METHODOLOGY OF TEACHING MATHEMATICS AT SECONDARY SCHOOLS USING COMPUTER SOFTWARE

Mirsanov Uralboy Muxammadiyevich
Doctoral student of the Institute of Pedagogical Sciences of Uzbekistan named after Kari Niyazi
Tashkent, **UZBEKISTAN**
E-mail address: goodlucjk_0714@mail.ru

ABSTRACT

The article explores the challenges of teaching programs (practical software) for 5-6th grade students and methodology of their implementation in mathematics classes.

Keywords: Mathematics, program, Internet, experimental test.

INTRODUCTION

The rapidly developing ICT sector has become an urgent problem as today every educational context demands the implementation of ICT instruction integrating its content into the minds and learning of students [1]. The problematic method of teaching modern ICT is widely used in combination with information-receptive and reproductive methods [2]. In this environment, the teaching programs are widely utilized as a means of controlling learners' knowledge.

The use of modern ICT in the instruction of mathematics has required both the content and the essence of the concepts. Therefore, a great attention has been paid to new approaches to teaching and learning and the usage of innovative technologies. Majority believe that learning is an integral process in the interrelationship between teachers and students. However, for the time being this process is also interconnected with teaching programs, interactive educational manuals, e-books, virtual educational technologies, video and audio resources, computer software, television and radio courses etc. In this process learners are more dependent on their inner abilities, intellectual potential, capabilities of receiving and acquiring information.

So, what is the current role of educational establishments in the integration of various practical software in education? What are the achievements and shortcomings in this area? and what are the problems that are waiting for their solutions?

LITERATURE REVIEW

A number of researchers such as N.I. Taylakov, M.Tojiye, D.Yunusova, S.Alixanov, M. Tsoy, E.V. Abramov, N.V. Akamova, E.N. Dronova, I.V. Kuznetsova, J.I. Zaytseva, Z.N. Ismailova, L.N. Lavrikova, N.N.Xoxanova, T.B.Plaxotya, I.V.Serjenko, F.L.Patner, A.B.Obrubova, N.N.Bikova, J.J.Karbozova and others have already conducted their research on the implementation of ICT in teaching mathematics. However, the problem of applying ICT programs in teaching mathematics at schools has not been fully solved. To have a clear vision of teaching programs, first of all, we should clarify what they are.

Relying on some foreign sources we can define teaching programs or practical software as programs designed to fulfill specific tasks and communicate directly with the users. They include computer programs created by users to perform the computer's specific tasks [6-8]. It is important to note that all e-learning resources and programs are created on the basis of

software or hardware. For that reason, the use of teaching programs in education may involve different educational tools or resources such as interactive educational manuals, e-books, virtual learning technologies, video and audio resources etc.

U.Yu. Yuldashev, R.R. Boqiev, and F.M. Zakirova define the practical software as "a set of programs designed to solve specific issues or tasks in a particular subject matter" [3]. According to our viewpoint, practical software is a tool that carries out individual activities based on the state educational standards providing the formation of learners' professional competencies in a particular specialty. The above-mentioned definition indicates that teaching programs are not didactic, encyclopedic or practical tools, but they create an interactive environment in a subject matter as a systematic object. With the help of practical software every individual may have an access to get necessary knowledge on subjects, organize learning processes, acquire practical or independent learning skills, set effective control over learning outcomes, review, enhance their knowledge, shape and develop particular types of thinking etc. Moreover, teaching programs support learners to observe processes which are difficult to demonstrate in real-life and provide the effectiveness of the level of learning outcomes, and the level of student acceptance.

Teaching programs used in mathematics can be divided into two groups:
1. Practical software having a wide range of opportunities with the Windows Operational System installation. These include Office shell programs, object-oriented programming languages, maths packages and vector graphics programs.
2. Software with narrow capabilities created by object-oriented programming languages, vector graphics applications and shell programs and having .exe, .swf, .html file extensions. These include electronic simulators, software for mathematical calculations, and self-assessment programs etc.

RESEARCH METHODOLOGY

In addition to the other subjects, the organization of instruction using practical software in maths classes also plays a significant role in acquiring thorough knowledge. Due to the fact that our research focuses on the very problem, we began it from observing students' knowledge on mathematics in secondary schools. Our observation was based on teaching mathematics in secondary schools in Tashkent, Namangan and Jizzakh regions and various interesting curricula were developed together with the maths teachers of 5-6th grades. More than 40 lessons were monitored to determine the level of students' knowledge on mathematics.

The in-depth analysis of our study suggests that the provision and application of special teaching programs on mathematics at secondary educational establishments is one of the today's demanding issues.

Based on the theoretical analysis of the scientific literature on the creation and use of multimedia applications, software, online testing and nonstandard adaptive tests, it should be noted that previous research works conducted on the introduction of such software included various problems such as:

- Creation of multimedia, animation effects, online tests and tasks, as well as educational online portals for in-network training;
- Designing programs for online assessment (test and nonstandard adaptive test banks) meeting international standards in mathematics;

- Enhancing the methodology of teaching mathematics at schools using various computer software;
- Strengthening the interactive Internet communication services and communicating with the trainees (students) using this service;
- Learning the guidelines for the appropriate usage of web-sites and web-portals in maths classes;
- Building skills and abilities to help students to work with home assignments on maths using special programs.

The principles of developing and implementing software in mathematics are derived from the system of didactic principles for the development of independent learning using the mainstream of existing approaches and computer technologies.

Online software for teaching mathematics at schools should be based on didactic, pedagogical, psychological, technological, organizational and communicative principles [1].

Basing on the above-mentioned problems and recommended principles, the **math-edu.uz** portal has been developed in four stages including presentations, samples and tasks for independent learning, video lessons, some maths calculation programs, students' knowledge assessment tools, online test and nonstandard adaptive testing bank, visual materials, electronic simulators, samples for erudition etc:

Stage 1. It is a stage of creation **math-edu.uz** portal and its cover window. When creating an educational portal on mathematics, the design must comply with its color compositions, as it creates a specific mood for its users. The red color can provoke anger, and the soft colors visa verse. Orange, yellow and red colors are warm colors when blue and purple colors are considered as cold colors. The combination of different colors is effective. Moreover, it is desirable to use bright and warm colors as basic, and cold colors as secondary. Also, it is advisable to use minimal animation effects, present information in separate small blocks, achieve harmony between the background text, font and title color, and the simplicity of reading texts. The web page should not have more than three matching colors (better to use one color and its shades), and no large fonts, as well as it should provide users with the convenient online platform taking into account students' interests, their learning preferences and capabilities of logical thinking and remembering abilities.

Using web-portals in mathematics classes will help to increase motivation towards teaching and learning, acquire and systematize basic knowledge in science, support by providing the methodological assistance in self-study, develop self-control skills and upgrade more effective learning of the theoretical foundations.

The most important task of teachers is to develop the creative thinking of learners. Special software placed on web-sites is designed to benefit students to search, sort, analyze, and organize academic content. The web portal can be enriched with presentations, animations, photos, sound effects, programs for mathematical sums and calculations and textual information. In other words, the web portal reflects the combination of different means of unifying information in one content. Software aims at increasing the efficiency of the teaching process, and the large portion of the curriculum should include the data about the process of using computer technologies.

Stage 2. This stage aims at selecting software for creating educational resources. It is advisable to use various presentations (PowerPoint), video lectures (Camtasia Studio 7), tasks for self-study (in MS Word), data about assessment, set of tasks and mathematical sums, e-tests and assignments checking learners' intellectual abilities (iSpring), special programs for mathematical calculations (Borland Delphi7), visual aids and electronic simulators (Macromedia Flash 8) etc.

Stage 3. The stage is called creating educational resources. All mathematical programs should be created only on the basis of experimented scientific, pedagogical, psychological, psychophysical, methodological, visualization, software and technical requirements.

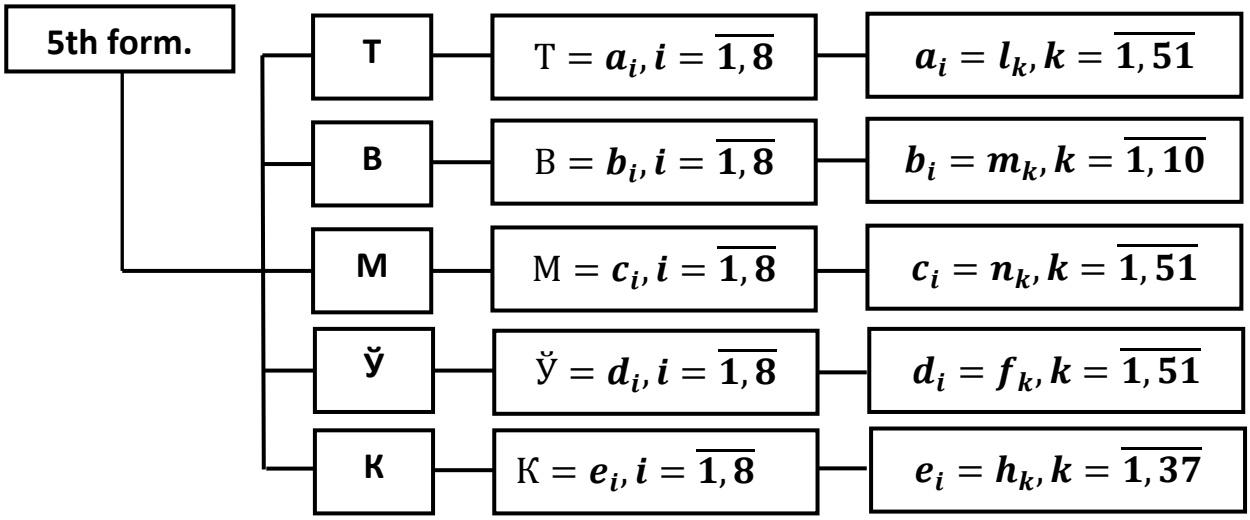
There were developed special criteria for creating and converting learner resources on mathematics. For instance: presentations were created colourfully in **.pptx** file extension to attract learners and help them acquire only basic information on subject; video lessons were created in **.mkv** file extension providing learners with topic-based information for daily lessons; self-study tasks were created in **.pdf** file extension using MS Word 2010.

Adaptive non-standard and online tests were developed on explanatory- motivational, cognitive, technological and creative criteria to evaluate students' knowledge according to the international requirements.

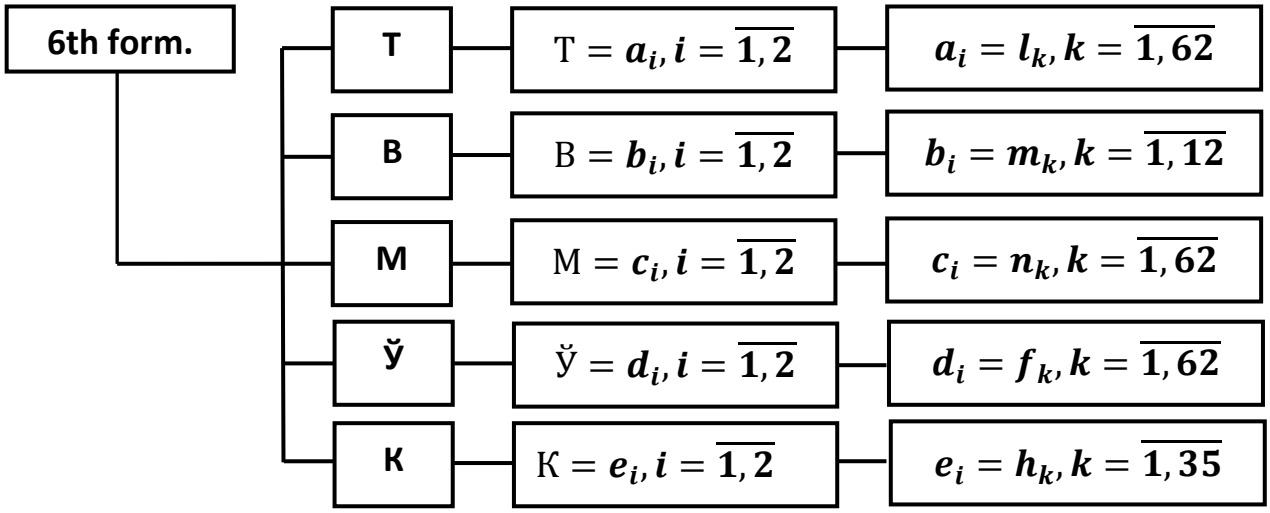
Subject related questions, e-tests and assignments checking learners' intellectual abilities were created in iSpring program with **.swf** file extension to assess students' knowledge, whereas the set of mathematical sums was created in iSpring Kinetics program using **.swf** file extension. Special software for mathematical calculations was created in Borland Delphi 7 and converted to **.exe** file extension [4]. All visual materials and electronic simulators were designed in Macromedia Flash 8 and converted to **.swe** file extension. For the creation of electronic simulators we used 21 windows for the 5th grade and 23 for the 6th [5].

Stage 4. This is the stage of placement of created educational resources in the portal (math-edu.uz). The size of internet software should not exceed 32 MB.

The forming structure of the 5 th and 6th forms of the portal is described in the following Figure 1-2.



1-picture. Structure of the 5th class.



2-picture. Structure of the 6th class.

In this case **Т** – presentations, **В** – video lessons, **М** – self-study tasks, **Ў** – Subject related questions, **К** – Special software for mathematical calculations . $\mathbf{a_i}$ –тақдимотларнинг боблари, $\mathbf{b_i}$ – sections of video lessons, $\mathbf{c_i}$ – chapters for tasks to perform independently, $\mathbf{d_i}$ – sections of questions that evaluate students' knowledge, $\mathbf{e_i}$ – the number of chapters of practical applications that solve math problems. $\mathbf{l_k}$ – number of presentations, $\mathbf{m_k}$ – number of video clips, $\mathbf{n_k}$– number of tasks for independent execution, $\mathbf{f_k}$ – the number of questions that will be used to evaluate students' knowledge, $\mathbf{h_k}$ – the number of applications to solve math problems.

Math teachers use various methods to teach their students at secondary schools. The main reason of this can be not active participation of students during their math classes. This will ultimately lead learners to not covering all materials from class to class. In order to eliminate such problems, we created educational portal **math-edu.uz** in the network. We uploaded all materials on math for 5-6th grade learners such as presentations, tasks for self-study data about assessment, set of tasks and mathematical sums, e-tests and assignments checking learners' intellectual abilities special programs for mathematical calculations, visual aids and electronic simulators etc.

Another task we faced was the development of methodology for conducting interesting and motivating math lessons oriented to individual approach.

ANALYSIS AND RESULTS

Some experimental works were conducted to determine the effectiveness of the **math-edu.uz** portal used in math classes. The approbations were conducted in local schools in Tashkent, Namangan, Jizzakh regions between 2014 and 2018. Totally 32 teachers and 1128 students were selected for the experimental groups. 561 of them were 5th grade students, and 567 were 6th grade. The experimental works were conducted in 4 stages - diagnostics and prognosis, organizational-preparational, practical and totalizing stages.

During the experiment, several interviews and observations were organized with 32 math teachers and 1128 students about the key features of the software. The results of the survey showed the following: 65,6% of teachers approved the usage of special programs in their math classes, 18,8% of them agreed to implement the software as extracurricular activity, 15,1% of teachers advised to use software in dealing with difficult themes and only 0,5% claimed that such programs would not help to master knowledge on math.

During the research, we came across with another problem. Many people believe that math can't be taught without a chalk and a board. The question arises here: how much time will it take to use special software in one lesson? We conducted two-stage experiment on this issue. In the first stage, classes were organized on the basis of programs and at the same time students' knowledge was evaluated. The following results were achieved at the end of the experiments:

- When using the software to learn mathematics, it was found out that programs should be used in accordance with the simplicity and complexity of the themes;
- The effectiveness of the lesson increases significantly compared to traditional method of teaching if schools will use software for 10-15 minutes in their math curriculum.

In order to check the efficiency of the software for 5-6th grade students the following number of people were chosen from 3 regions of Uzbekistan: for experimental group selected from schools 34 and 84 in Tashkent 90 students were chosen from 5th grades and 89 from 6th. In Namangan secondary schools 13 and 27 took active part with their 101 students from 5th grade and 94 students from 6th.

91 students from 5th grade and 102 students from 6th grades of schools 3 and 16 in Jizzakh put their own contribution to the experiment. For the controlling groups the following number of students were selected from the same regions: from schools 34 and 84 in Tashkent 89 students were chosen from 5th grades and 90 from 6th, from schools 13, 27 in Namangan 99 students took part from 5th grades and 92 from 6th, the number of students in Jizzakh from schools 3 and 16 exceeded 190, that is 90 of them from 5th grade and the rest 100 were from 6th.

In the experimental group, the teaching staff used the modern methodology based on software, and in the controlling group the methodology of traditional teaching was practiced.

In the totalizing stage all the results of the pedagogical experiments were studied and summarized (in 2018). To verify the reliability, accuracy of the results we used the mathematical-statistical analysis based on Student-Fisher criteria. According to the final results, in the experimental group, the average uptake of the math content was higher than in the controlling group.

The calculations showed that the experimental group consisting of 5th grade students' indicator increased by 11.3% compared to the controlling group, and experimental group with 6th grade students showed 10.9% increase over the controlling group.

CONCLUSION

To sum up, there are various formulas in the math class. Therefore, students need to absorb all the formulas and mathematical calculations in order to solve them and have necessary skills for their appropriate application. One of the easiest and motivating ways to put math formulas in the memory of the student is to demonstrate them animated motions, presentations etc. This requires the vast usage of various computer programs. Using special software will lead students to comprehensively understand the principles of different objects and processes in mastering mathematics, search and work with relevant information. We recommend using the above-mentioned program tools when creating software as they differ from others with their popularity among students and teachers, also the educational resources created by these tools can easily operate on the Internet attracting both students and instructors.

Special software will support students to increase their learning, develop cognitive, creative, motivational, intuitive thinking skills and upsurge the efficiency of learning materials on the basis of interactive learning content. Moreover, computer programs can help to create the models of difficult to demonstrate in real-time situations, track complicated processes, and ensure that the learning outcomes are more effective than the level of students' logic and acceptance. It also teaches students the scientific and creative approach to science, helps them to master academic topics, become an important factor in shaping their academic outlook, assist them to gain knowledge. Accordingly, we can say that such software can be used for students' creative activity in mathematical science and organization their academic activities. Parallely, students will acquire the necessary skills of solving problems and mathematical sums through independent study of mathematics.

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