ELECTRONIC TEXTBOOKS FOR LEARNING THE EDUCATIONAL CONTENT IN GEOMETRY AS PART OF THE EDUCATION IN MATHEMATICS FOR GRADES 1-4

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Abstract:

Introduction: The modernization of Bulgarian primary school education is directed towards the applied strategies, technologies, approaches, and methods as well as towards the introduction of new information technologies in the educational process in mathematics in primary school.

Object: The object of the present research work is to study certain specific characteristics, opportunities, the field of application and the efficiency of the electronic textbooks and their use by the teachers during the process of learning geometry content in the education of mathematics for Grades 1-4.

Methods: The experimental work includes qualitative and quantitative research of the problems specified in the above paragraph. The following methods were applied: didactical experiment, observation, test, content analysis, mathematical-statistical method for data processing.

Results: The researchers performed observations and analysis of the frequency of use of electronic textbooks by the primary school teachers during geometry classes. Based on the results of the study it was found out that 86% of the teachers use electronic textbooks in their methodology work on a regular basis, 10% of them – from time to time and 4% do not use electronic textbooks at all.

The analysis of the entry and the exit diagnostic determined that all student had an equal level of knowledge at the start of the experiment. However, the results on exit level of the knowledge, the skills and the competencies showed that there is significant difference. The results on the exit level of the students from the experimental class where electronic textbooks have been systematically used are from 26% to 34% higher than the results of the students from the referent class where textbook have not been systematically used.

Conclusion: The use of electronic textbooks for learning geometry content during mathematics classes in primary school must be scientifically grounded and precise. The introduction of the electronic textbooks into the educational process helps to put the students in an active cognitive position and motivates them for work during mathematics classes.

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Keywords: electronic textbooks, education in mathematics, educational content in geometry

Introduction

Nowadays the modernization of Bulgarian primary school education is directed towards the improvement of the strategies, the technologies, the methods, the approaches and the methodology of work as well as the information technologies and computer tools used during the educational process in Grades 1-4 aiming at education and in stimulating the didactic environment. The interaction between two main factors of cognitive activity of an individual are taken into consideration – the process of internal development of cognitive schemes (models) and their purposeful external actualization and stimulation through a wide application of computer technologies. Searching for the optimal parameters of this interaction outlines one functional variety in the process of internal acquisition and construction of knowledge.

Object, subject and aim of the study

The educational process must be structured in a way that its forms and methods of education aim primarily to the productive activity of the students and then to the educational content. The center of the pedagogue's attention is the student himself and his educational activity and not only the educational content. For the achievement of productive activity during mathematics classes, contemporary information and communication technologies take an important place.

Over the recent years significant and purposeful work was done for the improvement of the process of applying informational technologies during the course of education in mathematics for primary school. It is already a tradition to use a complete system for education in mathematics within the frames of the compulsory educational content containing integrated information technologies for Grades 1-4 including electronic lessons as part of electronic textbooks.

The aim of this research is to study certain specifics, characteristics, and possibilities, as well as the field of application and the efficiency of the electronic textbooks used by the teachers in the process of compulsory education in geometry in Grades 1-4.

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The object of the research is the process of education in mathematics in Grades 1-4.

The subject of the research is the efficiency of the electronic textbooks used by the teachers in the process of teaching the compulsory educational content in geometry for Grades 1-4.

In order to achieve the aim of the research, the following tasks were completed: the study and theoretical analysis of: research work of foreign and Bulgarian authors related to certain characteristics and fields of application of electronic textbooks; the study of some of the main aspects of the use of electronic textbooks by primary school teachers in the methodology work in mathematics for Grades 1-4; the study of the efficiency of the use of electronic textbooks during the educational process in mathematics in Grade 4; the analysis and assessment of the results from the empiric study; and finally a summary and the conclusions.

For the purposes of the empiric study the following criteria were introduced: the level of efficiency when using electronic textbooks as assessed by the primary school teacher; the frequency of use of electronic textbooks during different types of lessons in mathematics or during teaching separate components of the same lesson; the use of electronic textbooks for the purposes of visualization and to facilitate: acquiring of new knowledge and skills; affirming of the acquired knowledge and skills; summarizing and systematizing the knowledge and the skills of the students in Grades 1-4 from the competency Cluster "Geometry figures and bodies".

The development of education is directly dependent on the wide, pedagogically considered use of electronic and computing equipment and especially of electronic textbooks. At this stage, the following tools are used in the process of education in mathematics in Grades 1-4: electronic textbooks; *Mouse Mischief and Envision software; different computer games, series of Jumpido educational games, Open Sankore software for interactive white desk and Power Point presentations, preparation of Website of the class, Skype video connection (participation of students from different classes at the same time during the same lesson, demonstration of knowledge and skills, discussion of topics from the compulsory educational content, and option for mutual examining), tablets for every student (as a tool for searching, collecting of information, for work on dedicated creative tasks of an "open" or "semi-open type as per Rogier's classification).*

A high level of coordination is evident between the educational programs, the compulsory educational content presented in the textbooks and the notebooks in mathematics for Grades 1-4 from one side and the use of electronic textbooks in the process of education from the other. That is why this article further explicitly studies the application of electronic textbooks in the process of development in the students' knowledge, skills and competencies from the competency Cluster "Geometry figures and bodies". As a result of the analysis of the existing literature it was determined that there are multiple definitions for electronic textbook. This study refers to the description offered by L. Zaynutdinova who presented the following understanding for electronic textbook: "Multi-purpose educational program system which provides a non-stop and complete didactical cycle in the process of education, offering theoretical information, educational training activity and control over the level of knowledge as well as over the information-research activity, mathematical and imitation modelling with computer visualization, and service functions within the conditions of interactive feedback"(Kouznetsov & Zenkina, 2010, p. 38).

If we accept the idea that the electronic textbook must have all the functions of the traditional one (Kouznetsov & Zenkina, 2010) and also that the functions determine the structure then we have to admit that the electronic textbook makes sense only if more efficient, adequate to the purpose and to the content and more attractive ways for realizing these functions can be created in the information environment. Simultaneously, these functions shall take into consideration the specifics of the age of the students as well as the respective health and hygienic requirements (Delibaltova, 2012).

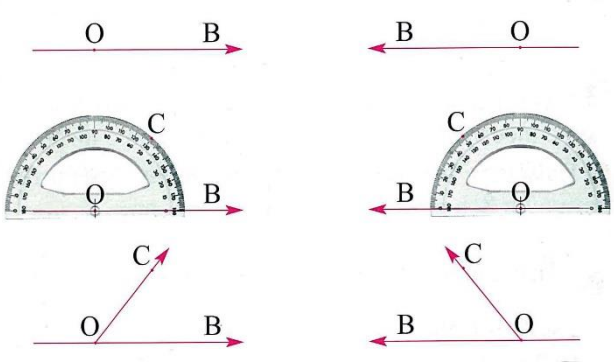
The research work was directed towards studying of successful models of electronic textbooks aiming at increasing the quality of education in mathematics with learning the geometry educational content for Grade 1-4. The models were developed on the basis of different scenarios by me and by the rest of the authors of the mathematics textbook for Grade 1-4.

The electronic version can be used for all types of lessons in mathematics for the purposes of acquiring new knowledge and skills, for affirming the acquired knowledge and skills, for summarizing and systematizing of knowledge. Some of the tasks included in the electronic textbooks make possible for the teacher to control the students' knowledge. There is a methodology developed for each lesson. The tasks are structured in a system and some of them have been included with the purpose to upgrade the

acquired knowledge. These additional tasks can be used depending on a teacher's personal assessment for individualization, differentiation during his work with the students or to offer conditions for creative work with them. Another specific feature of electronic textbooks is that there use over the entire course of the mathematics class has not been foreseen. This way the time for solving mathematical tasks is not restricted and there is no risk that the student will stop thinking. The aim is not only to change the means of teaching but to change the actual nature of teaching.The introduction of new knowledge through electronic books is done through the use of video files, audio files and graphic visualization that present the algorithms and the ways of using drawing tools for example for drawing an angle as per a given degree (Bogdanova et. al, 2015, p. 55):

Task: Draw an angle BOC=50˚.

Figure 1: Drawing an angle at a given degree



Source: Bogadanova et al., 2015

Algorithm of work:

-We draw half-line of the angle OB.

-Put the protractor as shown. Mark the 50° position of the protractor.

-Remove the protractor and draw the half-line OC.

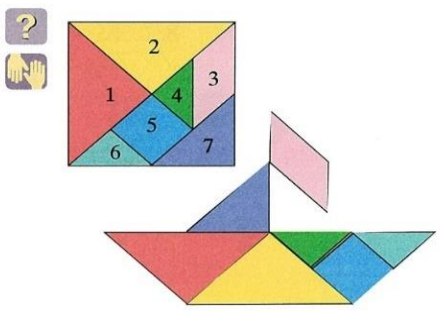
The demonstration which the teacher does on the blackboard is facilitated with an electronic textbook. This helps the students to understand the essence, the ways of constructing the algorithm as well as the sequence of each step that builds those algorithms. The electronic textbooks offer diversified and adaptive presentation of the educational content pursuant to the current level of knowledge of the students.

Some of the facilitating tools in the electronic textbooks offer demonstration of work with individual didactical materials which students have to perform. This makes it easier for the teacher to organize the lesson.

The presented tasks are related to design work with geometry figures as per a given example for students from Grades 1-4. The tasks contain game elements and elements from the area of combinatorics. This type of tasks are called "geometry puzzles". Such games are:

Tangram (ancient Chinese game) (Bogdanova, Temnikova, 2016, p.31)

Figure 2: Task related to the Tangram game

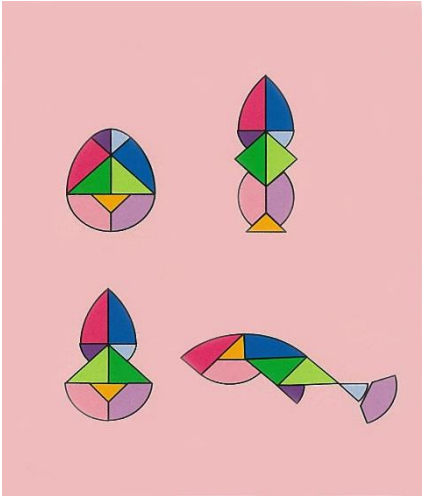


Source: Bogadanova et al., 2016

The students have to construct a new figure from the seven parts of the square that is given as a sample. Firstly, the students work with a dismembered profile of the figure. After that, the task becomes more complicated and the students have to construct new figures using only the given profile.

- Egg of Columbus (Bogdanova et. al, 2017)

Figure 3: Task related to the Egg of Columbus game



Source: Bogadanova et al., 2017

These tasks help to perform the transition from object-action and visual thinking to abstract thinking of the primary school students.

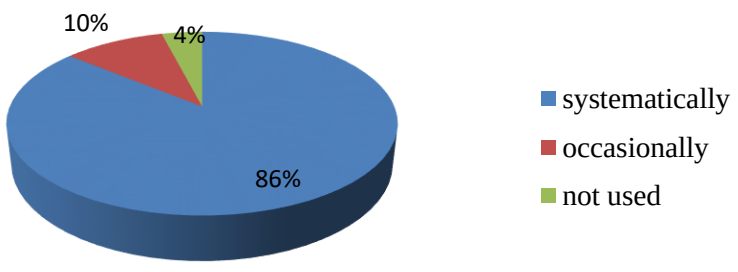
The methodology offered in the electronic textbooks supposes the establishment of a feedback connection in the process of checking the results by the teacher and also the creation of conditions for putting the students in a permanent active position. The interactive option in the electronic textbooks motivates students for active work during mathematics classes and induces their interest to mathematics as science. Another specific feature of the electronic textbooks is the possibility for the students to work independently outside school using the platforms developed for the purpose and an Internet connection. This creates additional opportunities for the students to fill in gaps in their knowledge and facilitates their work for preparation for mathematics classes.

Results

The research work was performed with primary school students and their teachers and the empiric study was performed with the Grade 4 students from all primary schools in the Town of Stara Zagora during the period 2017 – 2018. The researchers performed observation and analysis of the frequency of use of electronic textbooks by the teachers during mathematics classes.

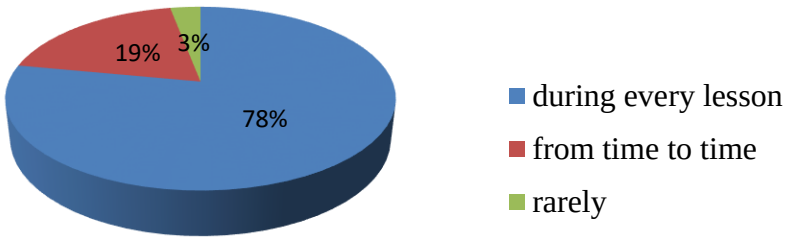
Based on the results of the study it was determined that 86% of the teachers use on regular basis electronic textbooks as part of their methodology work, 10% - from time to time and 4% of the teachers never use electronic textbooks.

Figure 4: Use of electronic textbooks during mathematics classes in Grade 4 determined via observation



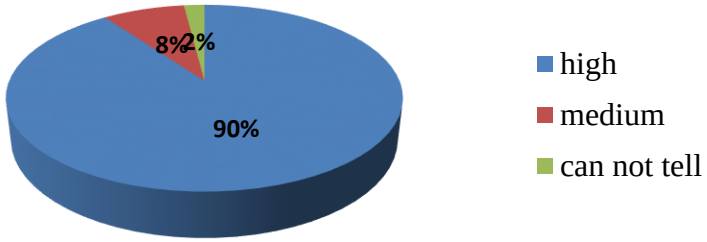
Source: Author

Figure 5: Frequency of use of electronic text books during mathematics classes in Grade 4 as determined via a poll amongst teachers



Source: Author

Figure 6: Efficiency of electronic text books for Grade 4 as determined by teachers



Source: Author

At this period of time during current and state practices with university students in mathematics an additional observation and poll with teachers took part. On the poll question regarding the use of electronic textbooks 78% of the teachers replied that they use them during every lesson, 19% use them occasionally and 3% - rarely. On the question of electronic textbook efficiency 90% of the teachers confirmed their high efficiency, 8% - medium efficiency and 2% of the teachers cannot answer the question as they don't use electronic textbooks at all.

On the question why textbooks have not been used during mathematics classes teachers explain this with lack of technical means in the classroom and respective professional competency to operate with them. The data obtained from the performed observations and polls are presented on the above graphs. During the experimental work the researchers performed entry and exit diagnostic with tests in two Grade 4 classes – an experimental class and a referent class. In the experimental class electronic textbooks were systematically used during mathematics classes and no electronic books were used in the referent class. In the beginning of the experimental work the students from both classes had relatively equal level of knowledge, skills and competences from competency cluster "Geometry figures and bodies".

The results from the exit level of knowledge, skills and competencies showed significant difference for each type of mathematical tasks. The results of the students from the experimental class are from 26% to 34% higher that the results of the students from the reference class.

Conclusion

These results support the concept for systematic use of electronic textbooks during mathematics classes in Grades 1-4.

The use of electronic textbooks: helps to enrich the education in mathematics in Grades 1-4 and makes it more intensive; increases the motivation and engagement of the students during the educational process in mathematics in primary school; offers the students opportunities to get familiar and work with alternative sources of information in addition to the traditional textbooks and class notebooks, additionally clarifies mathematical terminology; facilitates development of mathematical skills from competency cluster "Geometry figures and bodies", develops creativity, logical and critical thinking in the young students, contributes to the development in the Grade 1-4 students of a culture for independent thinking and logical reasoning during the process of solving problem mathematical tasks.

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