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METHODOLOGY FOR THE DEVELOPMENT OF FUNCTIONAL LITERACY OF SECONDARY SCHOOL STUDENTS THROUGH TEACHING SOLVING CONTEXTUAL PROBLEMS IN MATHEMATICS

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Abstract. The article discusses the problem of developing mathematical literacy as part of functional literacy within the context of modernizing school math education. It justifies the relevance of incorporating functional literacy into the general education system and explores various approaches to understanding it. The content and structure of mathematical literacy are defined, and the characteristics of contextual problems designed to develop and assess mathematical literacy are presented. The paper analyzes the challenges and proposes ways to incorporate mathematical literacy as an aspect of math education development. It also considers the possibilities of using subject-based, interdisciplinary, and practical contextual problems to foster mathematical literacy. Finally, conclusions are drawn regarding the outcomes of implementing functional literacy in math instruction. In this regard, the aim of our article is to justify the need for a methodology to develop functional literacy among secondary school students by teaching them how to solve contextual problems in mathematics.

When writing this article, we used certain scientific methods to explore the topic. To fully understand the topic, we applied theoretical and empirical methods, as well as methods for analyzing scientific literature, generalizing, comparing, and systematizing theoretical knowledge, which allowed us to describe the foundations of the methodology for developing functional literacy among secondary school students through teaching them to solve contextual mathematical problems.

According to the findings of this study, many researchers have found that the development of functional literacy through mathematics lessons not only enhances students' knowledge level but also fosters their critical thinking and analytical skills. This includes the ability to solve problems, which in turn contributes to contextual math problems. The conclusion of this study is that contextual math problems help students apply their mathematical knowledge to real-life situations, providing an opportunity for them to develop functional literacy.

Key words: mathematics, methods of teaching mathematics, functional literacy, secondary school, education, contextual problems, mathematical literacy, PISA

Introduction

The formation and development of functional literacy of schoolchildren, in particular mathematical literacy (one of the components of functional literacy), interests and worries many researchers M.A. Ushakov, G.A. Simanovskaya, I.N. Vlasov, E.I. Sanin, E.Yu. Lukichev and many others.

Thus, M. A. Ushakova uses special contextual problems, problem situations presented in a certain context and solved by means of mathematics accessible to the student, to form mathematical literacy in school mathematics lessons.

G. A. Simanovskaya offers introductory training, flexible interdisciplinary elective courses, where the emphasis is on problems that allow you to adapt mathematical knowledge to objects, situations and processes in various spheres of life.

Special attention should be paid to the study by I. N. Vlasov, devoted to the formation and development of general pedagogical skills of schoolchildren, which are an important component of functional mathematical literacy. In his research, he described the methodological conditions for the formation of basic logical actions of schoolchildren in mathematics lessons.

E. I. Sanina, I.V. Nasikan demonstrated that the development of functional mathematical literacy is possible through contextual mathematical problems that develop students' research literacy as the basis for mastering universal educational activities.

E.Y. Lukicheva in her article notes that for the development of functional literacy of schoolchildren, the teacher needs to adjust his activities in teaching mathematics at school, emphasizing the structure of the concept of "modern mathematical literacy" based on the principles of "fundamental mathematical ideas" and "mathematical literacy".

In our study, functional literacy in mathematics education refers to the use of the results of school mathematics education in real life. Functional literacy of students is inextricably linked with their culture of thinking and intellectual development. With this approach to the formation of functional literacy in teaching mathematics, under the culture of thinking of schoolchildren, we understand the correct application at a high level of development of meta-subject and subject-specific results of teaching mathematics, and intellectual development - the formation and improvement of mental actions, the appropriation of subject knowledge that allows solving various problems in the process of reproductive and productive activity [1].

So, in all the above studies, the concepts of "mathematical literacy" and "functional mathematical literacy" are presented as synonyms, which represent "facts, concepts, tools necessary to describe, explain and predict phenomena and events of professional and environmental life." By teaching mathematics to students and increasing their awareness and understanding of mathematical concepts and tools, their direct meaning of application, that is, interdisciplinary connection and with life, their functional mathematical literacy is formed.

All the above studies confirm that mathematical knowledge forms the basis of learning and literacy development. Mathematical problems are designed

to develop the ability to make mathematical calculations, reason and draw appropriate conclusions, with the help of which mathematical literacy is formed. Of course, with the help of mathematical problems, mental activity is successfully formed and developed, such qualities as speed, scale, independence, criticality, flexibility. It can be found that the style of thinking affects the way a person solves problems, behavior, and personal characteristics [2].

It should be noted that mathematical literacy is not a new phenomenon for Kazakh mathematical education. Suffice it to recall first the attempts to implement the concept of a labor school in the early twentieth century, and then the polytechnic school in the middle of the century, which, despite significant differences, were based on a practical approach. Let's consider some problems and ways to include mathematical literacy as a direction for the development of mathematical education.

Thus, the relevance of including mathematical literacy in the process of mathematical education of students should be considered not only as a response to external challenges - the need for new competencies of future specialists - but also as an internal response of each student. A significant part of students do not see the point in studying abstract mathematical concepts, because they do not imagine the possibility of their application in a real situation. This reduces motivation to study mathematics and increases negative attitudes. Showing students examples of how mathematics is used in our daily lives will help develop their motivation and interest in the subject. In addition, the safe use of mathematical tools makes it possible to increase the efficiency of solving various tasks both personally and in the future [3].

An important problem is the lack of special tasks in mathematics textbooks for the development of mathematical literacy, since most of them were created several decades ago, and publishing new ones is a time-consuming process in terms of intellectual and material costs. The preparation of textbooks and collections of problems can undoubtedly improve the situation, but only partially, since for this it is necessary to solve another task – the training of teachers who are able to systematically organize work on the formation of mathematical literacy in the process of using a specific program and an appropriate educational and methodological complex. Taking into account the above problems, we believe that the most effective way to form mathematical literacy is the use of contextual problems [4].

As school practice shows, the development of functional literacy is possible through contextual problems in mathematics. A contextual problem is a motivational problem, the condition of which describes a specific life situation in relation to the existing socio-cultural experience of students; the requirement of the task is to analyze, understand and explain this situation or choose a method of action in it, and the result of solving the problem is a meeting with an educational problem and awareness of its personal significance. Since the performance of contextual problems is one of the ways to organize the process of preparing students to complete the tasks of the PISA international study, contextual problems themselves are a means of preparing students to participate in the study.

Contextual problems contribute to the development of students' mathematical literacy. They differ from plot tasks in that they prepare students for life and create conditions for personal self-realization. Contextual problems allow students to gain experience in social relations, develop communication literacy, experience interaction and joint decision-making. Therefore, in the process of constructing contextual problems, we were guided by examples of contextual problems of mathematical literacy. The basis of the contextual problems is the text, which can be presented not only verbally, but also in symbolic form – in the form of a table, diagram, graph, geometric model. Therefore, in this research we focus on the methodology of developing the functional literacy of secondary school students through learning to solve contextual problems in mathematics

The modern level of development of society poses the task of general education of forming a personality capable of self-determination and self-realization, ready for continuing education. Therefore, school mathematical education, in accordance with the requirements of state educational standards, educational programs of basic and secondary general education, should be focused on the personal development of students and the achievement of educational results necessary for their personal and professional self-determination, readiness to continue education, in particular mathematical [5].

As you know, the International Student Assessment (PISA) and the quality of teaching mathematics and science in primary and secondary schools (TIMSS) are conducted to assess students' skills in various types of educational activities, in particular in mathematics, and their ability to apply knowledge in practice. The analysis of the results showed that children of school age 15 years have an insufficiently high level of functional literacy, reflecting the ability to apply knowledge in non-standard conditions similar to everyday situations. So, there is a contradiction between the required results reflected in the standards and the real state of mathematical education [6].

As is known, the need to resolve contradictions determines the relevance of the formation of functional literacy in teaching mathematics. Consequently, there is a contradiction between the required results reflected in the standards and the actual state of mathematical education. The need to resolve contradictions determines the relevance of the formation of functional literacy in teaching mathematics. Thus, today functional literacy is becoming one of the key factors of human success. This is the ability to apply the acquired knowledge and literacy to solve a wide range of problems in everyday life and professional activities [7].

An important role in the formation of functional literacy is played by the practical orientation of teaching mathematics, since it develops logical and analytical abilities, the ability to work with information and make decisions, as well as other school subjects. This means that the content, methods and means of teaching should be closely related to real life, the basics of other sciences and the preparation of students for the use of mathematical knowledge in the future. Therefore, the task of the teacher is not only to show and explain the material being studied to students, but also to involve them in the educational process, organize an independent search for new knowledge and, most importantly, show

how to apply the acquired knowledge to solve various life tasks and problems. And one of the main methods of developing functional literacy in mathematical education is solving contextual problems [8].

In this regard, the purpose of our article is to substantiate the need for a methodology for the development of functional literacy of secondary school students through learning to solve contextual problems in mathematics.

The research was based on the following tasks.

First, to reveal the problem of the formation of mathematical literacy as a component of functional literacy in the context of updating school mathematics education.

Secondly, to characterize contextual problems aimed at the formation and assessment of mathematical literacy.

Thirdly, to consider the possibilities of solving contextual problems for the formation of mathematical literacy using subject, interdisciplinary and practical contextual problems.

Fourth, to conduct research on the development of functional literacy of secondary school students through teaching them to solve contextual problems in mathematics and draw conclusions about the results of the introduction of functional literacy into the process of teaching mathematics.

The hypothesis of the study is that if contextual problems are applied in mathematics lessons in secondary school, then we will be able to develop the functional literacy of students.

Thus, within the framework of this article, the methodology for the development of functional literacy of secondary school students through learning to solve contextual problems in mathematics will be studied.

Materials and methods

When writing this article, certain scientific methods of revealing the topic were used. The article uses general scientific methods and approaches. Theoretical and empirical methods were used to fully disclose the topic in the study of this article. The following research methods were used in the work: text analysis in the form of an analysis of scientific literature that influences the study of methods for the development of functional literacy of secondary school students through teaching contextual math problems; as well as comparative analysis in the form of studying and summarizing the information obtained during the study. The following methods of empirical research are used as auxiliary methods: comparison, classification, generalization, and questioning. The methods and techniques of analysis were used in the work, corresponding to the set goal and the specified problems of the study. The mathematical processing of the data was carried out using generally accepted methods of analysis. In substantiating the directions of development, the monographic method, methods of analysis and synthesis were used.

The material for the research was articles and works of teachers in mathematics, textbooks, manuals, dissertations. As well as works on the topic of functional literacy. The study included 12 sources that meet the review criteria.

Results and discussion

Problems that develop functional literacy help students familiarize themselves with a variety of mathematical material, develop their creative abilities and cognitive interests. Additionally, consolidating and deepening students' knowledge on a given topic and developing practical skills involves working with various illustrations.

A special role in the implementation of these problems in the process of teaching a school mathematics course is played by a system of exercises, including contextual problems, as one of the ways to organize work on the formation and development of students' mathematical literacy, integration of mathematics with other subjects.

Research was conducted on the development of mathematical literacy at school, in particular, in order to determine the scope of use of contextual problems in the educational process, a survey was conducted among teachers on the topic "Contextual problems" (table 1).

Table 1 - Survey

Survey		
1	Name the distinctive features of context-sensitive problems (there may be several answers).	<ul style="list-style-type: none"> * the importance of the result obtained * context-based problems provide cognitive motivation for students * the task condition is formulated as a plot, situation, or problem * information and data in the task can be presented in various forms that require object recognition * specify the scope of the result obtained during the execution of the task (explicit or implicit) * non-standard in the structure of the task
2	Do you use contextual problems in the learning process?	<ul style="list-style-type: none"> * always * sometimes * I do not use
3	What types of context-based problems are used in the learning process (there may be several possible answers)?	<ul style="list-style-type: none"> * subject areas * Interdisciplinary * practicality
4	Where do you get contextual problems (there may be several possible answers)?	<ul style="list-style-type: none"> * I build myself * I get it from different sources
5	Name the sources that receive ready-made contextual problems (there may be several possible answers).	<ul style="list-style-type: none"> * International research objectives * UNT assignments * assignments written by colleagues * Internet * educational literature * collections of Olympiad tasks * other

During the study, methods of comparative analysis of the use of contextual problems in the educational process and analytical research were used.

The survey was conducted in the Google form. A total of 30 math teachers took part in the survey. The characteristics of the surveyed respondents are presented in Figures 1.

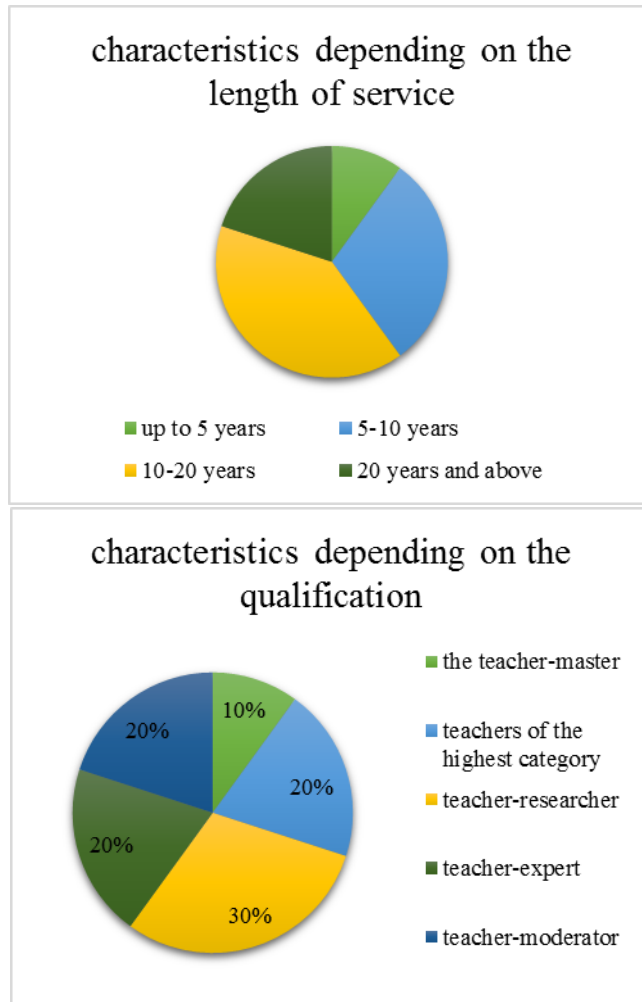


Figure 1 - Characteristics of the respondents

The content of traditional problems and contextual problems of a school mathematics course is designed to accompany the assimilation of the same elements of knowledge. However, traditional problems require certain knowledge, literacy and abilities, whereas contextual problems connect educational material with everyday life and are focused on the practical use of mathematics. Therefore, contextual problems differ from traditional problems.

To the question “what are the distinctive features of context-based problems” presented in the questionnaire, 60% of respondents replied that context-based

problems increase the cognitive motivation of students, 30% - that information and data in the problems are presented in various forms requiring object recognition, 20% - formulate the condition of the problems as a plot, situation or the problem, 30%, was based on the significance of the result (Figure 2).

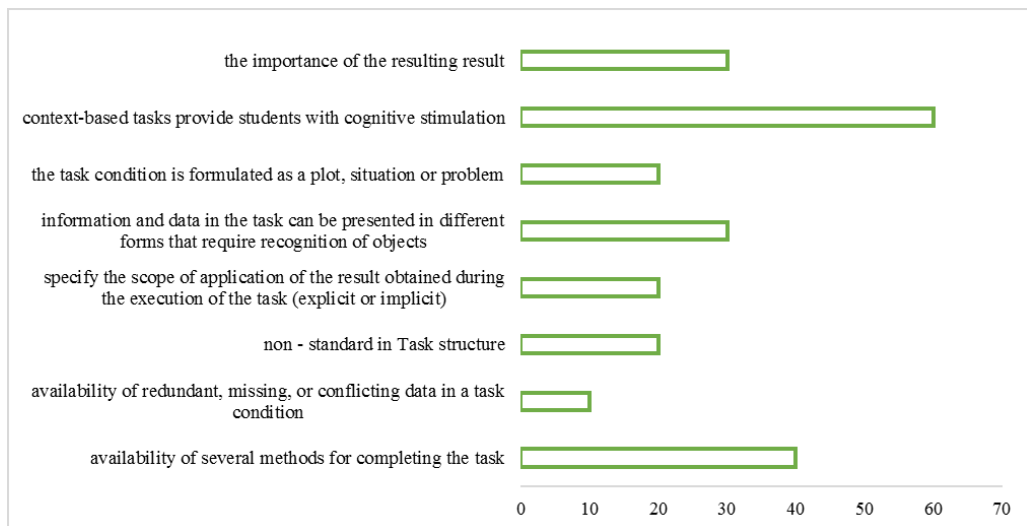


Figure 2 - Features of context-based problems

The use of contextual problems in the educational process connects educational material with life situations, shows its practical orientation, motivates students to learn and allows them to assess the importance of mathematics in everyday life.

In the survey, “do you use contextual problems in the learning process?” 20% of respondents said they use it all the time, 70% said they use it sometimes, and 10% said they don’t use it.

Contextual assignments should primarily correspond to the curriculum. When drawing up such problems, you should pay attention to the fact that:

- the terms used in them were familiar to the student or links to explanations were given.
- it contained enough new content to interest the student.
- there were systematic links between the questions.
- the problems consisted not only of text, but also of illustrations, etc.

What difficulties arise when composing problems based on the context “given in the questionnaire?” 32% of respondents stated that the difficulties lie in composing the text of the problems, 27%-in defining descriptors, 20%-in asking questions (providing instructions), 33%-in composing problems based on the context from traditional reports, and 18% said that there would be no problems (Figure 3).

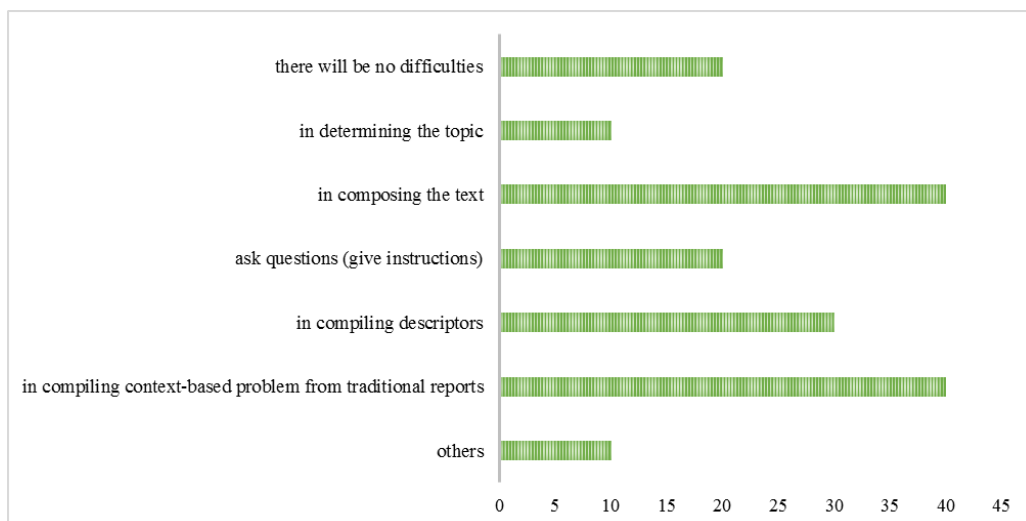


Figure 3 - Difficulties arising in compiling context-based problems

In addition, it was found that 60% of respondents receive context-based problems from the Internet, 50% from UNT assignments, 20% from collections of international studies, and 20% themselves.

As a result of the analysis of the questionnaire, the features of the contextual problems of the formation of mathematical literacy of students were revealed and the difficulties encountered in their compilation were revealed. In addition, the analysis shows that contextual problems should be widely used in the process of teaching and developing the functional literacy of secondary school students by teaching them to solve contextual problems in mathematics.

After conducting the research, it can be concluded that contextual problems should first correspond to the curriculum. When preparing such assignments, the following is necessary:

- make sure that the terms used are familiar to students or that links are provided for explanatory purposes.
- it contained enough significant news to interest the student.
- there were systematic links between the problems.
- the problems included not only text, but also illustrations.

The text of the math assignment may contain situations from other subjects or from everyday life, compiled in various directions. It is important to offer students a variety of contexts.

A contextual problem requires students not only to perform calculations, but also to justify their own answers. However, students must provide evidence explaining their actions. This contributes to the development of students' ability to think logically.

During the execution of a contextual problems, students develop the literacy of analysis, understanding and interpretation of a given situation, and choosing a way of conclusion. And, the cognitive interest of students increases, mathematical, educational, financial and information literacy develops [9].

To effectively develop functional literacy, it is advisable to more actively use contextual problems in the educational process, problems based on real stories, to motivate students to consciously acquire knowledge and develop literacy related to the application of knowledge in development in various contexts and situations [10].

Conclusion

Thus, the development of functional literacy in mathematics lessons not only increases the level of knowledge of students, but also develops their critical thinking, analytical abilities and problem-solving literacy. This is especially important in today's world, where rapidly changing technologies and economic conditions require people to adapt and respond quickly to new challenges. Therefore, the development of functional literacy should become one of the priorities in the education system. It is important not only to give students knowledge, but also to teach them how to apply this knowledge in practice, to solve real problems and problems. Only such an approach can ensure the successful development of a personality and prepare it for life in the modern world [11].

In conclusion, I would like to note that the development of functional literacy of students in teaching mathematics is a complex process. And its methodological basis is the formation of a culture of students' thinking and their intellectual development, aimed at students acquiring not only subject knowledge, but also the formation of meta-subject learning outcomes. In this process, the teacher uses contextual problems to create problematic situations and organize students' active and independent activities to solve them. After all, contextual math problems help to draw students' attention to the subject and help them apply subject-specific mathematical knowledge in real life, providing suitable conditions for this. They influence students' understanding of the importance of mathematics in solving practical life situations through their modeling using mathematical tools. Thus, the better, faster and more efficiently students solve contextual problems, the higher will be not only the level of knowledge of the subject, but also the results of meta-subject learning. This approach to the organization of teaching mathematics directly affects the quality of formation of the culture of thinking of students and their intellectual development, and therefore, the formation and development of functional literacy of students [12].

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ОРТА МЕКТЕП ОҚУШЫЛАРЫН КОНТЕКСТІК ЕСЕПТЕРДІ ШЫҒАРУҒА ҮЙРЕТУ АРҚЫЛЫ ФУНКЦИОНАЛДЫҚ САУАТТЫЛЫҒЫН ДАМУ АӘДІСТЕМЕСІ

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Аңдатпа. Мақалада мектептегі математикалық білім беруді жаңарту контекстінде функционалдық сауаттылықтың құрамдас бөлігі ретінде математикалық сауаттылықты қалыптастыру мәселесі ашылады. Функционалдық сауаттылықты жалпы білім беру жүйесіне енгізудің өзектілігі, оны түсінудің әртүрлі тәсілдері негізделеді, математикалық сауаттылықтың мазмұны мен құрылымы анықталады. Математикалық сауаттылықты қалыптастыруға және бағалауға бағытталған контекстік тапсырмаларға сипаттама беріледі. Мәселелер талданады және математикалық сауаттылықты математикалық білім беруді дамыту бағыты ретінде енгізу жолдары ұсынылады. Пәндік, пәнаралық және практикалық

контекстік тапсырмаларды пайдалана отырып, математикалық сауаттылықты қалыптастыру бойынша контекстік есептерді шешу мүмкіндіктері қарастырылады. Математиканы оқыту процесіне функционалдық сауаттылықты енгізу нәтижелері туралы қорытынды жасалады. Осыған байланысты біздің мақаланың мақсаты математикадан контекстік есептерді шешуге үйрету арқылы орта мектеп оқушыларының функционалдық сауаттылығын дамыту әдістемесінің қажеттілігін негіздеу болып табылады.

Осы мақаланы жазу кезінде тақырыпты ашудың белгілі бір ғылыми әдістері қолданылды. Тақырыпты толық ашу үшін осы мақаланы зерделеу кезінде теориялық және эмпирикалық әдістер, ғылыми әдебиеттерді талдау, теориялық білімді жалпылау, салыстыру және жүйелеу әдістері қолданылды, бұл математикадан контекстік есептерді шешуге үйрету арқылы орта мектеп оқушыларының функционалдық сауаттылығын дамыту әдістемесінің негіздерін сипаттауға мүмкіндік берді.

Осы мақаланың нәтижелеріне сәйкес, көптеген зерттеулер математика сабақтарында функционалдық сауаттылықты қалыптастыру оқушылардың білім деңгейін арттырып қана қоймай, олардың сыни ойлауын, аналитикалық дағдыларын және проблемаларды шешу қабілетін дамытатынын көрсетеді. Өз кезегінде математикадан контекстік есептер ықпал етеді. Бұл мақаланың қорытындысы математикадағы контекстік есептер оқушылардың назарын оқу пәніне аударуға ықпал етеді және оларға пәндік математикалық білімді нақты өмірде қолдануға көмектеседі, бұл үшін тиісті жағдайларды қамтамасыз етеді. Олар функционалдық сауаттылықтың дамуына әсер етеді.

Тірек сөздер: математика, математиканы оқыту әдістемесі, функционалдық сауаттылық, орта мектеп, оқыту, Контекстік есептер, математикалық сауаттылық, PISA

МЕТОДИКА РАЗВИТИЯ ФУНКЦИОНАЛЬНОЙ ГРАМОТНОСТИ УЧАЩИХСЯ СРЕДНЕЙ ШКОЛЫ ПОСРЕДСТВОМ ОБУЧЕНИЯ РЕШЕНИЮ КОНТЕКСТНЫХ ЗАДАЧ ПО МАТЕМАТИКЕ

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Аннотация. В статье раскрывается проблема формирования математической грамотности как составляющая функциональной грамотности в контексте обновления школьного математического образования. Обосновывается актуальность включения функциональной грамотности в систему общего образования, различные подходы к ее пониманию, определяется содержание и структура математической грамотности. Дается характеристика контекстных заданий, направленных на формирование и оценку математической грамотности. Анализируются проблемы, и предлагаются способы включения математической грамотности как направления развития математического образования. Рассматриваются возможности решения контекстных задач по формированию математической

грамотности с использованием предметных, межпредметных и практических контекстных заданий. Делаются выводы о результатах внедрения функциональной грамотности в процесс обучения математике. В связи с этим целью нашей статьи является обоснование необходимости методики развития функциональной грамотности учащихся средней школы посредством обучения решению контекстных задач по математике.

При написании данной статьи были использованы определенные научные методы раскрытия темы. Для полного раскрытия темы при изучении данной статьи были использованы теоретические и эмпирические методы, приемы анализа научной литературы, обобщения, сравнения и систематизации теоретических знаний, что позволило описать основы методики развития функциональной грамотности учащихся средней школы посредством обучения решению контекстных задач по математике.

Согласно результатам этой статьи, многие исследования указывают на то, что формирование функциональной грамотности на уроках математики не только повышает уровень знаний учащихся, но и развивает их критическое мышление, аналитические навыки и способность к решению проблем. В свою очередь, к которому способствуют контекстные задачи по математике. Вывод из этой статьи заключается в том, что контекстные задачи по математике способствуют привлечению внимания учащихся к учебному предмету и помогают им применять предметные математические знания в реальной жизни, обеспечивая для этого соответствующие условия. Они оказывают влияние на развитие функциональной грамотности.

Ключевые слова: математика, методика преподавания математики, функциональная грамотность, средняя школа, обучение, контекстные задачи, математическая грамотность, PISA

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