

The Effect of Rephrasing Word Problems on the Achievements of Arab Students in Mathematics

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Abstract

Language is the learning device and the device which forms the student's knowledge in math, his ability to define concepts, express mathematical ideas and solve mathematical problems. Difficulties in the Language are seen more in word problems, clarity and in the way the text is read by the student have a direct effect on the understanding of the problem and therefore, on its solution, could delay the problem solving process. The connection between language and mathematical achievements has a more distinctive significance regarding the Arab student. This is due to the fact that the language which is used in the schools and in textbooks is classical (traditional) Arabic. It is far different than the language used in everyday conversations with family and friends (the spoken Arabic). Our research examine whether rephrasing word problems can affect the achievements of the Arab students in it. The experimental group received mathematics instruction using learning materials of word problems that were rewritten in a “middle language” closer to the students' everyday language (spoken Arabic), thus keeping the mathematical level of the problems. The research findings showed that students in the experimental group improved their achievements in word and geometric problems significantly more than students from control group.

Introduction

The few studies that have dealt with word problems and geometry problems have focused on difficulties confronting students before the problem-solving stage, or - more specifically – the stage of understanding the problem. During this stage the linguistic and syntactic aspects of the problem are of utmost importance.

Word problems constitute an important part of the general curriculum from 1st to 12th grade. For this reason this study is extremely important. This issue is even more significant in the Arab sector where students speak with their peers and parents in colloquial Arabic, while the mathematics textbook from which they study is written in classical Arabic. For all practical purposes, this constitutes a “second language” for Arab students. Students in this research received mathematics instruction using study units that were rewritten in a “Middle language” – halfway between colloquial Arabic and Classical Arabic. The new rewording of word problems that is proposed in this study is closer to students' everyday speech and is therefore easier for them to understand.

The objective of this study was to examine the degree of influence that the rewording of word problems and geometry problems has on Arab students' achievements and upon their attitudes towards these problems.

The research questions were the following:

1. To what degree will rewording of word problems influence Arab students' achievements in solving this type of problem?
2. To what degree will the rewording of geometry problems influence Arab students' achievements in this type of problem?
3. To what degree will the rewording of word problems and geometry problems influence Arab students' attitudes towards these problems?

The Research Population

The research population included 1041 5th and 6th-grade students from the Arab sector in northern and central Israel. This population was made up of three groups:

- **The experimental group** who received instruction and were tested in reworded problems,
- The **first control group** who received instruction and were tested in word problems and geometry problems worded in the traditional manner
- The **second control group** studied word and geometry problems that were written in the traditional manner and were tested using problems written in the new version.

The research variables were the following:

1. improved achievements in word problems (the difference between the scores in the pre-test and post-test)
2. Improvement in achievements in geometry problems (The difference between the scores in the pre-test and post-test)
3. Changes in students' attitudes towards these problems (The difference between Arab students' attitudes before and after the experiment)

The research was performed in five stages:

The first stage: Before the research began interviews were conducted with 30 students from 5th and 6th grade classes. Students were asked to point to the strategies they used while solving word problems or geometry problems. Students appeared to use nine different strategies (that will hereby be referred to as "characteristics.")

The Second Stage: In order to examine the validity of these characteristics additional interviews were conducted with other students who were asked to offer their opinion about the characteristics that were found in the first interviews. This stage constitutes an essential prerequisite stage to the writing of the two study units that were based upon syntactic and linguistic difficulties that present an obstacle to students in understanding word and geometry problems.

The Third Stage: All the students filled out a questionnaire to assess their attitudes towards word and geometry problems. In addition, a pre-test on word and geometry problems was given to the entire research population. This pre-test was in the traditional language similar to that written in mathematics textbooks approved by the Ministry of Education.

The Fourth Stage: During the fourth stage the experimental group received mathematics instruction using learning units of word problems as well as an additional unit of geometry problems that were rewritten in a "middle language" closer to the students' everyday language. At the completion of the study students were given a post-test. Students in the experimental group and the second control group were given the same test using the new, rewritten version of the word and geometry problems. The first control group was tested using the same word and geometry problems, but which were worded in the traditional form similar to that in the textbooks. All the students once again filled out the attitude questionnaires that they had filled out during the third stage.

The Fifth Stage: After completing the two study units we interviewed 36 students of both genders from both grades. This constituted the fifth stage of the research. During this stage students were presented with word and geometry problems identical to those in the third stage: once in the traditional form and once in the new, rewritten form. 169 items were received that were connected to solving word and geometry problems. These items were divided into five categories:

- a. The words in the word and geometry problems (number of words, and frequency of occurrence)
- b. the sentences in the word and geometry problems (long or complex sentences)
- c. Hidden or evident clue words
- d. The location of the question (at the beginning, middle, or end of the problem)
- e. The wording of the problem

Method of Analysis

This research is an integrated quantitative and qualitative research. It was conducted based upon pioneering research results that was conducted in the Arab sector that yielded results that justified this present study.

The research findings showed that students in the experimental group improved their achievements in word problems significantly more significantly than students from the first and second control groups. (The improvement in achievements in word problems among students in the experimental group was 8.96 point while students in the second control group improved their scores by 4.7 points and those in the first control group improved by 2.13 points on a score of 1-100. Additional findings show that students in higher levels of mathematics improved their achievements in solving word problems less than those studying in lower levels. Students whose parents had a higher level of education showed a less significant improvement in achievements in solving word problems. 5th grade students' achievements improved more significantly than 6th graders'. No difference was found in achievements in word problems between the genders, or between students with various levels of Arabic.

Students in the experimental group showed an improvement in solving word and geometry problems of 6.27 points on a scale of 1-100. The degree of improvement in geometry problems among students of the second control group was 3.17 points, while the students in the first control group improved their scores by 1.97 points. 5th grade students improved their achievements in geometry problems significantly more than 6th-graders.

The students studying mathematics on a high level improved their achievements in geometry problems significantly less than students studying at the lower levels. No difference was found between the genders or between the various levels in Arabic from the aspect of improved achievements in geometry problems.

Research results revealed a significant and positive change in students' attitudes towards word problems and geometry problems after the students were exposed to the newly worded study units. This change was significantly greater among boys than girls. Changes in attitudes among students studying higher levels of mathematics were significantly less than among those studying on lower levels, and students whose parents had a higher level of education changed their attitudes less, while students of parents with a lower level of education showed significant, positive changes in their attitude towards these problems.

No significant difference was found between 5th and 6th grade students, or between students with different levels of Arabic regarding changes of attitude towards word problems and geometry problems. The above conclusions were proven clearly during the interviews that were conducted with students after studying the two units.