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IMPLEMENTATION OF THE METHODOLOGY FOR TEACHING MATHEMATICS IN SECONDARY SCHOOL USING PORTABLE COMPUTER MEANS

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Relevance of the research is that methodological system for teaching mathematics that would allow for using portable computer means does not exist, but requires a more detailed research of the possibility of using in teaching mathematics using portable computer means.

Purpose of the research is to improve the methodological system of teaching mathematics through integrated use of portable computer means, aimed at improving the quality of schoolchildren in mathematics and its approbation. This paper uses the following research methods: system analysis with the aim of definition of methodological bases of perfection of a technique of training of mathematics and structure of learning activity; theoretical analysis of literature; meaningful analysis of periodical press materials; analysis and generalization of pedagogical experience of using portable computer means; conducting pedagogical experiment, analysis and processing of experimental results, personal teaching. Results of the research: the article substantiates the necessity of using portable computer means in the process of teaching mathematics. Practical significance of the research is that a methodical system for teaching mathematics based on the use of portable computer means was developed, implemented and tested.

Keywords: mobile learning, portable computer means, methodical system, mathematics, algebra, geometry

INTRODUCTION

In order to give an accurate and complete definition of the term "mobile learning", it is necessary to consider the sources of the origin of this phenomenon. In our point of view, the formation of mobile learning is inextricably linked with the development of e-teaching. In 2005, the English scientists J. Traxler and A. Kukulska-Hulme described the emergence of mobile learning as follows: "...in the UK, in most countries of Europe and North America, mobile learning emerged in the scientific communities teaching the e-teaching. This process was accompanied by expectations and disappointments, methods and technologies similar to those that were previously used and adapted for the introduction of e-teaching. This means that many early mobile learning projects have only attempted to update the methods and technologies of e-teaching, as well as virtual teaching environments (VLE) on mobile platforms. At the time, in the early 2000s, mobile phones and

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handheld personal computers had obvious limited application compared to personal computers - these limitations were expressed in connection speed, functionality, battery life, screen sizes, processor speed. At that time, mobile devices were not yet able to demonstrate their unique capabilities" (Traxler J., Kukulska-Hulme, 2005).

Modern mobile learning researchers M.Sharples, J.Taylor and G.Vavoula attempted to update the definition of mobile learning, pointing out that communication and context are important constructive elements for understanding this type of teaching. The authors propose the definition of mobile learning as "... a process of communication in several contexts and the use of personal interactive technologies" (Sharples, 2007).

Mobile learning has been emphasized in the scientific literature for the last ten years as a new form of education. During this short time, a number of worldwide, international conferences and other events were held aimed at the introduction, formation and further development of mobile learning. There are many scientific articles and books devoted to the problems of mobile learning, which reflect pedagogical, technological, social and other aspects of mobile learning in various educational institutions, including schools.

Analyzing the foregoing, it is possible to conclude that, despite significant number of researches devoted to the research problem it helped to determine the basic **contradiction** that exists objectively between the need for a modern education system in a dynamically developing mobile educational environment and the insufficiently developed methodological systems on the part of pedagogical science in organizing the use of portable computer means of training and their solution.All of the above makes the topic of "Methods of using portable computer means in secondary school" relevant.

MATERIALS AND METHODS

The main research methods were laws, education programs, statistics on the use of mobile technologies in the higher education system in Kazakhstan, and other foreign countries, the works of domestic and foreign educators, philosophers, psychologists; standard documents of the Republic of Kazakhstan, materials of world and international scientific and practical conferences in the field of mobile learning; materials of the pedagogical experience of the researcher.

Pilot and experimental base of the research was the schools named after N.Ondasynov "Daryn" in Turkestan, schools for gifted children "Daryn" in Kentau, the Republic of Kazakhstan.

The research of the problem was carried out in three stages:

At the first stage, a theoretical analysis of scientific, methodological, psychological and pedagogical literature in the field of theory and methodology of teaching mathematics, analyzed the specifics and possibilities of using portable

computer means in the process of teaching mathematics; analysis and assessment of the state of implementation and use of portable computer means in the process of teaching mathematics. The aim, tasks, working hypothesis are revealed, the validity of the research is justified. In parallel with this, in the process of working with schoolchildren, accumulation of the necessary material took place, and its theoretical analysis was carried out.

At the second stage, verification and concretization of key concepts and theoretical provisions of the research were carried out; approaches to the classification and selection of portable computer means for teaching mathematics are formulated. The methodical system of teaching mathematics with the use of portable computer means was improved; the contents of a special training course for schoolchildren was developed, and pilot and experimental paper was carried out.

At the third stage, the results of the research are tested in the practice of the work of educational schools; the results of the pedagogical experiment were summed up, processing, systematization and analysis of the research results were carried out, conclusions were formulated, the results of the dissertation research were prepared.

RESULTS

The heart of portable computer means is handheld computers. They became very popular, including in education, both abroad and in Kazakhstan. In the article (Grigoreva, 2004; Grigoreva, 2007), the aims and content of the course devoted to the research of the use of handheld personal computers in the field of education are considered.

Let us consider a special "Use of Portable Computer Means in Mathematics" course, intended for secondary schoolchildren. The course can be used in the process of retraining teachers. The course assumes the presence of the following content lines:

1. Portable Computer Means. Their role and place in the methodological system of education in modern school in mathematics;
2. Portable Computer Means Classification. Requirements for portable computer means and their operation in the school environment;
3. Technological features of software for mobile computer systems:
   - The communication program of the personal computer and portable computer means on the basis of mobile application;
   - Methods for exchanging files between a personal computer and a mobile application;
   - Creation of files libraries on external carriers for portable means;
   - Training in portable computer means (Mobile learning) (Internet resource);
   - Algebrion Mathematical Assistant Math Helper;

- "Geometry" application;
- The Kahoot program.

4. Organization of group and other extracurricular activities with schoolchildren using portable computer means in mathematics.

The "Use of Portable Computer Means in Mathematics" course presumes lecture and practical classes. Lectures - 17 hours, practical work - 17 hours. Practical classes should take place in a special computer class equipped with personal computers which have communications tools with mobile means.

The method of teaching the "Use of Portable Computer Means in Mathematics" course is carried out with the use of various types of classes, which require computer technology and specialized software.

The methodical aims of the "Use of Portable Computer Means in Mathematics" course are:

- mastering the methodical principles of using portable means and peripheral equipment for portable computer means in the education system by schoolchildren,
- acquaintance with theoretical principles of creation and development of soft-and hardware means of portable computer means and peripheral equipment,
- development of cognitive activity of schoolchildren, interest in the researched science and the taught subject in the teacher's training.

Classes in mathematics should be the most informatized. The teacher should be armed with a computer with the appropriate software and a connected projector. During the lesson, not only graphic objects that are elements of course content are demonstrated, but also individual software systems, development means in a step-by-step mode.

In the process of mathematics teaching, practical and self-guided works, organically supplementing the lessons, is of great importance. Practical works are designed for self-guided work of schoolchildren, in the course of which, with the help of educational and research activities, students repeat, consolidate and generalize theoretical and -methodological knowledge, practical skills and skills by solving practical problems in the use and programming of portable computer means in mathematics. Practical work always implies an active creative activity of the trainee, within the framework of which new knowledge; basic skills are acquired by the schoolchildren independently through obtaining the required result using the informatization means.Of the various methods of teaching, the most suitable method for practical work in mathematics is the method of real-world example.

M-learning - teaching using mobile information technology - allows you to improve your writing and math skills; Helps to understand your abilities Improved

group and individual teaching experience; Allows the learner to identify areas in which - more intensive teaching is required (Kuklev, 2007).

Practical work is carried out on the basis of descriptions in which tasks and exercises performed by schoolchildren in the course of practical work are given. Tasks of practical work should vary in type and complexity: some should serve to consolidate the material covered, in others, schoolchildren should use the modification of examples from the text of practical work, and still others should familiarize students with new concepts of working with portable computer means.

Let us consider the teaching technology (the teacher's actions) while using the "Algebrion Mathematical Assistant" application using mobile means (tablets, net-books, etc.).

Algebrion Math Helper (for Android OS) is a free version of the application for solving mathematical problems of the school and university course with step-by-step solutions, as well as a unique graphical interface supplemented with a solid theoretical base.Algebrion Math Helper is a graphical calculator for algebra in your smartphone replaces bulky and expensive portable calculators. The application is indispensable during the exams, sessions and home and examinations.

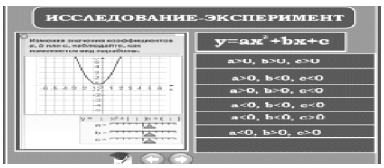
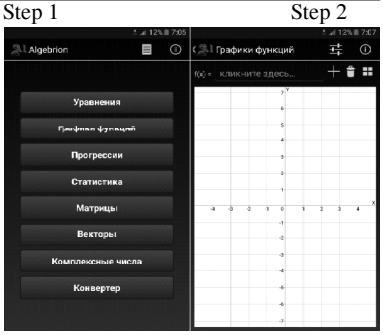
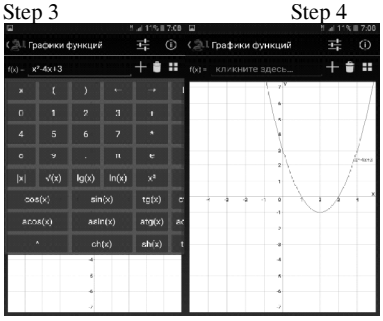
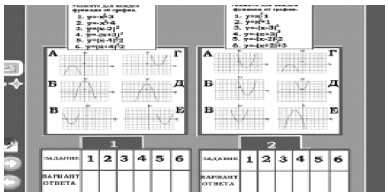
First, the teacher develops methodical instructions for each practical work using Algebrion Math Helper. Algebrion Math Helper includes 7 thematic sections: 1. Equations. 2. Graphs of functions. 3. Progression.4. Statistics. 5. Matrices. 6. Vectors. 7. Converting.

Practical works with the use of Algebrion Math Helper implies joint activities of teacher and schoolchildren to summarize the results of the task. Teacher advises schoolchildren and accepts the completed tasks, completed in the form of a report. A schoolchild can carry out self-guided work at school within the framework of training or preparation for it and at home.

The peculiarity of the self-guided work of schoolchildren is that this form of educational work logically completes the teaching in the framework of other forms of practical activity of schoolchildren, which makes it possible use in self-guided work to check your knowledge using the application during independent work. Papers by Pidkasisty are devoted to the types of self-guided work. It was shown in these researches that it is possible to perform self-guided work on the model, reconstructive and variable (Pidkasisty, 1972).

Self-guided work is built on the model, for example, the development of a new application for portable computer means is based on the mathematics course: algebra and geometry. Reconstructive self-guided work is based on the transformation of existing experience in solving problems on the topic "Quadratic function and its graph" for the 8th grade of the general education school. As an example, one can cite educational tasks using portable computer means on algebra on the topic "Quadratic function and its graph" (Table 1).

TABLE 1: EXAMPLES OF TRAINING ASSIGNMENTS USING PORTABLE COMPUTER MEANS ON THE TOPIC "QUADRATIC FUNCTION AND ITS GRAPH"

1. **NEW INFORMATION.** Teaching means: PPT. Using the presentation, we determine the algorithm for plotting the quadratic function given in the form of a quadratic polynomial. Structuring the algorithm for plotting **Frontal work.**	
1.1 **RESEARCH-EXPERIMENT. INTERACTIVE** Collective Frontal Work**.** Investigation of the dependence of the function position on the parameters a, b, c	
1.2 **Fixing new information.** Work in pairs. Construction of a graph based on the algorithm studied. Interactive check on tablets with the help of "Algebrion Mathematical Assistant"	Step 1 Step 2  Step 3 Step 4 
2. **Self-guided work.** Individual form of educational activity Determine the correspondence of the analytical function record to the graph in the drawing Check on the board.	

3	**Check of knowledge.** Interactive simulators. The game of two teams.individual answers on the board. Fixing the results on an interactive scoreboard.	

As an example, let's use the application "Geometry" using portable computer means. The developers of the application tried to make a calculator for all the figures that you can often see while studying various topics about geometry. The interface is made with a bias in simplicity, so you do not have to do a lot of unnecessary actions to get to the desired section. You just need to select one of the shapes, and then select the variable you want to find. Then just fill in the required fields with the data that you are given in the task or you have already found it and the application will immediately give you the correct result. However, it is very unfortunate that there is no possibility to look at the detailed decision; therefore it will be necessary to sort out the topic, since the teachers are unlikely to like the finished number without a detailed solution of the problem. It is fine that every figure has a completely understandable picture, which shows the variables that correspond to the values found.

In the settings, you can select the accuracy of the results that will be output, as well as the value of the Pisot-Vijayaraghavan number that will be taken for the solution. Let's give an example on the topic "Square of a parallelogram" using tablets.

Teaching of schoolchildren assumes the final control of the acquired knowledge and skills after completing the research of specific topics or sections on mathematics. Herewith, the use of portable computer means can have a significant impact on the effectiveness of organizing feedback from the schoolchild to the teacher. In this case, feedback can be based on current and periodic monitoring, testing of certain skills and abilities of schoolchildren related to the specifics of conducting practical classes. Informatization of such measurements of teaching outcomes can be carried out on the basis of universally recognized pedagogical testing means and with the help of special monitoring means designed to identify knowledge on the "Application of Mobile Educational Systems" course.

In this paper, the main forms and types of educational activity are established in the framework of the teaching "Use of Portable Computer Means in Mathematics" course in schools.

As software teaching means, high-level programming languages can be used, as well as packages of application software, software to support the operation of portable computer means, development systems. Typically, these systems are in the open access system or in the access mode, which allows them to successfully apply them in the process of work.

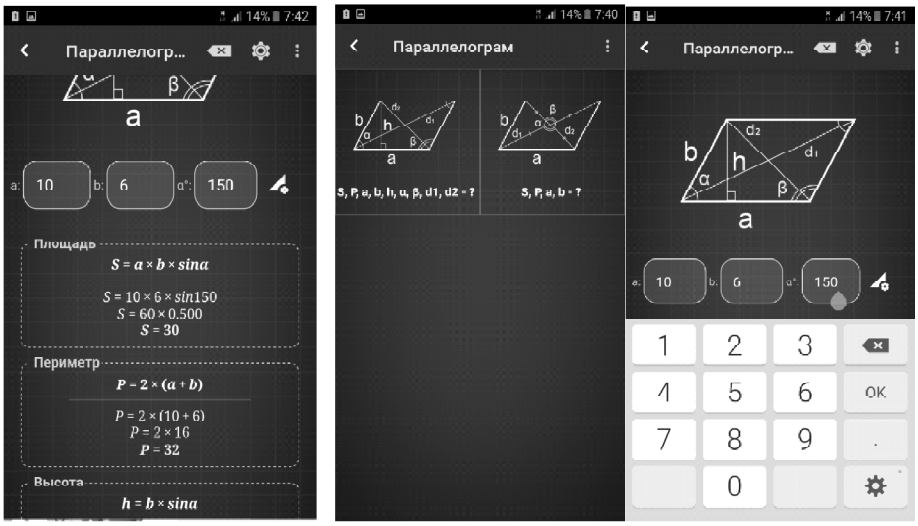


Figure 1: Interactive Check on the Tablets Using the Application "Geometry"

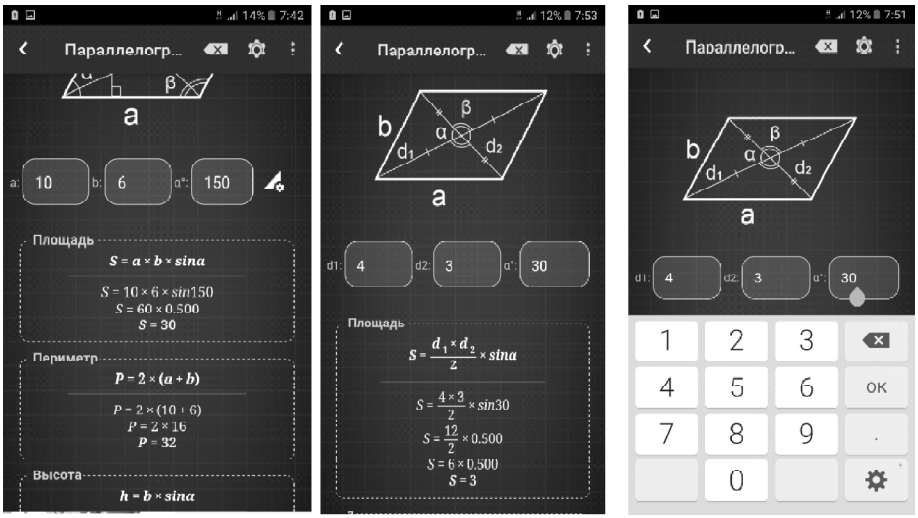


Figure 2: Solving Problems on the "Square of a Parallelogram" Using Tablets

Ascertaining experiment was based on a comparison of the results of the control and treatment group, which included secondary schoolchildren.

During the experiment, the following tasks were solved:

– approbation of the effectiveness of methods and means of using portable computer means while teaching schoolchildren in mathematics, determining the level of methodological training;

- comparative analysis of the level of preparation of the control and experimental groups;
- testing the effectiveness of the effective use of portable computer means in teaching schoolchildren in mathematics.

Teaching with mobile means is the most advanced type of training. It does not require being in a particular place at a particular time. You can study at any time, anywhere. You can develop your own teaching schedule. Teaching with mobile devices helps a person to develop a variety of skills, especially in the humanitarian and information fields. Teaching with mobile technology provides new methods of teaching, training and teaching. Teaching with mobile technologies is innovative distance teaching. This is a breakthrough in the development of education. Learn by mobile technology can all users of mobile devices and everywhere (adults and children, schoolchildren and students, at home and on the street). The environment for mobile learning is different from the traditional one. This is like an individual room with access to the Internet, constantly moving in the virtual space (Duiseyeva, 2016).

Traditional didactic conditions were formulated, specific didactic requirements due to the use of portable computer means, as well as:

- condition for the correct reflection of the features of the use of portable computer means in the content of the educational course of mathematics;
- condition for the unity of pedagogical and psychological aspects of the use of portable computer means in mathematics;
- condition for the correspondence of portable computer means involved in teaching mathematics, various teaching tasks.

Thus, in the context of the implementation of mathematics teaching, each student, depending on age, personal characteristics, level of computer skills and portable computer means, has specific needs and motivations, which can stimulate cognitive activity in organizing the teaching process of mathematics. Therefore, it is very important to correctly organize the work of students using portable computer means in math lessons, to strive to ensure that the external entertainment side of the application of this powerful technical means necessarily turned into an internal motive for using a computer in aim to realize the schoolchild abilities and the formation of his cognitive interests.

The pedagogical experiment was conducted on the basis of the N.Ondasynov school "Daryn" in Turkestan, the school for gifted children "Daryn" in Kentau, Republic of Kazakhstan. 99 schoolchildren participated in the experiment, which were divided into two groups.

Let us consider the analysis of the effectiveness of the use of portable computer means in the teaching of schoolchildren mathematics, conducted on the basis of general education schools.

The first indicator of the success of the experimental verification of the mathematics course developed content using mobile computer systems. The developed content in the field of the use of portable computer means obviously has an objective difficulty in understanding and assimilation for schoolchildren, so an important indicator of its characterizing is the schoolchildren' assessment of the availability of the presented training material.

To assess this indicator in the classroom on mathematics, it was carried out an experienced approbation, after classes anonymous questioning of schoolchildren was carried out. The data obtained are shown in Figure 3.

As we can see, the overwhelming majority of the schoolchildren surveyed assessed the level of accessibility of the presented training material, how high and significantly less their number determined it to be satisfactory. Thus, in general, schoolchildren who learn using portable computer means are satisfied with the quality of the received training content in the field of necessary knowledge and skills in computer science.

On the graph: 1st group of indicators - schoolchildren of a comprehensive school, 2nd group of indicators - schoolchildren of classes of natural-mathematical direction, 3rd group - schoolchildren of social and humanitarian classes.

The second indicator is the formation of schoolchildren' readiness for effective and adequate use of portable computer means. The developed aggregate of forms, methods, methodologies and means, which implements all the theoretically grounded elements of the developed technology and its formulated principles, is intended to prepare schoolchildren for effective and adequate use of portable computer means, so it was interesting to learn about it the opinion of students. For this purpose an anonymous questionnaire was conducted during the lessons of mathematics.

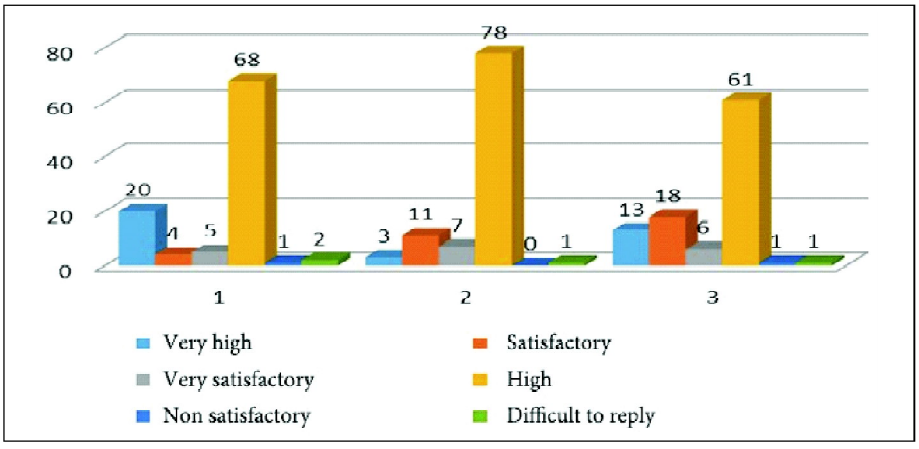


Figure 3: Assessment By Schoolchildren of the Availability of the of the Teaching Material on Mathematics Provided at the Classes

From the diagrams presented that, in the opinion of the majority of respondents in the lesson, enough time was allocated for the employment of mobile computer systems, at the same time about 1/3 of the schoolchildren considered this time not sufficient.100% of the schoolchildren surveyed showed their satisfaction with the proposed form of teaching.

The schoolchildren were very satisfied with the use of portable computer means in the mathematics class; their overwhelming majority rated the computer software as "good" and "very good". So, schoolchildren positively evaluated new methods and means for teaching mathematics.

Thus, the conducted analyzes showed the satisfaction of schoolchildren, developed content and technology with the use of portable computer means. This was confirmed by the opinions of schoolchildren about teaching using portable computer means (Figure 4). As we can see, all schoolchildren who answered the questions gave a high assessment for the new form of the teachingsession; they considered that training using portable computer means is necessary, interesting and useful.

On the graph: indicators of group 1 - schoolchildren of a comprehensive school, indicators of group 2 - schoolchildren classes of natural-mathematical direction, group 3 - schoolchildren of social and humanitarian classes.

Rapid development of mobile technologies will certainly entail their further more active penetration into education. Let's hope that there more and more

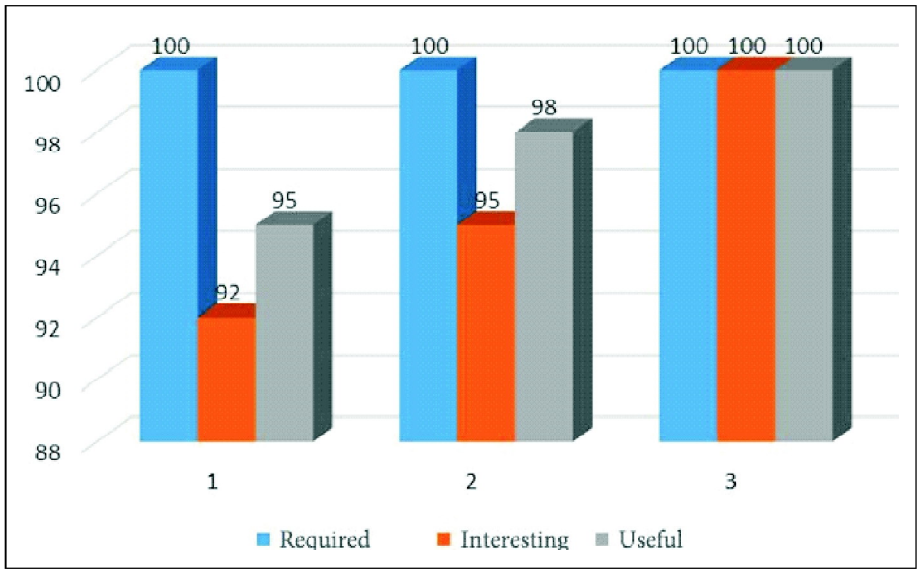


Figure 4: The Opinion of Schoolchildren about Teaching Mathematics on the Basis of Using of Portable Computer Means

examples of creating mobile classes in educational institutions will be, which will help prepare a new generation of educated and modern-minded students.

Thus, the experimental data testify to the effectiveness of the developed special "Use of Portable Computer Means in Mathematics" course and the content in the conditions of using portable computer means for teaching schoolchildren in mathematics.

Thus, the analysis carried out and the results obtained clearly demonstrate that the research objectives are fulfilled, the aim is achieved.

DISCUSSIONS

In the United Nations Educational, Scientific, & Cultural Organization materials, mobile learning is defined as "modern ways of supporting the teaching process through mobile technologies, such as laptop computers, MP3 players, smartphones and mobile phones" (UNESCO). In this definition, there are only references to technical means without specifying the pedagogical conditions for the realization of this type of technology.

I.N. Golitsyna and N.L. Polovnikova (2011) in her paper offer several definitions of the concept of "mobile learning": 1) "Mobile learning is the transfer of knowledge to a mobile device (phone or handheld computer) using WAP or GPRS technologies (that is, the ability to access the Internet)" and 2) "mobile learning is a kind of distance teaching for which the knowledge are transmitted to the personal devices of the trainee (laptop, handheld computer or mobile phone" (Golitsyna, 2011).

V.A. Kuklev, citing all-Union State Standard 52653-2006, cites the following definition of mobile learning: "E-teaching via mobile devices, not limited to the location or change of the student's location" (Kuklev, 2010). In his research, D.V. Poguliaev (2006) defines mobile learning as a "form of organization of educational process based on the use of mobile computer devices and wireless communication" (Poguliaev, 2007).

The first group of definitions reflects only the technological side of the capabilities of mobile devices; different from each other by enumeration of mobile communication devices, on the basis of which it is possible to carry out the teaching process; and further, does not include pedagogical aspects. However, these definitions are united by two key points: a) mobile learning is training based on *mobile portable* devices; b) mobile learning involves access to the Internet. It is these two technological factors that will determine the main differences between mobile learning and other types of distance teaching, widely used both in Kazakhstan and in other countries of the world. Such an emphasis on the pedagogical side of the teaching process is also made in the definitions of foreign authors and software developers.

The main tasks of education informatization are the development of interactive spheres of cognitive activity management and access to modern information and

educational resources (multimedia textbooks and textbooks built on the basis of hypertext, various databases, mobile learning sites and other sources) (Akeshova, 2013).

S. Wexler, B. Schlenker and others under mobile learning understand activities based on the use of compact and portable devices that allow learners to more effectively master the studied material, extract and create information (Wexler, 2007).

Mobile learning is "an activity carried out regularly through compact, portable mobile devices and technologies and allows students to become more productive by communicating, receiving or creating information" (E-Learning). Mobile learning is "the use of convenient portable mobile devices and wireless, always available technologies, to facilitate, support, optimize and expand the teaching and teaching processes" (Mobile learning network).

Also, scientists H.Uzunboylu and F.Ozdamli published their first results of a study on the attitude of teachers to the use of mobile devices. The authors describe the "Scale of Mobile learning Perception" developed by them. According to preliminary results of scientific paper- teachers demonstrate a high level of perception of mobile learning (Uzunboylu, 2001).

Kazakhstan scientists E.Y. Bidaibekov, V.V. Grinshkun and G.B. Kamalova in their study presented the results of the project: "Fundamentals of development, monitoring of quality and experimental approbation of computer educational and methodological complexes of a new generation". The authors carried out research work aimed at forming conceptual provisions and components of the model for creating, monitoring and testing experimental computer-based academic and methodological complexes of the new generation for higher education, adapted to the specifics of the system of continuing education in the Republic of Kazakhstan (Bidaibekov).

Analysis of definitions indicates that mobile learning is a multifaceted concept. Scientists, depending on the aims in their definitions, focused on various aspects of mobile learning, not opposing, but, on the contrary, complementing each other.

CONCLUSION

The conducted research allows drawing the following conclusions:

The algorithm for realizing the technology of using portable computer means in teaching mathematic is described in detail. The summary of the lesson with the subsequent analysis and the program of the special course "Application of portable computer means in mathematics" for, as well as the evaluation of the effectiveness of the developed technology and the results obtained in the course of pilot and experimental paper is given. The stages of pilot and experimental paper on the experimental verification of the effectiveness of the use of portable computer means for the schoolchildren when teaching mathematics are defined. The logic of pilot

and experimental paper was aimed at modernizing the methodological system of teaching mathematics in the field of portable computer means using. The aims, content, means, forms and methods of teaching mathematics on the basis of using mobile computer tools were tested in the complex. This logic of pilot and experimental paper allows us to justify the effectiveness of the methodical system of teaching computer science, including mobile computer systems. While choosing the criterion for effectiveness assessing in mathematics teaching with the use of portable computer means, they proceeded from the principle of pedagogical expediency. A common criterion for assessing the effectiveness of the use of portable computer means in the teaching of schoolchildren in mathematics is the creation of conditions for the realization by each participant of the educational process of the right to learn, corresponding to his individual needs and opportunities.

The indicators selected for the aim of determining the effectiveness of pilot -and experimental paper were monitored in the system of pedagogical and methodological experiments, and they confirmed the reliability of the developed technologies for the use of portable computer means in the teaching of schoolchildren to mathematics.

Thus, according to the results of the pilot and experimental paper, it can be stated that the assigned aims were realized. In the course of scientific research, the technological possibilities of realizing the use of portable computer means in the teaching of schoolchildren in mathematics were experimentally tested.

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