impossible for the child to be a full participant in it” (308). The intent of this study was to investigate an approach of how to bring the child’s reality into mathematics instruction which by making this connection between the child and mathematics it is a broad view of ethnomathematics. By not deeply discussing the culture of schools and mathematics instruction, we favored using the term culturally relevant to more clearly illustrate our efforts to suggest ways to improve our instruction in becoming more responsive to our students rather than the use of ethnomathematics.

Definitions

Definition clarification is essential to this study. The literature offers multiple definitions of culture and culturally relevant instruction. Asher (1991) defines culture this way: “What most [definitions of culture] have in common, and what is significant to us, is that in any culture people share a language; a place; traditions; and ways of organizing, interpreting, conceptualizing, and giving meaning to their physical and social worlds” (p. 2). Notably, this definition includes place which helps define a culture, as explained in Haymes’ work on the “pedagogy of place” (1995). Where a person lives influences all aspects of their lives, including their culture. Therefore, for this research, culture is viewed as a group’s or person’s dialect, geographical locale, or views of the world rather than a restricted view that is solely focused on a group's artifacts or a person's ethnicity.

A concise definition for culturally relevant mathematics teaching is provided by Leonard and Guha, who tell us that "culturally relevant teaching embeds student culture into the curriculum to maintain that culture" (2002, p. 114). The researchers further state that "including aspects of students' culture into mathematics problems is one way to avoid the cultural deficit model and help students and teachers value the culture of the community" (Leonard & Guha, 2002, p. 114-5). To understand the impact this type of instruction can have for culturally diverse students, it helps to understand the cultural deficit model, which assumes that school must help low-income students to overcome the deficits that result from their family and community (Banks, 2004). Leonard and Guha's suggestion of including students' culture in mathematics instruction can help to alleviate the effects of deficit views of students' culture. Thus, culturally relevant problem solving is defined as inclusion of the students' culture in mathematical problems by making the context of the problems relevant to the culture of the students.

Design

This study used a pre- and post-test control group design with random assignment of the participating schools to the control group or to one of the two experimental groups. The two treatment schools' teachers taught textbook or culturally relevant word problems for fifteen minutes twice a week for the duration of the four-month study. The control group teachers followed district-adopted texts, which include some word problem instruction integrated with other math concepts. Pre- and post-tests in this study consisted of 10 basic addition and subtraction problems and six textbook word problems for a total of 16 questions. The study started in September and ended in December of 2006.

Participants

Twelve classrooms from two school districts located in Northern Utah participated in this study. The control group, school A, consisted of four classrooms with a total of 49 participants. School B, the word problem group, had 65 participants in four classrooms. There were 29 participants at School C, the culturally relevant word problem group. Overall, there were 143 participants in the study. The three participating schools have some of the largest minority and lower socioeconomic populations in the two school districts. Table 1 demonstrates the demographic breakdowns of each of the participating schools.

Table 1

Summary of Demographic Information for Each School

		A	B	C
Gender	Male	19	38	13
	Female	30	27	16
Socioeconomic Status	Free	9	22	17
	Reduced	10	12	4
Ethnicity	Caucasian	40	48	13
	Non-Caucasian	9	17	16

Instrumentation Development

There were several different aspects of instrumentation development for this study. An analysis the textbook word problems to determine if they were culturally relevant to the participants in this study was a cornerstone of this study. Work on developing the home survey and culturally relevant word problem guide were critical in this study. An instructional recording sheet and the pre- and –post tests were the last two instruments that were developed for this study.

Word Problem Analysis

The analysis of the cultural relevance of the word problems in the textbook followed the guidelines set forth by Coldman, Braun, and Gallagher (1988) in their study on the classification of ethnic status using name information. Coldman, et al. suggest using a large established database as a comparison for the classification of names.

The purpose of this analysis was to determine if the names used in the textbook word problems were representative of the sample population in this study. An analysis of the male and female names used in the textbook word problems resulted in equal numbers of each gender, which indicated no gender bias in the word problems. We found that 79% of the names in the textbook word problems appeared on the list of top 100 names since 1960, as determined by the Social Security Administration (SSA, 2007). We then compared the participating students' names with those found in the textbook word problems as well as in the Social Security top 100 name list. The comparison revealed that only 7% of the participants' names were found in the textbook problems; furthermore, that same 7% was also found on the Social Security top 100 name list. Using Coldman, et al.'s guidelines, the size and volume of the Social Security Administration name database was sufficient to draw conclusions about the name analysis done for this study. Therefore, we concluded that the names used in the textbook word problems were not representative of the sample population.

Home Survey

The home survey was adapted from a field-tested survey (Ross, Anand, & Morrison, 1988; Lopez & Sullivan, 1991; Davis-Dorsey, et al., 1991; Davis-Dorsey, 1989). The home survey was field-tested in a pilot study. Simple modifications of the pilot study home survey were made in order to elicit more information from the families. A Spanish home survey was created to meet the needs of the Spanish speaking families in the sample population. The sole purpose of the home survey was to collect information about the students in order to create word problem situations rather than for measurement purposes or assessment.

Culturally Relevant Problem Revision Guide

A revision guide was developed to assist teachers as they changed textbook word problems to make them more culturally relevant. Asher's definition of culture (1991) and results from the home survey served as the basis for the development of the revision guide. We met with the teachers to revise textbook word problems and used the guide to make the problems culturally relevant for each class in the culturally relevant word problem treatment group.

The cultural dimensions listed on the revision guide were: 1) names of students in class; 2) local settings (parks, stores, etc.); 3) games, activities, sports, or hobbies of students; 4) food or restaurants particular to the students; 5) names of family members or pets; and 6) special celebrations of the students and their families. We encouraged the teachers to change every possible dimension in the word problems to make them reflect students' culture. For example, one textbook problem stated, "Judy has 6 marbles. Billy gave her 6 more marbles. How many marbles does Judy have now?" The teacher replaced the word problem names with those of several of her students. Additionally, the teacher changed "marbles" into "toy cars" an item listed on a student's home survey. The edited culturally relevant word problem read, "Mason has 6 toy cars. Braden, his brother, gave him 6 more toy cars. How many toy cars does Mason have now?" By changing the names and the item used in the word problem to reflect the students' culture, this teacher created a word problem which met the suggestions set forth in the revision guide.

Instructional Recording Sheet

Teachers in both treatment groups used a recording sheet to track problem solving instruction that occurred in their classes. Teachers recorded the date, time, number of questions used in their problem solving instruction, and any additional comments. The recording sheet not only allowed us to ensure the integrity of the intervention but also understand what the teachers' thoughts were on the implementation of the problem solving intervention.

Pre- and Post-Test

The pre- and post-test was a combination of 10 addition and subtraction algorithm problems and six problem solving problems taken from the math textbooks used by the districts. Algorithms and word problems varied in procedural difficulty. The problems ranged from basic math facts to double-digit algorithms with no regrouping. Two of the word problems included numbers from the algorithms in the computation section of the test. The pre- and post-tests were based on the textbook assessments because that is what the districts used as assessment throughout the school year. It should be noted that the textbook assessments have not been validated as effective tests or measures. The pre-test was given in September and the post-test was given in December. Using the textbook assessment materials as the basis for the pre- and post-test allowed us to align the assessments with the current district assessments and decrease the disruption of instruction in the classroom. Due to the fact that students received four months of mathematics instruction between the two testing dates, we used parallel forms of the pre- and post-tests to account for testing effect. The tests used the same algorithm types, but the post-test used slightly larger numbers than the pre-test.

Procedures

The following explains the procedures for implementation for each of the three participating schools. There is also a description of what the mathematics instruction looked like in each class.

Control Group

The control group followed the adopted math text, which introduced different problem types from the beginning of the text. Students learned to distinguish between a joining problem (addition) and separation problem (subtraction). The textbook problem solving instruction included one word problem in the guided whole group practice and one word problem on the homework page. The control group encountered word problems as part of the mathematics instruction but problem solving was not the main focus of a mathematics lesson. All of the problems in the textbook were joining (addition) or separation (subtraction) type problems. Teachers in the control group followed the script of the mathematics text. Observations done by the researchers indicated that this was an accurate description of the mathematics instruction in the classrooms.

Word Problem Group

Mathematics instruction in this treatment group was comprised of two parts: 1) adopted math text, and 2) 15 minute lessons on problem solving twice a week. The math textbooks were the same as the control group, which included one problem in the whole class guided practice and one problem in the homework. Treatment for this group was 15 minutes twice a week of problem solving instruction in addition to the textbook instruction. Word problems used in the instruction were collected from the textbook and placed into a binder by the researchers.

Teachers recorded their problem instruction on the above described instructional recording sheet. We made visits to the classrooms to ensure the invention was taking place.

Culturally Relevant Word Problem Group

The teachers in the culturally relevant word problem group also taught the adopted text and had 15 minutes of problem solving instruction twice a week with the use culturally relevant word problems. Culturally relevant information for creating the word problems was collected from a home survey as explained above. The survey was completed by the participants and their parents prior to the starting of treatment. We had a training session with the teachers using the culturally relevant revision guide, during which we helped the teachers to create their culturally relevant problems for their students.

Observations

We observed all the participating classrooms biweekly. The purpose of the observation was to determine if the interventions were occurring at the prescribed frequency and length of time. The observations were not formal in nature. We documented the biweekly visits on a checklist to ensure consistency among instruction in each classroom.

Results

Multiple regression analyses were use to examine the change from pre-to-post-test. The change in test scores was analyzed in three different ways. First, the overall change score was examined. Then the change score for the algorithm section and word problem section were analyzed separately. Follows is a discussion of the results from the three analyses.

Overall Test Scores

Multiple regression analysis was conducted to predict the change in overall test scores from pre- to post-test using gender, socioeconomic status, ethnicity, treatment group, and oral reading fluency level as predictor variables. There were several predictors that yielded significant results in this analysis shown in Table 2 The overall model relationship was mildly significant, F (8, 114) = 2.16, p = .04.

Table 2

Summary of Multiple Regression Analysis of Change in Pre- and Post-Test on Ethnicity, Gender, Gender, Treatment Group, Socioeconomic Status, and Oral Reading Fluency Level

Predictor	*B*	*SE*	*p*
Intercept	-0.181	0.51	0.72
Non-Caucasian	-1.923	0.77	0.01
Males	1.282	0.50	0.01
School B	-0.003	0.57	0.99
School C	1.197	0.77	0.12
Reduced	0.138	0.67	0.84
Free	0.542	0.67	0.42
ORF Medium	1.040	0.68	0.13
ORF Low	-0.801	0.81	0.32

Note: F statistic 2.16 on 8 and 114 *df*. $p = 0.03$, $R^2 = 0.13$, $R^2_{adj} = 0.07$.

In this analysis, ethnicity was a significant predictor of change in score. When comparing change scores for Caucasian and Non-Caucasian students, there was a 1.92 point decrease in the mean overall test score for Non-Caucasian students (p =.01). These results also mean that on average there was a 12% decrease in scores for non-Caucasians versus Caucasians. Whereas, male students change in score was 1.28 points higher on average versus female students (p = .01). Put another way, on average males scored 8% higher than females when looking at the change in score from pre-test to post-test. Figure 1 illustrates the difference in range in scores for gender. This analysis suggests that receiving an increased amount of word problems or the use of culturally relevant word problems has the potential to improve male second grade students' test scores.

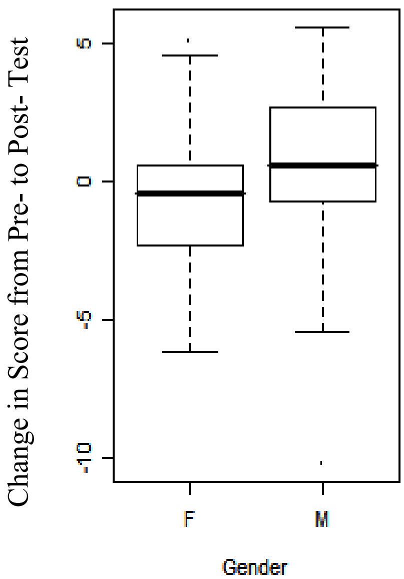

Figure 1. Range in overall change in scores for gender

Algorithm Subtest Scores

The next analysis examined changes in scores on the algorithm subtest from pre-test to post-test. In Table 3, the results are summarized. The overall relationship of the model was significant $F(8,114) = 2.19$, $p = .03$. Gender, ethnicity and school C were all significant predictors of change in algorithm score.

Table 3

Regression Analysis of Change in Pre- and Post-Test Algorithm Subtest Scores
Summary of Multiple

Predictor	*B*	*SE*	*P*
Intercept	-0.41	0.39	0.30
Non-Caucasian	-1.44	0.59	0.02
Males	0.87	0.39	0.03
School B	0.08	0.44	0.85
School C	1.37	0.59	0.02
Reduced	0.68	0.51	0.19
Free	0.30	0.51	0.55
ORF Medium	0.47	0.62	0.25
ORF Low	-0.71	0.52	0.37

Note: F statistic 2.19 on 8 and 133 *df*. $p = 0.03$, $R^2 = 0.11$, $R_{adj} = 0.06$.

The results revealed that between Caucasian and Non-Caucasian students, there was a 1.44 point decrease for non-Caucasian students (p = .02). This translates into a 14.4% decrease in scores for Non-Caucasian students' on average. Meanwhile, male students scored .87 points higher than female students on the algorithm subtest (p = .03). This resulted in an 8.7% increase in algorithm subtest scores for male versus female students. The range in scores for gender, ethnicity and schools is presented in Figure 2.

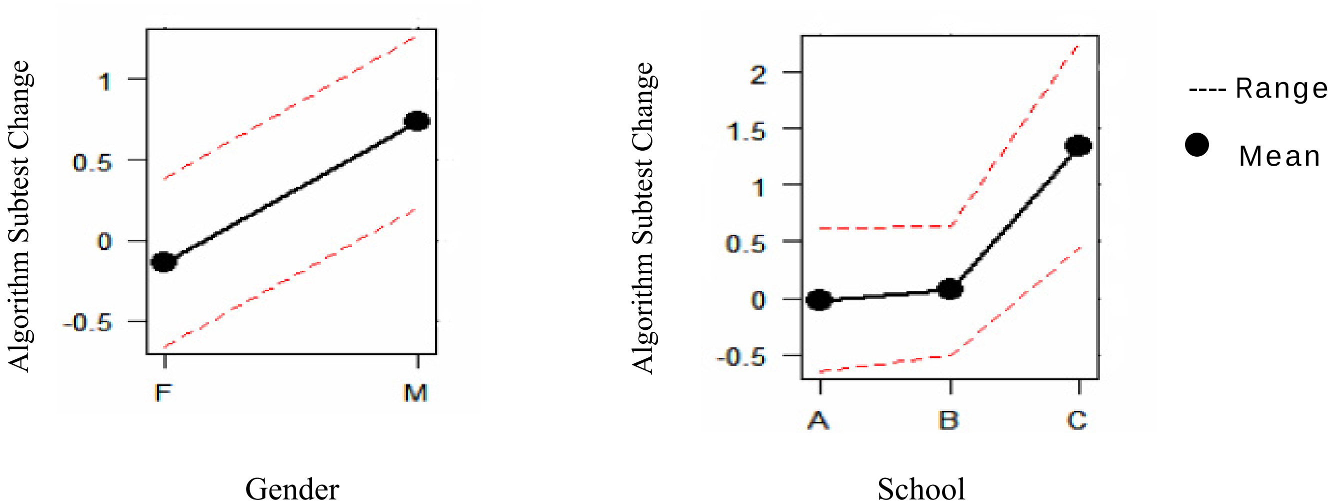

Figure 2. Range of change in algorithm subtest scores for gender and school.

The third predictor in the algorithm subtest was school C, where the culturally relevant word problem intervention occurred. In comparison with the control group (school A) and treatment one group (school B) there was a 1.37 increase on average for students in school C (p = 0.02). This indicated a 13.7% increase in algorithm subtest scores for students who were in the culturally relevant word problem intervention versus the control group and word problem intervention. The range in scores for the three different schools is found in Figure 2. The algorithm subtest analysis indicates that the problem solving intervention in this study has possible benefits for male students. Students at the school with the culturally relevant word problem intervention seemed to have benefited from this intervention.

Word Problem Subtest Score

The final analysis examined the changes in the word problem subtest scores (See Table 4). An omnibus F-test indicates that the overall fit of the regression model was very poor (R^2 = .11). Two predictors were statistically significant in this model: gender and medium oral reading fluency level.

Table 4

Summary of Multiple Regression Analysis of Change in Pre- and Post-Test Word Problem Subtest Scores

Predictor	*B*	*SE*	*p*
Intercept	-0.33	0.29	0.26
Non-Caucasian	-0.79	0.44	0.07
Males	0.62	0.29	0.03
School B	-0.17	0.32	0.59
School C	-0.12	0.44	0.78
Reduced	0.73	0.43	0.09
Free	0.43	0.38	0.25
ORF Medium	0.75	0.39	0.05
ORF Low	0.10	0.46	0.83

Note: F statistic 1.77 on 8 and 114 *df.* $p = 0.93$, $R^2 = 0.11$, $R_{adj} = 0.05$

Male students scored .62 points higher on change score averages versus female students' algorithm subtest scores ($p = .03$). In the word problem subtest, there was a 10.3% increase in scores for male versus female students. The outcome for this analysis showed that for every one point gain for students with both high and low oral reading fluency levels on the word problem subtest, there was a .75 point gain for students at the medium oral reading fluency level. This signified a 12.5% increase in word problem scores for students at the medium oral reading fluency level. Figure 3 demonstrates the range of change in the word problem subtest scores. The word problem subtest analysis suggests that the problem solving interventions in this study have potential benefits for male and medium oral reading fluency level students.

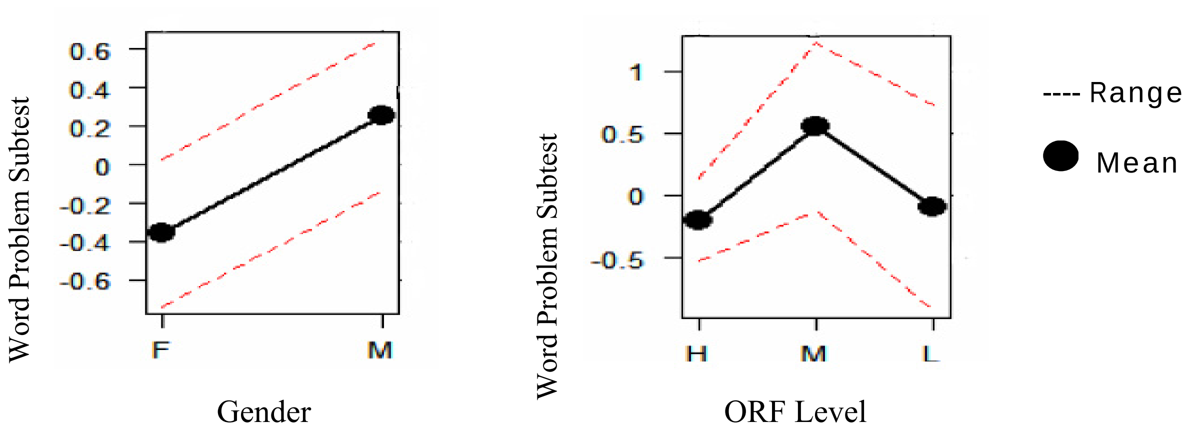

Figure 3. Range of change in word problem subtest scores for gender and oral reading fluency level.

Interactions

We also explored possible interactions between independent variables in the analyses. One significant interaction was found in all of the analyses. There was an interaction between Non-Caucasian students and low oral reading fluency levels on the algorithm subtest analysis. Table 5 shows the results from these interaction analyses. There was a 3.11 point decrease in algorithm subtest change score for Non-Caucasian students at the lower oral reading fluency levels. In other words, there was a 31.1% decrease in scores on the 10-item test. The findings suggest that the problem solving interventions may not beneficial for Non-Caucasian students with low oral reading fluency scores.

Table 5

Summary of Interaction between Ethnicity and Oral Reading Fluency Levels in Multiple Regression Analyses.

Analysis	Predictor	*B*	*SE*	*P*
Overall Change*	Non-Caucasian: Med	-0.95	1.57	0.55
	Non-Caucasian: Low	-2.15	1.83	0.24
Algorithm Subtest**	Non-Caucasian: Med	-0.96	1.18	0.42
	Non-Caucasian: Low	-3.11	1.38	0.03
Word Problem Subtest***	Non-Caucasian: Med	-0.29	0.90	0.75
	Non-Caucasian: Low	0.70	1.04	0.50

Note:* *F* statistic 1.86 on 10 and 112 *df.* $p = 0.06$, $R^2 = 0.14$, $R_{adj} = 0.07$, ** *F* statistic 2.32 on 10 and 112 *df.* $p = 0.02$, $R^2 = 0.17$, $R_{adj} = 0.10$, *** *F* statistic 1.80 on 10 and 112 *df.* $p = 0.16$, $R^2 = 0.11$, $R_{adj} = 0.04$.

Possible Effects

In the various analyses, the research explored all possible combinations of indicated variables and outcomes. While most of these were not statistically significant, the potential effects of some of these variables are noteworthy. Figure 4 indicates the effect each school or group had on the change in scores in all three analyses. These representations support the findings in Table 3 that for school C, culturally relevant word problem treatment, had positive effects on the change of scores. Figure 4 indicates that possible further research on the use of culturally relevant problem instruction should be considered.

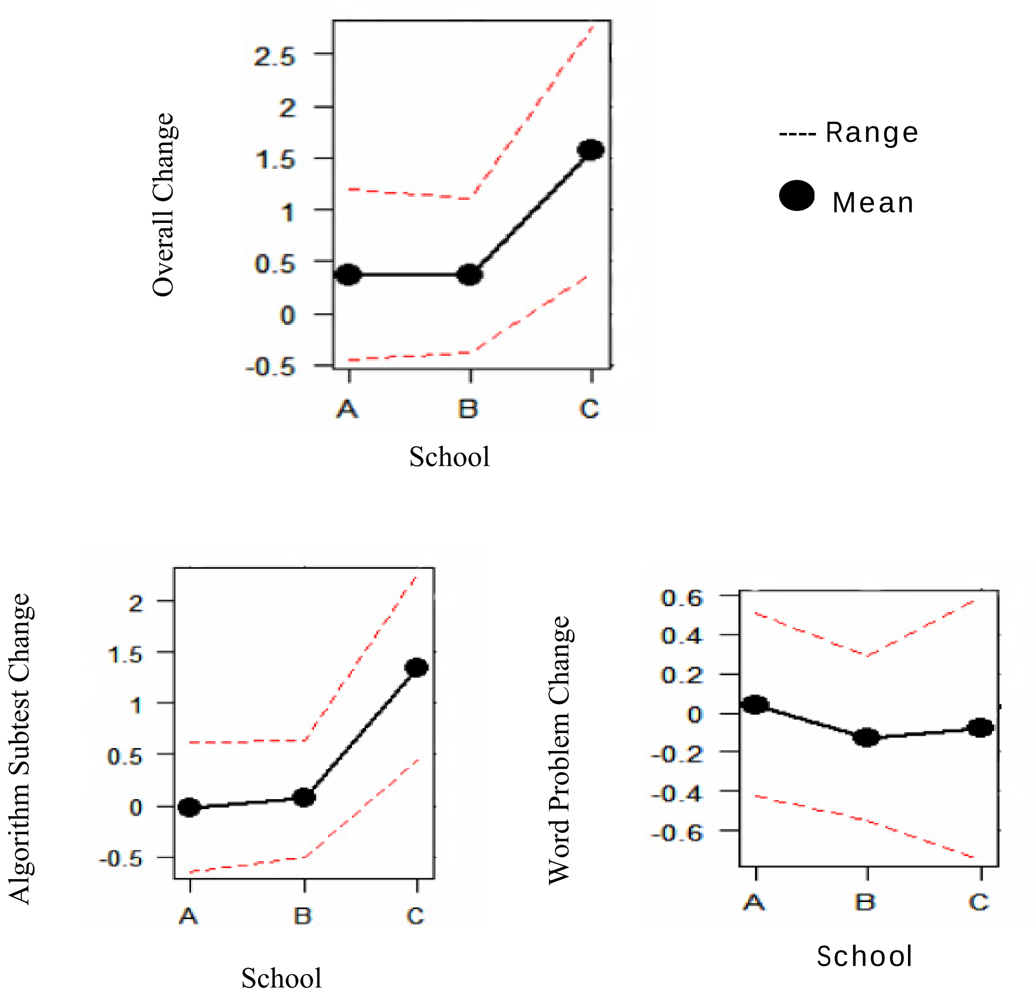

Figure 4. Plot of school effects for each analysis.

The final variable that had potential effects was socioeconomic status. The algorithm subtest analysis (see Table 3) demonstrated there are possible positive effects ($\beta = .73$) for students who receive reduced lunch ($p = .09$). Figure 5 displays the effects for socioeconomic status in all three analyses. Each analysis revealed potential positive results for students who receive reduced and free lunch, which suggests further research to understand the effects of problem solving and culturally relevant problem solving interventions, is warranted.

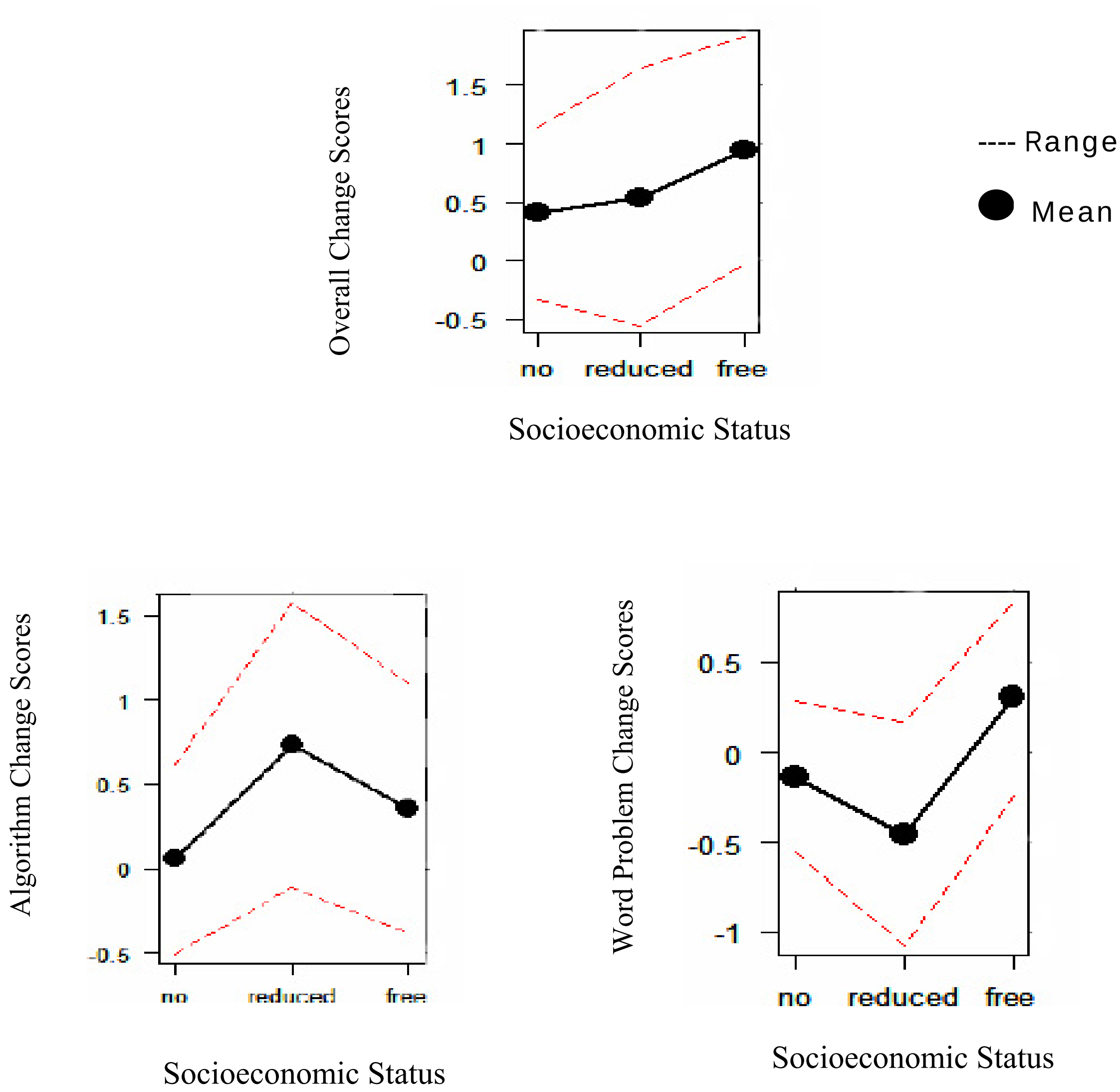

Figure 5. Plot of socioeconomic effects for each analysis.

Overall the results from the interactions, school effects, and socioeconomic status effects, indicate that future research examining the use of culturally relevant word problem in mathematics instruction.

Post-Hoc Analysis

A post-hoc analysis was conducted to examine if the results in all three analyses were influenced by ceiling effects. In all three analyses, overall change, algorithm subtest, and word problem subtest, nineteen students who scored the maximum points on the pre-test were omitted from the analyses. ANOVA and multiple regression techniques were used with the new data set. The results from the post-hoc analyses yielded the same results as the original analyses.

Limitations

The use of 16 questions for the pre- and post-test was based upon the literature (De Corte, E., Verschaffel, L. & De Win, L., 1985; Davis-Dorsey, et al., 1991; Villasenor & Kepner, 1993). These studies included 16 word problems and not a mix of algorithm and word problems. It seemed as if 16 questions would be sufficient to elicit change in scores. Of the 16 questions, only six were word problems which did not allow much room for change. As a preliminary investigation into the effectiveness of culturally relevant word problems, the number of items on this assessment was adequate for establishing tentative findings; however 10-15 algorithm questions and 10-15 word problem questions would be more appropriate. The increased number of questions would allow for a broader range of problem types and difficulty.

Implications

Studies on the use of culturally relevant instruction (Gutstein, et al., 1997; Brenner, 1998; Lopez & Sullivan, 1991; Lipka & Adams, 2004) in conjunction with the studies on the use of problem solving with children (Carpenter, et al., 1993, 1998; Villasenor & Kepner, 1993) revealed that problem solving and culturally relevant problem solving instruction was beneficial for students. This study supports this claim specifically as it relates this type of instruction and its benefits for male second grade students. The minimal intervention of personalizing problems to make them culturally relevant warrants further investigations due to the short duration and preliminary nature of this study.

We also believe that the intervention used in this study goes beyond a mere multicultural response. We are working to make mathematics instruction more pertinent to a select group of students who are providing us information about their "cultural identities". It appears the textbooks used in schools attempt to be multicultural but as our study indicates; even their selection of names is not representative of the majority of students who use them. An implication of this study is that by investigate this type of culturally responsive instruction the field of ethnomathematics may be able to address a broader audience.

Discussion

There are several factors and recommendation that we would like to suggest. The following are recommendations for future research for creating culturally relevant problems, implementing the interventions, and replicating this study with students at early grades.

Language Level of Students

This study did not take into account the language levels of the participating students. In every analysis non-Caucasian students did not benefit from the intervention. One possible explanation for these results is that this study did not control for language levels of the students. There were varying levels of English language proficiencies in the classrooms. In future studies, it is essential to determine the English Language Proficiency especially considering that being able to understand word problems is dependent on the student's reading and comprehension proficiency. Determining the English Language level of the students would provide a clearer understanding of how language can be an issue in working with word problems. The interactions presented in Table 5 indicate why future studies need to look at the relationship.

Culturally Relevant Problem Revision Guide

The teachers understood the purpose of the home survey, but further explanation and training could help the teachers more effectively use the home survey. Previous studies used a computer (Anand & Ross, 1987) and a researcher (Davis-Dorsey, et al., 1991) to create the culturally relevant problems for the students. In this study, the teachers and the researchers used the culturally relevant revision guide to create the problems together. This was an effective method because we were able to guide the teachers and help maintain the integrity of the word problems. In future research, providing the teachers with more background information about the intent, purpose, and use of the culturally relevant problem revision guide would be beneficial. This study only had one training session. To ensure better understanding of the process, a successive training session could increase the teachers' knowledge about the process of designing culturally relevant problems based upon the home survey information.

Implementation of the Interventions

The teachers were asked to teach problem solving twice a week for 15 minutes. When reviewing the problem solving instructional recording sheets in both treatment groups, we found that the problem solving instruction occurred more than twice a week and for 10 minutes rather than 15 minutes. The teachers reported that they used the problems as a morning or math warm-up. They reported teaching two to three problems in the 10 minute time frame. It was confirmed through observation, that the teachers presented the problems, students then solved the problems, and together they discussed the problem solving that occurred during the 10 minute practice sessions. The teachers in this study found a practical way to implement the interventions. While the design of the study asked for two-15 minutes sessions per week, totaling 30 minutes per week, the implementation actually resulted in more frequent, but shorter, instructional periods.

Since the entire group of treatment teachers taught shorter and more frequent sessions totaling 30 minutes per week, the integrity of the invention was preserved. The idea of shorter more frequent interventions may or may not prove more beneficial. Another possible impact on the implementation of the inventions is the scripted nature of the mathematics programs used in the classrooms. This type of instruction may have provided limited opportunities for the inclusion of the problem solving interventions. Future studies might consider two different instructional approaches: 1) using longer periods of problem solving instruction, which provides more instructional minutes focused on problem solving; or 2) establishing a daily routine of problem solving, which allows for more frequent instruction and may better align with current teacher practices, thus resulting in better treatment fidelity.

Suggestions for Future Research

Due to the preliminary nature of this study, we have several suggestions for future research. While this minimal intervention was not effective for all second grade students, examining the use of culturally relevant word problems in conjunction with professional development on problem solving instruction is an avenue of research that could provide additional empirical evidence. The limitation of using a minimal intervention such as making changes in word problems to make them more culturally relevant means that future research should look at the potential benefits of a more in-depth intervention.

When examining these research questions in a future study, important points to examine are teachers' methods and perceptions of problem solving instruction. The observations in this study found that the teachers all had similar methods of problem solving instruction that followed the methods suggested by the textbook. Other studies (Carpenter, et al., 1993, 1998; Villasenor & Kepner, 1993; Lipka & Adams, 2005) included professional development which showed teachers how to engage their students in problem solving through classroom discourse and how to help students examine their own thinking. These studies demonstrated positive benefits for young children who received this type of instruction. Future studies should examine the use of culturally relevant word problems in combination with professional development on how to teach problem solving with young children.

While socioeconomic status was not a significant factor in this study, this variable should be considered in future studies. Literature on mathematics achievement and socioeconomic levels reveals that students in the lower socioeconomic levels lag behind their peers (NCES, 2004, 2005). Continued research examining how to increase achievement for students of lower socioeconomic levels is paramount for the field of mathematics education.

All is not lost, we are just beginning to understand and examine the different ways to use culturally relevant instruction in the classroom. Continuing to empirically investigate the different instructional strategies that use culture in mathematics instruction is not only necessary, but an obligation we have to provide optimal and equal access to mathematics for *all* children in our schools.

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