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Mathematics word problem solving for third grade students

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Abstract

The purpose of this study is to examine the impact of action research to improve students' abilities for word problem solving. The cooperation between a third grade teacher (Rajmonda) and a professor from the university focused on examining the results of the implementation of the two activities within the action plans, 'Developing the mathematical vocabulary' and 'Formative assessment- feedback'. Thus the project reviewing the impact of 'activities' in the process of word problem solving can be seen as 'under-study' within the broader study of the effect of collaboration in action research. From the analysis of qualitative data (interviews with students, observation and journal entries) and quantitative (questionnaires and tests) seen a significant improvement of the results of students in word problem solving. Developing mathematical vocabulary enabled them to understand mathematical terms and requirements while providing feedback problems led to the improvement of the 'gap' in the process of problem solving.

Keyterms: Word problem, math vocabulary, feedback, action research, collaborative action research..

Introduction

Word problem solving in mathematics is an important aspect of learning mathematics and the mathematical thinking. Everyday work in the classroom shows that students express difficulties in solving word problems, although in solving other tasks they are skillful. They can solve very well different tasks with mathematical operations: addition, subtraction, multiplication, division, identify units of measurement and other tasks that require calculations, tasks with numbers and equations, but when they are behind word problems many of them give up and show the need help.

During word problems solving it happens that students write some numbers, using one or more mathematical operations, but they don't know exactly how to act in further. In other cases they can compute and use the appropriate operations, but they can not provide the required answers to the problems.

How to develop students' abilities to solve word problems? What are the barriers that present students in solving word problems? What can we do as teachers? Which activities can help students in this particular case? Which skills should develop to students to be able to solve word problems? Can we apply certain strategies on this issue?

There are some of the concerns that I have as a teacher, but also many other teachers. Therefore, together with the professor of the Faculty of Education (coauthor) decided to carry out this collaborative action research to develop students' skills in solving word problems. First of all we reviewed the relevant literature related to word problem solving in mathematics and then planned action plans.

Word problem solving is studied topic by many authors, whose guidelines have been effectual for this study (National Council of Teachers of Mathematics NCTM, 2000; Sharma, 2001; Van de Walle, 2007; Burns, 2007). Many authors have studied the role of mathematical vocabulary and its impact in students' achievements in mathematics and word problem solving (Amen, 2006; Blessman & Myszczyk, 2001; Georgius, 2006; Brethouwer, 2008; Kranda, 2008; McConell, 2008).

It's not enough for students to learn mathematics only by solving tasks that require computations or memorizing concepts and operations. Students should be able to solve problems that encourage and develop thinking and their logic. They will be faced by problem solving in their life in different situations, in many competitions and tests in which word problems are present. The purpose of this research is to find ways and appropriate activities to develop students' skills in solving word problems. Developed action plans in action research cycles were 'Developing the mathematics vocabulary' and 'Formative assessment- in particular- feedback'.

Literature review

Collaborative action research is the joint research between two or more teachers, or between universities and teachers. They collaborate and influence in changing the curricular approach and their main focus is on practical problems or individual teachers. (Vula & Berdynaj, 2011).

Mathematical vocabulary and mathematical language

The difficult part in solving word problems is the understanding of the problem, especially the words in which is shown that problem. Not understanding of certain words affects the first difficulties in word problem solving, one of which may be the application of inappropriate mathematical operations.

Burns (2007) compares the learning of mathematics with learning of second language. According to her, mathematics is described as a language, and a learning of the mathematics as a learning of a second language. But it is clear that the learning of the mathematics as a second language has to do with other purposes of learning a foreign language.

Sharma also compares mathematics with language. According to him, "mathematics is a kind of language where communication takes place through the symbols, it has its letters, symbols, vocabulary and grammar" (Sharma, 2001, p.66). Students can not be successful in mathematics if they don't know the meaning of certain words of mathematics, it's also valuable for their subjects, if they don't know the meaning of words they can't learn the relevant subject. If students know the meaning of terms they can learn mathematical concepts and develop necessary skills in mathematics.

Formative assessment- feedback

Integral and very important part in the learning and teaching process is the students assessment, not only to assess students' achievements, but also for the purpose of improving their work. According to Burns (2007) the assessment of should focus on understanding of students' ideas, problem solving skills and learning reactions. A good assessment can improve learning in many ways.

Feedback on assignments can assist students in setting goals taking responsibility for their learning and becoming more independent in learning. Also help students to understand the characteristics of accurate and complete response. To ensure high quality learning for all students, assessment should become a routine part of classroom activities.

Opportunity to observe students work provide Formative assessment as a type of assessment which is implemented in the classroom and aims at improving the performance of students, motivating and orienting them to work in further activities. Formative assessment is a process of systematic observation that provides a better understanding of what student have learned and how to engage them deeply in the learning process.

This process "direct students in the learning process and enables them to acquire necessary skills that will be useful to achieve better results" (Murchan, Shiel, Vula, 2012, p.17). Feedback as learning assessment strategies provide feedback for performed work and instructions for improvement.

Research related to impact of vocabulary in solving word problems

Different research findings have shown that the development of mathematical vocabulary affects students' abilities in mathematics. Blessman& Myszcza (2001) have examined the impact of mathematical vocabulary on students' understanding. According to them, one of four causes that cause confusion in mathematics is vocabulary, so students need to be strengthened in their understanding of mathematical vocabulary to be successful in mathematics.

Understanding of mathematical vocabulary influences comprehension of lessons, tasks, various tests, especially in solving word problems, so a lack of understanding of mathematical terms affects locking capabilities to solve problems (Amen, 2006). There is a direct link between success in problem solving and vocabulary. Student's ability to understand words in mathematics classes is related to its ability to solve word problems. Improving communication about mathematics is studied by Georgius (2006). The findings of this research indicate that students feel that the knowledge of the definitions of mathematical term is significant and increases their achievements.

Kranda (2008) conducted research about the relationship between students accurate understanding of mathematical vocabulary and their achievements, particularly focusing on understanding word problems and abilities to use appropriate mathematics language in word problem solving. The impact of of vocabulary instruction for the understanding of mathematical concepts by student is researched by McConell (2008). When students are directly instructed to use the language of mathematics, in many ways they develop better understanding of mathematical concepts and word problem solving becomes easier.

Results of research by Solomon (2009) showed that taking time to write words related to problems and discussing their meaning in the context of the problem, students will have more opportunities to know what to do with problems

Method

Purpose and research questions

The purpose of his research is to find appropriate ways and activities to develop students' abilities to solve word problem in mathematics.

Research questions are:

What impact has the development of mathematical vocabulary to develop students' abilities in word problem solving?

What impact has the application of feedback in the development of students' abilities word problem solving?

School context and participants

This research is carried out with third grade students, in elementary school "Yll Morina" in Gjakova, exactly III₃ class in which attend 34 students 8- 9 years old (20 boys and 14 girls). Elementary school "Yll morina" in Gjakova is public school in urban environment and has 1229 students and 59 teachers. The total number of students in third grade is 132 students. Elementary school "Yll morina" in Gjakova is one of the most distinguished schools in Gjakova for successes and achievements of students, participation and performance of students in different competitions and organizing extracurricular activities.

Research design

Planning of this research is based on action research methodology, the research was carried out in the period November 2011-June 2012. At the beginning the literature has been reviewed, various items and related research studies in this area. Before planning action plans was conducted questionnaire for teachers in order to identify the attitudes of teachers about word problem solving and actions in enabling students in this direction. The questionnaire was conducted with 24 teachers from "Yll Morina" elementary school. After that are realized interviews with students from III₃ class in order to obtain information about their attitudes in word problem solving. Then is realized the first test for students whose role was to identify the current students situation in the classroom during word problem solving. The test contained four problems and from students is required to solve them. Analysis of data from the teachers questionnaire and the results from the first test gave the same results that helped in the planning of the first action plan. To ensure the validity of this research is used "triangulation" of the data (Creswell, 2008, p.266) and collaboration with "Critical – friends".

During analysis of results, we have been working separately, then together with professor we looked at the results. Problems from tests were assessed on the basis of the rubrics for assessment to ensure equal access to assessment of problems.

The first action plan

The first action plan was implemented in the classroom during November 2011.

At the beginning of this plan it has been realized a pre-test with students. Pre-test contained 11 words from the terminology of mathematics for which from students is required to write what they understand from those words. At the end of this plan was carried out post-test with same words (Amen, 2006).

During the implementation of this plan in the classroom were conducted various activities to develop students vocabulary, in enabling students to understand and use different mathematical terms.

Students in many cases by the lack of understanding of the terms perform wrong actions, or either do not understand the terms expressed in mathematical language. To solve word problems students should know mathematical vocabulary, understand mathematical concepts and translate words from native language to mathematical (Sharma, 2001). Every hour of teaching mathematics started with clarifying mathematical terms of lesson unit (Chard, 2003), but their explanation continued in other phases of lesson.

Besides are explained extensively with words terms, students have written the vocabulary with special terms in their notebooks and behind them the clarification, they formed mathematical dictionary (Blessman & Myszczyk, 2001; Brethouwer, 2008).

Formation of the "word wall" was an activity in which many words from the terminology of mathematics are located in the wall of the classroom, where students at any time have been able to see and read them.

In many studies the word wall has been very effective for the development of mathematical vocabulary (Amen, 2006; Fogelberg et al., 2008; Georgius, 2008; Brethower, 2008). Presentation of the word wall was support for all students, because in this way the words have been exposed at all times and near students (Burns, 2007).

During this time, there have been developed other activities such as: the game in pairs between students, word explanation for mathematics word problems, where was important the use of mathematical terms during explanation and not only the use of common words from the dialy vocabulary (Solomon, 2009).

Another activity was the presentation with drawings or examples for different words, exercise in worksheets called *What does it mean?* In which studnts explained the words: addition, subtraction, multiplication ad division through word explanations, presenting examples and illustrated with drawings.

Summary of the first action plan

- Pre-test about mathematical terms
- Clarification of everyday mathematical terms and students dictionary
- Word wall in classroom
- Games in pairs with words
- Two part diary – word expalanation during problem solving
- Activity: What does it mean?
- Post-test mathematical terms (the same as the pre-test).

The second action plan

The second action plan was the implementation of formative assessment strategies-feedback. Was conducted in period March-June 2012. During the implementation of this plan was use feedback during word problem solving. Feedback was provided by teacher, but also by students for each other. Feedback was mainly provided in writing, but sometimes in verbal.

The purpose of the feedback was to improve the performance of students and to orient them to the proper procedures in word problem solving, highlighting potential errors in order to improve and clarify steps in problem solving.

Students solved word problems and for every problem solved is given feedback for improving the students performance, clarification and guidance in further work.

Summary of the second action plan

- Writing and verbal feedback by the teacher
- Feedback by students for each other

At the end of each action plan are carried out tests to identify the impact of the action plans and the final test.

Findings and interpretation

The results and findings from this research have provide not only answers to the research questions, but also to concerns about word problem solving.

Results of the questionnaire with teachers

Teacher questionnaire contained 11 questions, of which 9 questions have been formulated according to Likert's scale and two were open ended.

Answers from the questionnaire were analyzed by statistical method and the answers from open-ended questions first were read carefully to gain a general impression, identified text segments and then marked "codes" to describe the meaning of those segments. After that is formed a list of categories with 'codes', are reviewed and reduced and are selected writing materials (Creswell, 1998).

Answers of teachers questionnaire showed: students have difficulty on understanding and solving word problems, they need guidance during problem solving and they lack necessary skills to solve word problems.

"Students have difficulty to understand mathematical terms, do not understand the language of mathematics."

"Students do not have the patience to read mathematical problems, they see mathematics as numbers rather than words." (Some of teacher answers).

Teachers give many reasons for the importance of developing students abilities for word problem solving: students will be more logical and will develop higher levels of thinking, will develop various skills they need for everyday life, will understand better concepts and mathematical content.

"Word problem solving develops students' logic and promotes high levels of thinking".

"Enabling students to solve word problems help them to be better problem solvers in the future." (Some of the teacher reasons).

Results of the interview with students

Of the 34 interviewed students, 30 students (88%) answered that they like to solve word problems, while 4 students (12%) stated the opposite.

Table 1 Students attitudes for word problem solving


Word problem solving
Positive attitudes Word problems are fun. We like to solve word problems because we learn more. Word problems are interesting to be solved, there are always new things.
Negative attitudes Difficulty in problem solving is misunderstand of words. In word problems we have difficulties to find a solution. Determining the appropriate mathematical operation to solve problem is not easy.
Neutral attitudes Word problem solving is the same as the solution of other tasks in mathematics.

Results of the first test with students

Results from the first test showed that students have difficulties to solve word problems. Average scores achieved by students in this test is 10.74 (67% of the maximum score). Analysis of these results showed that students have difficulty in understanding mathematical terms.

Figure 1 Wrong solution (failure to understand the word decrease)

1. Shumën e numrave 39 dhe 47 zvogëloje për prodhimin e numrave 6 dhe 7.

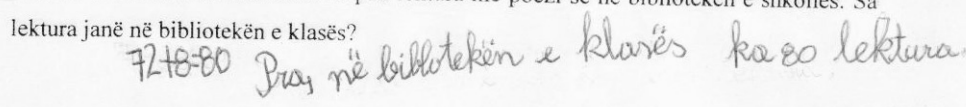


$(39+47) + (6 \cdot 7) = 86 + 42 = 128$

In the absence of the meaning of word decrease student failed to solve accurately, has increased the amount of numbers (39 + 47) with production of numbers 6 and 7, while the problem required the opposite. This case showed that students don't understand the words in problems, do not pay attention to the meaning of these words, so they do not solve problems. From this example and others noted that students do not understand the words: increase, decrease, double, x times more, y times less etc. Students often confuse the words: less than or x times less, or more than, y once more, which leads to the wrong operations during problem solving.

Figure 2 Wrong solved problem

2. Në bibliotekën e shkollës janë gjithsej 72 lektura me poezi për klasën e tretë, kurse në bibliotekën e klasës ka tetë herë më pak lektura me poezi se në bibliotekën e shkollës. Sa lektura janë në bibliotekën e klasës?



72+80 Pasi në bibliotekën e klasës ka 80 lektura

Wrong solution to the problem due to the misunderstanding of expression eight times less.

2. Në bibliotekën e shkollës janë gjithsej 72 lektura me poezi për klasën e tretë, kurse në bibliotekën e klasës ka tetë herë më pak lektura me poezi se në bibliotekën e shkollës. Sa lektura janë në bibliotekën e klasës?
 $72 : 8 = 9$

Figure 3 Lack of answer formulation

Lack of students' mathematical vocabulary is often accompanied by a lack in formulation of answers from students for solved problems. In many cases the problems are correctly calculated, but lacks written answers.

Figure 4 Wrong solution of the problem

2. Eni lexoi një libër me 112 faqe për tre ditë. Ditën e parë lexoi 28 faqe, ditën e dytë lexoi dyfishin e faqeve të ditës së parë. Sa faqe lexoi Eni ditën e tretë?
 $28 : 2 = 14$
 Për Eni ditën e tretë lexoi 14 faqe.

Misunderstanding of the word twice than a number affects computation of twice by dividing.

Noting the causes that impact the misunderstanding of mathematical words and the types of difficulties expressed by students in these and other cases, was realized the first action plan.

Results of the second test with students

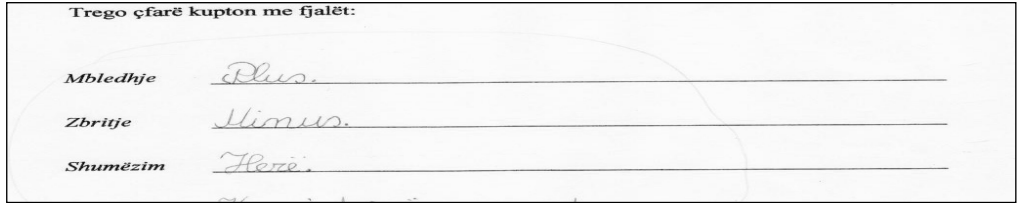
The second test was realized in order to identify the effects of the first action plan. Average score achieved by students was 12.56 (78% of the maximum score). The results showed that the first action plan has been influential in the development of students' abilities to solve problems.

Table 2 Average scores of pre-test and post-test

	Pre-test	Post -test
Pikët maksimale	11	11
Average scores achieved by students	7.68 (69.82% of the maximum score)	10.41 (94.64% of the maximum score)

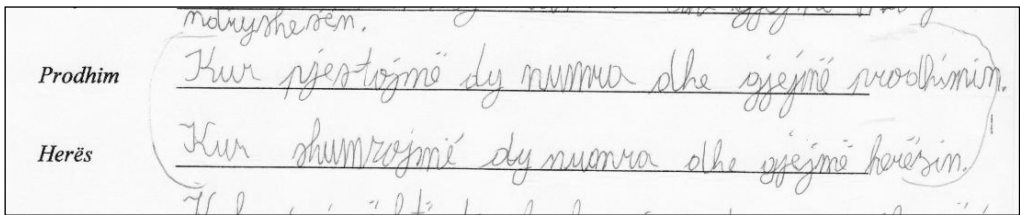
Post-test results showed the improvement of student's vocabulary and understanding of mathematical terms.

Figure 5 Interpretation of mathematical concepts and difficulties in their explanation



Students in some cases could not explain the different mathematical terms, so they explain them by using mathematical symbols.

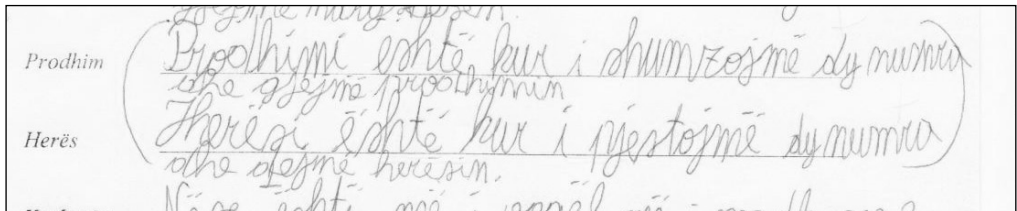
Figure 6 Wrong interpretation of the meanings product and quotient



Lack of understanding of mathematical terms affects inaccurate explanations. When are confused by mathematical words students use inappropriate actions to solve problems

Figure 7 Verbal explanation of mathematical concepts

After working with vocabulary student understood correctly mathematical words



and gave proper explanation.

The first action plan on the development of students' mathematical vocabulary has developed students skills. Students who at the beginning had difficulties in understanding of different mathematical terms, after working on the development of vocabulary showed that they understand certain terms. This is noticed after being collected and analyzed one by one all the works of students after problem solving. However, students have continued to have other difficulties in solving these problems. For this reason continued the second action plan.

Results of the third test with students

Average score achieved by students in the third test was 13.97 (87.31% of the maximum score). The results confirmed the positive impact of the second action plan in the development of the students' skills in problem solving.

Figure 8 Feedback

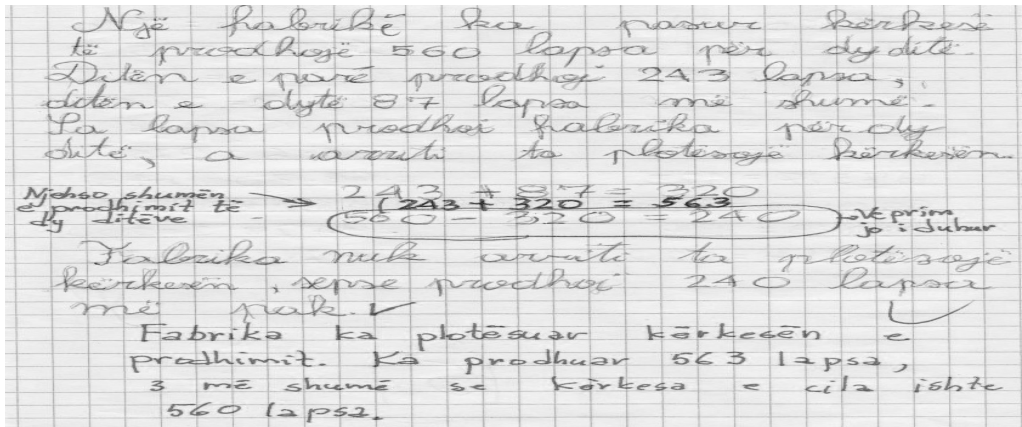
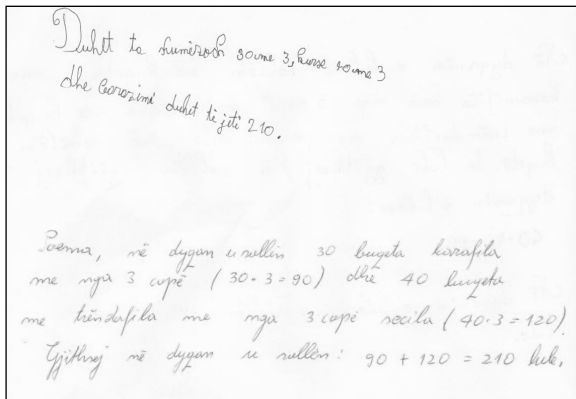


Figure 9 Providing feedback by teacher and students.



Feedback through the explanations for correct problem solving for students showed improvements in their further work, because in this way students had opportunity to see their mistakes and have taken appropriate explanations for any uncertainty.

The final test results

The final test results showed the positive impact of actions in developing students' abilities in word

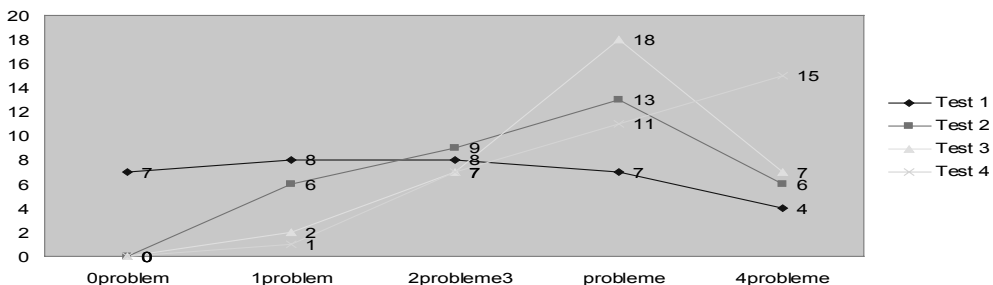
problem solving.

Average of final test score is 16.68 (91.75% of maximum score).

The results of four tests

Figure10 The results of four tests

From the analysis of the results of four tests we see changes, exactly increase of the results in the number of problems solved correctly by students and average score for



each test. Action plans have shown positive effects on students performance, after every action plan are increased students results and is increased the number of students who solve problems correctly. Generally emphasize that the actions in this research developed students' abilities in word problem solving.

Discussion

Word problem solving affects the development and application of student's knowledge and abilities in mathematics, thus, it must be an integral part of the teaching and learning of mathematics. Difficulties which present students in word problem solving can be improved by different strategies and activities and students can be trained in this regard. Implementation of collaboration action research proved to be very efficient for the development of students' skills and improving their work in word problem solving and changing teachers practice.

Implementation of the actions plans included in action research cycles resulted in achieving the purpose of the research and answered to the research questions. The research results showed that there is a direct link between problem solving and understanding of the vocabulary (Amen, 2006; Burns, 2007; Brethower, 2008; Georgius, 2006; McConell, 2008). After working with mathematical vocabulary "students had higher achievement test scores" (Amen, 2006, fq. 23). The research showed that the first action plan on the development of students' mathematical vocabulary contributed to enabling students to understand mathematical terms. Understanding of mathematical terms, frequently explanations have higher impact on the results of word problem solving. In her study, Amen (2006) showed that 'students should write, visualize and act about mathematical vocabulary' (p.24) and repeat it constantly. This was one reason that this research the work on vocabulary continued in further.

Findings from Brethouer (2008) showed that the impact of vocabulary in learning of mathematical concepts is related to a deeper understanding of them. McConell (2008) showed that students are better at problem solving when they understand the words in problem and the learning of vocabulary improves students' understanding of mathematical concepts. Beside the impact of the learning vocabulary in problem solving, the research showed that the learning of vocabulary improved students communication and expression at mathematics and expanded their answers and reasoning for problem solving.

Using the "word wall" and retaning vocabulary from students has been an effective tool to help students in memorizing various mathematical terms and acting with them (Georgius, 2008; Brethower, 2008; Fogelberg, et al, 2010). A very useful strategy in this research was the feedback. Feedback provide a clear information for students for their work, for correction, but also served as a guide in future work. Two-way communication between me as a teacher and students provide information for identifying the difficulties faced by students and at the same time it helped the discovery of the causes which bring the difficulties (Murchan, Shiel, Vula, 2012). Feedback was very productive, especially when students give useful information to each other.

Conclusions

Action research methodology was a very good way to develop student's abilities

in word problem solving and to improve our practice in the classroom. Difficulties that students express in word problem solving can be overcome through various strategies and activities. It is important for students to have more opportunities to solve word problems and not to be included only in accounting tasks, because these problems allow them to connect mathematical concepts with real life problems.

Developing of students' mathematical vocabulary help students to understand the different words in mathematics, to express and communicate freely about mathematics and to understand words and demands in word problems. Knowledge of various mathematical terms allows students to be better problem solvers. Students need clarification and guidance in their work, especially in word problem solving. Feedback was a useful strategy that enables students to improve their work and be focused on further work.

As conclusion, identification in time of students' difficulties in learning, planning of activities according to the needs of students, the implementation of 'action plans' and reflection of them can provide a quality education for our students.

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