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Impact of Personalization of Mathematical Word Problems on Student Performance

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This research investigated the impact of personalizing mathematical word problems using individual student interests on student problem-solving performance. Ten word problems were selected randomly from a mathematics textbook to create a series of two assessments. Both assessments contained problems exactly as they appeared in the textbook and problems that were personalized using student interests based on student-completed interest inventories. Fourth-grade students' scores on the non-personalized and personalized problems were compared to investigate potential achievement differences. The scores were then disaggregated to examine the impact of reading ability and problem type on the treatment outcomes. The results showed no significant increase in student achievement when the personalization treatment was used regardless of student reading ability or word problem type ($t = -.10$, $p = .46$).
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"Problem solving is the cornerstone of school mathematics. Unless students can solve problems, the facts, concepts, and procedures they know are of little use" (National Council of Teachers of Mathematics, 2000, p. 181). Students can learn mathematical procedures, but without real-world applications, these skills are rendered meaningless and are forgotten readily. In the school curriculum, word problems allow one means by which students can work toward developing problem-solving skills within contextualized settings that do not require application of rote procedures. However, research has shown that students have difficulty solving word problems (Hart, 1996).

At least three reasons have been proposed for why students have little success solving word problems: limited experience with word problems (Bailey, 2002), lack of motivation to solve word problems (Hart, 1996), and irrelevance of word problems to students' lives (Ensign, 1997). These factors should be addressed in an effort to improve student performance on word problems, a fundamental component of mathematics education. Personalizing word problems—replacing selected information with students' personal information—can address the latter two, motivation and relevance, which may in turn lead to the first, greater experience with word problems.

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The purpose of this study was to investigate the impact of personalizing word problems on fourth-grade students' problem-solving performance. Results of this research, conducted at Copper Flats Elementary School[1] in Northern Nevada, were disaggregated to examine how reading ability and problem type might influence scores in solving personalized versus non-personalized problems.

Review of Related Literature

The Role of Word Problems

Conventional word problems, despite their artificial nature, are likely to "stick around" in school mathematics (D. Brummett, personal communication, February 29, 1996; Sowder, 1995; J. Stephens, personal communication, February 29, 1996). This may be due to their strong grounding in tradition, their potential for fostering mathematical thinking, their ease of use (e.g., conciseness and practicality within the confines of school walls), and a lack of abundant and pragmatic alternatives. Word problems may, in fact, serve several important functions in the mathematics classroom: They provide questions that challenge students to apply mathematical thinking to various situations, and they may be an efficient means of relating this thinking to the real world. Practically speaking, word problems are either readily available in mathematics texts or can be written in a short period of time, which makes them useful to time-conscious teachers (Fairbairn, 1993).

Personalization and Student Interest

The idea of individualizing instruction certainly is not new. Almost a quarter of a century ago, Horak (1981) stated, "Meeting the educational needs of the individual student has long been a concern of professional educators" (p. 249). Personalizing instruction to student experiences and interests is one way to individualize instruction that may be important for mathematics learning (Ensign, 1997). In particular, it can enhance interest and motivation, which are critically important factors in teaching and learning.

Mathematical word problems have been targeted for personalization. Students "don't care how many apples Bob gave to Suzy. They're much more interested in things like music, video games, movies, trading cards, money, and friends" (Bailey, 2002, p. 61). Giordano (1990) adds, "student fascination with problems can be enhanced when names, locations, and events are changed to personal referents" (p. 25). It is important that word problems appeal to students in order to generate interest in and motivation for solving a problem (Fairbairn, 1993; Hart, 1996) However, in practice, classroom mathematics rarely links to students' life experiences (Ensign, 1997).

Research on Personalized Word Problems

Numerous studies have investigated the impact of personalizing problems—inserting individual students' names and/or information from their background experiences into the problems they solve—on student interest/motivation and problem-solving success. Personalized problems have been computer-generated in some cases. Most of these studies found positive effects on the three major variables investigated—interest, understanding, and achievement (Anand & Ross, 1987; d'Ailly, Simpson, & MacKinnon, 1997; Davis-Dorsey, Ross, & Morrison, 1991; Hart, 1996; Ku & Sullivan, 2002; López & Sullivan, 1991, 1992; Ross & Anand, 1987; Ross, McCormick, & Krisak, 1985; Ross, McCormick, Krisak, & Anand, 1985).

Several researchers and educators credit personalization of word problems with positively influencing student affect, such as interest and motivation. Hart (1996) notes, "Most students are energized by these problems and are motivated to work on them" (p. 505). Davis-Dorsey et al. (1991) say personalization fosters and maintains attentiveness to problems, and Jones (1983) claims that personalized problems invest students in wanting to solve them correctly.

López and Sullivan's (1992) research found individual personalization (tailoring problems to individual rather than whole-class interests) to be particularly effective in fostering positive attitudes toward word problems. However, Ku and Sullivan's (2002) study involving 136 fourth-grade Taiwanese students and their teachers also found group personalization to have a positive impact. Both students and teachers using personalized problems showed better attitudes toward the program than those using non-personalized word problems. Ku and Sullivan argue that familiarity (reduced cognitive load) and interest are the major factors that lead to greater success solving personalized versus non-personalized problems.

Another major area where personalization of word problems has yielded favorable results is student understanding. Davis-Dorsey et al. (1991) say personalization supports development of meaningful mental representations of problems and their connections to existing schemata, and that it creates strong encoding that aids retrieval of knowledge. Personalized word problems may be more meaningful in general and make contexts more concrete and more familiar (López & Sullivan, 1992). Familiar people and situations in personalized problems can aid understanding (Davis-Dorsey et al., 1991; López & Sullivan, 1992).

In their research, d'Ailly et al. (1997) employed a type of personalization known as *self-referencing*. A variety of problems were taken from a standard mathematics text and some of the character names were replaced with the word *you*. One hundred students in grades three, four, and five were asked to solve the problems within a mix of self-referencing and non-self-referencing problems. The researchers found, "When a *you* word was involved in the problem, children asked for fewer repeats for the problems, and could solve the problems in a shorter amount of time and with a higher accuracy" (p. 566).

As noted, d'Ailly et al.'s (1997) study found that personalized word problems (specifically, those using self-referencing) positively impacted student achievement—the third main area where word problem personalization can benefit students. Numerous other researchers have attained similar results in this area, although some findings demonstrate positive effects in some cases but not others, as some of the following studies show.

For their study, Ku and Sullivan (2002) personalized problems using the most popular items—as determined by a completed interest survey—for students as a whole. Students attained higher problem-solving scores on personalized problems both on the pretest and on the posttest (i.e., before and after instruction). The 53-minute interim instruction and review used either personalized or non-personalized problems. Students who worked with personalized problems performed better on both personalized and non-personalized problems than those who received non-personalized instruction, suggesting that transfer of learning had occurred from the personalized to non-personalized problems.

Davis-Dorsey et al. (1991) studied the effects of personalizing standard textbook word problems on 68 second-grade students and 59 fifth-grade students. Prior to the treatment, all of the students completed a biographical questionnaire that was later used to develop the personalized problems. Personalization proved to be highly beneficial to the fifth graders, but it did not positively impact the second-grade students' test scores.

Wright and Wright (1986) researched the use of personalized word problems with 99 fourth-grade students. They examined both the processes used to solve the problems and the accuracy of the answers. Interestingly, the researchers found that a correct process was chosen more often when the problems were personalized, but correct and incorrect answers were given equally on personalized and non-personalized problems.

López and Sullivan (1992) found significant differences favoring personalization on problem-solving scores for two-step but not for one-step problems, although the seventh graders in their study also scored higher on the latter in comparison with non-personalized problems. The researchers say personalization may be particularly important for more demanding (e.g., unfamiliar or mathematically complex) cognitive tasks. They found personalization to be effective on a group basis—personalizing problems using dominant interests of a group of students—as well as on an individual basis—personalizing problems for each student using individual interests—in relation to students' problem-solving scores.

Most evidence indicates that personalizing word problems can be an effective technique in teaching and understanding mathematical word problems. Nevertheless, some research data suggest caution in assuming that personalization of word problems always yields positive results. As noted, López and Sullivan (1992) found significant differences favoring personalization for two-step but not one-step problems, and the Wright and Wright (1986) study showed no significant improvement in student achievement on personalized word problems, even though students more often chose appropriate solution strategies for personalized problems. Ross, Anand, and Morrison (1988) raise other issues for consideration. They suggest that the effectiveness of the personalized treatment may wear off over time. The researchers express concern that the higher scores on personalized tests could be due, in part, to the novelty of the personalization and that the novelty might dissipate if the treatment were used often. They also point out that preparing individualized materials could limit its use in the classroom due to time constraints. Finally, in their research with 11-year-olds, Renninger, Ewen, and Lasher (2002) found that personalized contexts based on individual interests can have a differential effect on students. For the most part, these contexts encourage students to connect with the meaning of problems. This leads some students to consider a task more carefully to be sure they understand it. However, it leads others to assume falsely that they have answered a problem correctly, which hinders a "healthy skepticism" that encourages problem solvers to check their work after completing problems.

More research is needed to address how problem type interacts with word problem personalization, where personalization has its greatest impact—student attitude, understanding, or achievement, grade levels and types of students that are most responsive to personalization, the long-term effects of personalization, and the potentially differential impact of individual versus group personalization. Ku and Sullivan (2002) also call for future research on tapping technology's potential for creating personalized problems and on investigating the implications of using personalized problems for assessment.

Research Purpose

The purpose of this exploratory study was to investigate if the predominantly positive research results concerning personalization of mathematical word problems would apply to elementary school students regardless of reading ability or word problem type. The intent was to contribute to the body of knowledge about the impact of personalizing word problems and to extend previous explorations by considering particular student subgroups and problem types (simple translation and process, discussed under *Instrumentation*). If the benefits of personalization were to outweigh the time constraints of planning and preparing for this type of activity, the use of personalized mathematical word problems could be an effective tool for elementary teachers working with students who struggle to understand and solve word problems.

Research Method

Sample

Participants in this study were fourth-grade students at Copper Flats Elementary School. Copper Flats is a small desert community in rural Northern Nevada. The school receives federal Title 1 money, reflecting the fact that Copper Flats Elementary serves students from a lower-income community. The school houses four fourth-grade classrooms. Students who returned parental consent forms in all four of these classrooms were selected for the present study.

Ninety-seven parental consent forms were distributed. Of those, 42 were returned in time for the study. Therefore, the sample included 42 students— 22 boys and 20 girls. Students not participating in the study worked on classroom assignments given by their regular teacher, while the participants completed the assessments. All participants in this project were present for the two data-collection sessions. By reading ability, 20 participants ranked *high*, 8 ranked *medium*, and 14 ranked *low*.

Research Design

This study was a quantitative analysis of the effects of personalizing word problems on fourth-grade students' achievement in solving the problems. In the fall of 2002, participants completed an interest inventory to provide individual information for personalizing the assessments. One week later, participants were administered an instrument containing 10 word problems to solve. On that assessment, 5 problems were personalized and 5 were not. Two weeks later, participants were given a similar 10-item instrument. On this second and final assessment, parallel versions of the 5 problems that had been non-personalized on the initial instrument were personalized, and vice versa. Therefore, all participants—across the two test administrations in which they took part—answered 20 problems, 10 personalized problems and 10 similar problems that were not personalized. The two-week period between the two tests provided necessary time to reduce threats to validity due to repeated testing of participants on similar test items (Parsons & Brown, 2002).

During each test administration, each participant was given an instrument and a blank sheet of paper on which to solve the problems. Participants were allowed 15 minutes to complete each assessment. All participants finished within the allotted time.

Teacher-reported scores on the Developmental Reading Assessment (DRA) (Beaver, 2001) established participants' reading level for the purpose of comparing achievement on personalized versus non-personalized problems in relation to reading ability. DRA levels 30 to 38 are considered to be third-grade reading ability, DRA level 40 is fourth-grade reading ability, and DRA level 44 is fifth-grade reading ability. For this study, participants with DRA scores higher than 40 were considered *high* readers, or above grade level. Participants with DRA scores at 40 were considered *medium* readers, or at grade level. Participants with DRA scores below 40 were considered *low* readers, or below grade level.

This research was not designed to include a qualitative component. However, student comments were recorded as field notes on the few occasions where students made relevant, unsolicited remarks.

Instrumentation

Ten problems were randomly selected from *Mathematics: The Path to Math Success* (Fennell et al., 1999), the third-grade mathematics text, for use in developing the assessment instruments (see Appendices B and C). This text was chosen because it was the text used for teaching third-grade mathematics at Copper Flats Elementary School; therefore, the participants were familiar with the format of the problems. The problems were selected by scanning every third page of the text that contained word problems. Of the word problems selected from those pages, five of each of the two problem types described below were drawn from a basket and incorporated into the assessments.

The problems selected for the assessments were differentiated by problem type. Five of the problems selected for the assessments were *simple translation problems* and five were *process problems* (L. R. Wiest, personal communication, August 27, 2002). Simple translation problems can be solved using a one-step mathematical algorithm. An example of a simple translation problem is: "There are 7 seats in each of 6 vans. How many seats are there in all?" (Fennell, et al., 1999, p. 360). Process problems typically are not solved through direct application of an algorithm. Another strategy is generally sought and chosen, such as working backward, drawing a picture or diagram, or using guess-and-check. A sample process problem is: "Jen is older than Arnie. Paul is older than Jen. Who is the oldest?" (p. 313).

An interest inventory (see Appendix A) was created to determine selected participant preferences. Inventory items included students' name, favorite toy, favorite store, something to buy at that store, names of friends, something they like to make, name of a game, and favorite type of vehicle. Each inventory was used to personalize the original textbook word problems.

Two assessments were developed from the word problems taken from the mathematics text. Items from the interest inventory replaced the original characters, objects, and situations in order to personalize the problems for each individual student on five of the ten problems on each of the two instruments. On one assessment, the odd-numbered problems were personalized (see Appendix B). On the other, the even-numbered problems were personalized (see Appendix C). Participants randomly received one instrument on the first administration and the other instrument on the second administration two weeks later. This method of alternating personalized and non-personalized items on the assessments was shown to be an effective technique used in other research on this topic (Davis-Dorsey et al., 1991; d'Ailly, Simpson, & MacKinnon, 1997).

Data Analysis

A paired-samples *t* test (available online at http://faculty.vassar.edu/lowry/tu.html) was performed to compare the number of correct answers on personalized versus non-personalized problems. Mean scores and standard deviations were calculated and significance was tested at the .05 level using a one-tailed test. This analysis included 42 pairs of scores.

An additional paired-samples *t* test was performed to compare the number of correct responses on personalized versus non-personalized items disaggregated by participants' predetermined reading levels. Again, mean scores and standard deviations were calculated and significance was tested for at the .05 level using a one-tailed test. There were 20 pairs of scores at the high level, 8 pairs of scores at the medium level, and 14 pairs of scores at the low level.

Two final paired-samples *t* tests were performed to compare the number of correct responses on personalized versus non-personalized test items disaggregated by problem type. Each assessment contained five simple translation problems and five process problems. On the first of these two paired-samples *t* tests, correct responses on the personalized simple translation problems were compared to correct responses on the non-personalized simple translation problems. On the second of the two paired-samples *t* tests, correct responses on the personalized process problems were compared to correct responses on the non-personalized process problems. Through these statistical methods, mean scores and standard deviations were calculated with significance tested at the .05 level using a one-tailed test. Both of these analyses included 42 pairs of scores.

Results

Mean scores for the number of items answered correctly out of ten showed a difference of .03 points between the personalized and non-personalized problems (see Table 1). This difference was not statistically significant ($t = -.10$, $p = .46$).

Table 1
Paired-Samples t Test for Personalized and Non-Personalized Problems

Context	*n*	Mean	SD	*t*	*p*
Personalized	42	5.26	2.07	–.10	,46
Non-personalized	42	5.29	2.28		

Table 2 provides mean scores for the number of problems answered correctly out of ten, separated by student reading level. The high-reader scores for non-personalized problems were .10 points higher than for personalized problems, a nonsignificant difference ($t = -.26$, $p = .39$). The medium-reader scores for non-personalized and personalized problems differed by .50 points, also favoring non-personalized problems. A paired-samples t-test indicated that this difference was not significant ($t = -1.08$, $p = .15$). The low-reader scores were .35 points higher for personalized problems than for non-personalized problems. This was the only group who attained better scores on personalized problems, although the scores were not significantly higher ($t = -.84$, $p = .20$).

Table 2
Paired-Samples t Test for Personalized and Non-Personalized Scores by Reading Ability

		Personalized		Non-Personalized			
Reading Group	*n*	Mean	SD	Mean	SD	*t*	*p*
High	20	5.90	1.77	6.00	2.15	–.26	.39
Medium	8	5.50	2.07	6.00	2.14	–1.08	.15
Low	14	4.21	2.19	3.85	1.96	–.84	.20

Mean scores for the number of problems answered correctly out of 5 were separated by problem type (see Table 3). Scores for simple translation problem means were 0.16 points higher for non-personalized than for personalized problems. A paired-samples t-test showed that these differences were not significant ($t = -.84$, $p = .20$). Process problem means showed a difference of 0.1 points between the personalized and non-personalized problems, favoring the former. Again, this difference was not significant ($t = .45$, $p = .32$).

Table 3
Paired-Samples t Test for Personalized and Non-Personalized Scores by Problem Type

		Personalized		Non-Personalized			
Problem Type	***n***	**Mean**	**SD**	**Mean**	**SD**	***t***	***p***
Simple Trans.	42	2.41	1.56	2.57	1.74	–.84	.20
Process	42	2.86	0.98	2.76	1.12	.45	.32

Discussion

The results of this study suggest that students are no more successful answering word problems when the word problems are personalized and reflect their areas of interest than when the problems are taken verbatim from a mathematics textbook. Only in the subgroup of low-reading-level students and the subcategory of process problems did the personalized problem scores improve slightly, although statistically significant differences were not found in either case. The mean scores in each other subgroup and subcategory were somewhat lower on the personalized versions of the word problems than on the non-personalized versions.

These research results point to a different conclusion than many previous studies on this topic. However, given the rather substantial amount of previous research weighted toward positive effects of personalizing word problems and the reasons explained below, it is still quite possible that personalized word problems can be a beneficial part of school mathematics programs. Several factors may have caused the lack of positive findings in this study. First, the personalized problems may not have adequately addressed the three aforementioned reasons students fail at mathematical word problems. Second, the age of the students may have been a factor in the treatment's lack of success. Third, this study looked only at comparisons of personalized and non-personalized problems on assessments. No attempt was made to introduce personalization as an instructional practice.

The three reasons offered earlier for why students fail at solving mathematical word problems were limited student experience with word problems (Bailey, 2002), lack of motivation to solve the word problems (Hart, 1996), and irrelevance of word problems to students' lives (Ensign, 1997). The format of this study could not—and did not intend to—have much impact on student experience with word problems. By simply taking two 10-problem assessments, student exposure to word problems was not greatly increased. Increased motivation was noticed, however, when students saw their names or favorite things included in a problem. On several occasions while completing the assessments, students made comments such as, "Hey, this has my name," or "These problems are fun ones." This acknowledgement and the smiles that followed were taken as signs of increased student motivation. It was anticipated that by utilizing student names and other referents to student lives, relevance would be increased. This may have been the case to an extent, but just seeing their names and favorite things may not have given the problems enough personal context to encourage correct answers. In effect, the ability of this study to address the three major reasons students fail at solving word problems was not substantial or sustained enough to help distinguish performance on the two problem contexts. Personalized problems per se might not be advantageous unless they are an integral part of a larger instructional effort.

The young age of the students may also have contributed to the results of the present study. These students fall at the lower end of the grade levels previously researched on this topic. Most studies that found positive results for personalized problems took place at upper elementary or middle grades (Anand & Ross, 1987; d'Ailly et al., 1997; Davis-Dorsey et al., 1991; Hart, 1996; Ku & Sullivan, 2002; López & Sullivan, 1991, 1992; Renninger et al., 2002; Ross & Anand, 1987; Wright & Wright, 1986). Only two studies included younger grades—second and third—among the older grades they investigated (Davis-Dorsey et al., 1991; d'Ailly, et al., 1997). The present study dealt exclusively with fourth-grade students and found no relationship between personalization and student scores. Perhaps fourth grade is somewhat early for the personalization treatment to be effective. Interest in problem contexts may become more important across the many years in which students encounter school word problems. In relation to their study involving the impact of word problem context, Parker and Lepper (1992) state that it is "clear that the need for techniques to enhance student interest in traditional educational materials may actually increase with age" (p. 632). Advancing grade levels also deal with increasingly difficult mathematics problems, the complexity of which may allow for a factor such as personalization to influence student performance. As noted earlier, López and Sullivan

(1992) found personalization to have a positive impact on two-step but not one-step problems, leading them to conclude that personalization may be particularly important for more difficult problems. Use of third-grade problems in this study may also have reduced the cognitive demands of this research task, creating less sensitivity to or discrimination among problem variations.

Several previous studies found a significant increase in correct answers on mathematical word problems when students were taught with the personalized format (e.g., Anand & Ross, 1987; López & Sullivan, 1992). After the instructional period, participants in these studies were assessed using standard word problems. The present study sought to discover the effects of the personalized format on student achievement on the test items themselves without prior instruction using these types of problems. Perhaps these two approaches yield different results. Students may need time to adjust to the new problem contexts.

One benefit that did appear in using this treatment was student excitement. Similar to the Ross, McCormick, and Krisak study (1985), many participants were visibly and audibly excited to discover the personalized problems. In informal discussions after the test administrations, participants reported that they really liked reading about themselves and their friends. They enjoyed seeing familiar stores and games they like to play in this testing situation. This affirms Hart's (1996) reference to the personalized treatment that "students are energized by these problems" (p. 505). It must be recalled, however, that interest in problems can be detrimental to some students, who may incorrectly assume that they have attained correct answers (Renninger et al., 2002). Also, too much interest in a problem context can distract some students, particularly girls (Boaler, 1994; Parker & Lepper, 1992). If these potential negative effects took place in this study, they might have countered and thus masked potentially positive effects in the overall results.

Limitations of the Study

The two major limitations of this study were the sample size and the somewhat simplistic nature of the research design. The sample size was reduced due to the small number of parental consent forms that were signed and returned so that students could participate in the study. Ninety-seven consent forms were distributed, but only 42 (43%) were signed and returned in time for the first test administration. (Time constraints prohibited a second distribution of consent forms, which might have raised the return rate.) This greatly reduced the sample size, thus limiting the power of the data used to determine the effectiveness of the treatment.

This study was also limited by its lack of complexity. Merely assessing student performance based on two test administrations was restrictive. It only gave a look into the results of those two tests. It would be interesting to discover how students might perform on word problems when they were *taught* with the personalized format. Time and other constraints did not allow for this additional research component. Analysis of solution strategies might have yielded further information. It is also difficult to know what long-term impact the motivational aspects of these problems may have.

Implications for Further Research

This study, in conjunction with the professional literature discussed earlier, yields at least three major implications for future research.

- The potential of personalization of word problems as an instructional method should be studied.
- Alternative technologies should be explored to decrease the time-intensive nature of preparing individualized word problems.
- Longitudinal research should be conducted on the impact of personalizing mathematical word problems.

As a teaching strategy, personalization of mathematical word problems has been shown to increase student achievement, particularly in the upper elementary and middle grades (e.g., Anand & Ross, 1987; López & Sullivan, 1992). While this study did not find such results for assessment problems, which may be due to the mitigating factors discussed earlier, it did find some anecdotal evidence that supported other research findings of increased interest in these problems. This might be an important underpinning of mathematics learning. Personalization as an instructional strategy could be implemented at various grade levels and studied to assess its effectiveness for students of those ages. Rather than comparing test items only, as the present study did, students could be taught with the personalization treatment and assessed on standard textbook word problems to determine the level of transferability of any possible positive effects. This instructional method may increase student motivation and interest when learning how to solve problems in mathematics, thereby increasing their comprehension of the material and increasing their scores on textbook and other assessments.

In order to employ personalization as a teaching strategy—based on the assumption that it may yield positive results in affect, understanding, and/or achievement—alternative methods of personalizing word problems would be needed to decrease the amount of time researchers and educators spend creating personalized problems. One such method might utilize the Internet. The capability of the Internet to deliver individualized materials immediately and simultaneously to a large population of students remains untapped. A researcher could develop a web site that allows students to complete an interest inventory online and then submit the inventory to the server. The server would then apply that information to an existing word problem template document, updating the characters and other referents to individualize the problems for each student. This process would take only seconds and would eliminate researchers' (and later teachers') time investment in personalizing individual worksheets and tests. Students could then either print the problems or complete them on the computer screen. The preparation time would be greatly reduced and the number of participants could be increased significantly. This technique would allow researchers to create countless individualized word problems for student instruction, practice, and assessment. Such research should include attention to what types of problems lend themselves well to this type of problem generation. In the research reported in this paper, for example, problems using names were the easiest to personalize, with difficulty increasing where gender-specific pronouns were included. The process problems seemed to require greater attention than the simple translation problems in preparing personalized problems, mirroring the greater mathematical complexity of the former compared with the latter.

The present study and similar earlier studies discussed here have been shorter than three months in duration. Long-term effects of the personalizing strategy have not been determined at any educational level. Researchers might look at the use of personalized word problems in a classroom over the course of a school year and its relationship to word problem achievement on standardized tests.

Closing Thoughts

Personalization of mathematical word problems may not be an efficacious approach in fourth-grade classrooms due to the age of the students and the simplistic nature of the word problems the students are required to complete. This should not, however, discount other research on the personalization of educational materials. Other researchers have shown personalization to be an effective method in teaching older students to solve mathematical word problems.

Excitement and interest tend to be rare when students are working on word problems. Fairbairn (1993) suggested that the terms *story problems* and *word problems* can invoke uncomfortable memories for many people. This may be due to the fact that word problems can be boring and tedious to solve. Unfortunately, student motivation is difficult to quantify. In the present study, as well as in others, the excitement level of individual students visibly and audibly rose when personalized problems were presented. At the very least, personalization could be used as an instructional strategy to break the monotony of word problems containing unknown people, dealing with unfamiliar situations, asking uninspiring questions.

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[1] Pseudonym.

Appendix A: Interest Inventory

Favorite Toy ____________________

Name of a Store You Shop At ____________________

Something You Would Like to Buy at That Store ___________

Name Three Friends ________ ________ ________

Name a School Supply ____________________

Something You Like to Make ____________________

A Game You Like to Play With One Partner ________________

Name a Type of Vehicle ____________________

Appendix B: Sample Assessment

(odd numbered problems personalized)

1. Four students are collecting empty soda cans. Josh has more than Jon but fewer than Warren. Robby has the same number as Josh. Who has the greatest number of cans so far?
2. Tom has a ball. He passes it to Wally, and Wally passes it to Anne. Anne passes it back to Tom. If they continue in this order, who will catch the ball on the 10th throw?
3. Suppose 30 bottles of glue are shared equally among 6 classes. How many bottles of glue would each class get?
4. It's the grand opening of Futura Florists! Every day for 8 days they give away 50 roses. How many roses in all do they give away?
5. Josh read 67 pages of a book. Jon read 32 pages. How many more pages did Josh read than Jon?
6. Jordan, Nina, Amy, and Gia are practicing for a dance. They take turns dancing in pairs. If each girl practices one dance with each of the other girls, how many dances do they practice in all?
7. A toy maker can put together 1 Gameboy™ every 6 minutes. How many Gameboys™ can he put together in 60 minutes?
8. There are 7 seats in each of 6 vans. How many seats are there in all?
9. Josh is older than Jon. Warren is older than Josh. Who is the oldest of the three?
10. Paula made first-aid kits to sell at the fair. She made 1 kit on Monday, 2 kits on Tuesday, 3 kits on Wednesday, and so on, until Saturday. How many kits did Paula make on Saturday?

Appendix C: Sample Assessment

(even numbered problems personalized)

1. Four students are collecting empty soda cans. Meg has more than Jo but fewer than Sid. Bart has the same number as Meg. Who has the greatest number of cans so far?
2. Josh has a ball. Josh passes it to Jon, and Jon passes it to Robby. Robby passes it back to Josh. If they continue in this order, who will catch the ball on the 10th throw?
3. Suppose 30 musical instruments are shared equally among 6 classes. How many instruments would each class get?
4. It's the grand opening of Winco! Every day for 8 days they give away 50 chocolates. How many chocolates in all do they give away?
5. Wendy read 67 pages of a book. Ellie read 32 pages. How many more pages did Wendy read than Ellie?
6. Josh, Jon, Robby, and Warren are playing Battleship™. They take turns playing Battleship™ in pairs. If each kid plays one game of Battleship™ with each of the other kids, how many games do they play in all?
7. A toy maker can put together 1 toy robot every 6 minutes. How many toy robots can he put together in 60 minutes?
8. There are 7 seats in each of 6 Toyotas™. How many seats are there in all?
9. Jen is older than Arnie. Paul is older than Jen. Who is the oldest of the three?
10. Josh made dented cars to sell at the fair. Josh made 1 on Monday, 2 on Tuesday, 3 on Wednesday, and so on, until Saturday. How many did Josh make on Saturday?