

**WORD PROBLEMS IN THE SCHOOL MATHEMATICS
COURSE AS A TOOL FOR DEVELOPING
STUDENTS' SOCIAL COMPETENCE**

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The paper considers word problems in the context of the acquisition of a social component in school mathematics courses. It provides a definition of a word problem, requirements for its construction, recommendations for its composing, reveals some details of the formation of habits of mathematical modeling when dealing with such problems.

Mathematical literacy is a necessary element of the cultural, social, personal and professional competence of individuals. In the Russian project “A concept for the development of mathematical education” [1] dated 2013 some priority goals of preschool and school mathematics education are raised concerning the formation of the following abilities:

- logical thinking, designing, communicating and interacting on broad mathematical content (from geometry to programming);
- solving of fundamentally new mathematical problems, experimenting and observing, forming of internal (mental) representations and models of mathematical objects, formulating and testing of hypotheses, overcoming obstacles for intelligence;
- mathematical modeling of reality, constructing models and interpreting results, applying mathematics by means of included ICT.

A special role is traditionally assigned to independent problem decisions and “fundamentally new and unexpected choices at the limit of the student’s abilities” [1, 2]. The full achievement of the raised goals counts on word problems elaborated in the activity approach logics for motivation [3]. The essence lies in the fact that in the classroom the teacher creates models of real or imaginary life situations and offers possibilities for students to act in them supported by their actual knowledge and experience.

The notion of “word problem” is rather tentative, since it is not a task in the conventional sense but a “life imitation” situation requiring use of mathematical tools by students to describe and to solve it. Here is an example of a story implemented into a word problem that could be used in mathematical classes: “A young family, living in a rented flat, wants to buy a house of their own. It is possible to accumulate the necessary amount of money or to carry out the purchase on mortgage. Given are the price of the house, the interest rate of the mortgage, the monthly amount of money which could be accumulated and the monthly rent payment for the flat. Determine the most profitable way of acquiring the property.”

The following requirements for a word problem are formulated in [3]:

1. The context should be based on actual student life experience, views, knowledge (including the common life and the pre-scientific one), opinions, preferences, etc. This will help to overcome the knowledge formalism, which results in a mismatch, in a breach between stable life views and the new scientific concepts.

2. The word problem is notable for its principal uncertainty and openness. It has no standard of regularity. On the contrary, it presumes a set (an infinite one not rarely) of variable answers and solutions. Performing such a task, it is impossible to make a mistake and to give a wrong answer. This eliminates the possibility of internal obstacle appearances: anxiety, fear of failure, of making a mistake – which characterizes the task as not difficult for students at all, regardless of the level of complexity.

3. Word problems are non-standard, original, sometimes even paradoxical in their context. This feature creates a powerful effect of curiosity and novelty, thus raising the interest.

4. Word problems play the role of traps and in a non-evident way lock the tasks which are related to the basic ideas of the teaching class or the training session. Taking part in the process of their solutions students fall into educational problems, which become personality significant, growing up from the context of previous activities.

The essential characteristics of word problems allow them to be considered as effective tools of stimulating student interest to the discipline. In school mathematics courses they could also act as a significant base for the development of mathematical modeling skills and this presumes their use at the stage of the topic generalization.

It is well known that the process of mathematical modeling involves several stages. The first one is the information mathematization, which means a translation of the given data into mathematical values. For such a reason, after reading and discussing the content it is necessary that students identify the corresponding mathematical values which are reflected in the conditions of the problem. Also, one should pay attention to the measure units (it is better if different units of measurement are used in the problem, which gives another reason for repetition).

The next stage should be the establishment of functional dependencies between variables. It is very useful to work with records in the form of formulae. For example, the writing $A = B \cdot C$ could be performed by various values, specifying the connection between them each time. On the contrary, students could be asked to write down the relation by their own through letter symbols, using the variables which are involved in the problem.

The third stage is the formulation of a proper mathematical problem (equation, inequality, system, etc.), which should be backed with arguments! To the moment of the start to work with a word problem all used approaches and methods should be learned to a level of skills (or better – habits), since the goal should be the formation of mathematical modeling techniques! Solutions of proper mathematical problems should be fast, without any cumbersome calculations (in extreme cases one may use a calculator and this could be made even interesting).

The fourth stage is interpretation of the obtained result in mathematical terms at the beginning and in terms of the problem afterwards.

The next stage is very important. A generalized model should be constructed by alphabetic symbols. Because the data is not known, an equation is composed, in which

the numerical data is replaced by letters (for example, $ax + by = c \dots$)

It is not necessary to replace all the data by letters immediately. This could be done consecutively. Further, additional data is offered (in a table for example), which could be replaced in the obtained letter system and to solve it (each student has his/her own system). Be sure to select such a data for which unsolvable (even for excellent students) system exists. Discuss the reasons for the result.

It is important to have in mind that the problem situation created by the teacher should grow up not from an academic problem but from contradiction and from a problem of student real life, from his/her personal experience, which form the context of the lesson reflecting the public or the social-cultural experience, the requirements of the standard and the needs of the trainee.

The following algorithmic recommendations are proposed in [3] for the construction of word problems, which could be used in school mathematical courses:

1. When defining the topic of the lesson think over facts possibly known to students.
2. Determine details in the content, which could be novel to students.
3. Discover the personal significance of the new knowledge, which could be acquired by students during the forthcoming classes, i.e. formulate answers for your own use of the following questions: "Which are the reasons to consider the planned new knowledge to be important for students?"; "What kind of interest would the new knowledge provoke?"
4. Formulate answers of the previous questions generally in a form of personality significant problems. The formulations should be of inquiry-based type but this time from the side of students.
5. Think of any real life situation for self-determination and realization of a personality significant problem for students after analyzing and acting in it.
6. Construct a text describing the given situation, i.e. determine the conditions of the word problem.
7. Formulate the task, which requires analysis of the situation or realization of actions corresponding to it.
8. Evaluate the quality and the expected effectiveness of the constructed word problem from two points of view:
 - firstly, determine whether it helps to meet the problem, which corresponds to the program topic of the class lesson;
 - secondly, determine whether the given task contains orientating features for students to obtain an answer of the personality significance question concerning new knowledge and skills.

Not only subject knowledge and skills are exhibited by means of word problems but also systematics and functionality, independence and creativity thinking, other personality characteristics. In the process of word problem solving trainees receive additional knowledge and form abilities to apply mathematical tools in real situations. In such a way word problems could become a base for financial literacy formation of students, which is one of the contemporary directions of renewing the curriculum of the general education.

Subjects of word problems could be: the most effective means to save money in different currencies, definition of the advantage in house buying on mortgage, purchase gain on credit, choice of the most economical route of a trip, etc. The results of the word

problem use in mathematics teaching make evident the level increase of motivation and cognitive interest to the discipline and as a consequence the level of learning achievements.

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ТЕКСТОВИТЕ ЗАДАЧИ В УЧИЛИЩНИЯ КУРС ПО МАТЕМАТИКА КАТО СРЕДСТВО ЗА РАЗВИТИЕ НА СОЦИАЛНА КОМПЕТЕНТНОСТ

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В статията се разглеждат текстовите задачи в контекста на придобиване на социална съставяща в училищния курс по математика. Дадени са дефиниция на текстова задача, изисквания за конструирането ѝ, препоръки за съставянето ѝ, разкрити са особености на формирането на навици за математическо моделиране при работа с нея.