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Development of Electronic Educational Resources for Studying Mathematics by Adobe Flash and HTML5 Systems at Elementary Schools

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Abstract

In the modern educational space, the focus on realities of the information society is an important issue relating to the provision of a high level of education informatization that implies teachers' mastering as the necessary competency and the ability to introduce electronic educational resources into educational and training practice. Adobe Flash as a platform for creating web applications and multimedia presentations enjoys the greatest popularity with users including teachers. However, because of the announcement that Adobe Flash is going to terminate its functioning in 2020, the issue of choosing a suitable analog to create web applications and presentations for teaching purposes has become particularly important. The present paper provided a comprehensive analysis of developing electronic educational resources by teachers using Adobe Flash and HTML5 for teaching mathematics at primary schools. In the present paper, we shared the experience of teaching future primary school teachers the technologies for creating multimedia and web applications, in particular with Adobe Flash and HTML5. The experience was based on teaching the special course "The Technique of Using Computer Techniques in Lessons at Primary Schools" that taught Adobe Flash in 2012-2015, and HTML5 in 2016-2017.

Keywords: Developing interactive educational applications; Flash technology; Adobe Flash; HTML5; Future primary school teacher.

1. Introduction

Flash technology is a tool of creating educational multimedia presentations, websites and games enjoying popularity with teachers. This platform has proved its effectiveness in the process of teaching various disciplines to school students, for example, mathematics (Antúnez, 2013) biology (Auhadeeva *et al.*, 2017) chemistry (Bakhoum, 2008) and social sciences (Drijvers *et al.*, 2010).

Unfortunately, in July 2017, Adobe announced terminating service of Flash technology in 2020. The main replacement for Flash technology is the open standard for the development of HTML5 web content. Its standard was recently published in 2014 (Gregorius *et al.*, 2010).

In the current research, "HTML5" is perceived not only as a markup language, which in itself does not determine ways of creating animation and interactivity on a web page, but also as the additional related special JavaScript programming languages and style sheet language CSS 3. Adobe Flash is also presented in a package with ActionScript, the programming language to create interactivity (Hwang *et al.*, 2012).

It should be noted that HTML5 is a designed technology to make the Internet faster, easier and more affordable for each user, and in conjunction with CSS3, it can successfully replace Adobe Flash in many of its purposes including educational ones (Kadochnikova *et al.*, 2017). In addition, HTML5 is the only unified markup language that fully works alongside with the native programming languages of most modern operating systems such as Android, iOS, Windows Mobile, and Blackberry, while the Apple operating system (iOS) does not support Flash. To date (January 4, 2018), only 5.5% of websites have been created using Flash, and 94.9% by JavaScript (Kim *et al.*, 2013).

2. Methods

Consistent with above-mentioned objectives, the following research methods were utilized at various stages of research:

– *Eempirical:* pedagogical questionnaire, interviews, conversations with teachers and learners, the observation of process and results of developing electronic educational resources in mathematics for primary schools by the use of Adobe Flash and HTML5 systems;

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– Methods of mathematical statistics: For quantitative and qualitative analysis of results of the pedagogical experiment.

The pedagogical experiment was being conducted on the base of Yevpatoria Institute of Social Sciences (branch) and Humanities and Education Science Academy (branch) at Yalta of Merkibayev *et al.* (2018) Crimean Federal University.

In this article, a few research questions were asked:

- How important is it to use electronic educational resources in the modern educational space?
- What kind of electronic educational resources are more suitable at elementary schools?

3. Results and Discussion

It is necessary to note the following cases: The conducted survey of practicing teachers (150 respondents) to use of Adobe Flash and HTML5 systems in teaching mathematics to junior school children indicated that most teachers believed that Adobe Flash and HTML5 technologies with new complex ways of representation, structuring, storage, transmission and processing of educational information allowed moving more effective forms of organization of students' learning activity and could play greater, and perhaps, determining roles in changing traditional educational technologies. However, the actual process of introducing Adobe Flash and HTML5 into the teaching process of schools is now rather sporadic and spontaneous in the nature. Teachers noted that new distant learning technologies were included in educational technologies for the mere sake of their use. At modern schools, there is a contradiction between the objective need for using universal and accessible EER within the traditional class system and the inability to apply computerized systems (e.g. Adobe Flash and HTML5) offered by developers for this purpose.

According to interviewed school teachers in the Republic of Crimea (150 respondents), 97% of them use various electronic educational resources at their lessons as well as in developing and presenting analytical reports. When asked 'What tools did you use to develop multimedia software applications in the teaching process?' we obtained the following responses in Table 1:

Table- 1. The Number of Questioned teachers (150 Respondents) who used the Following Electronic Resources in their Teaching practice at Least once

Electronic resource	Microsoft PowerPoint	Electronic books	Video hostings (e.g. YouTube)	Adobe Flash applications
The number of teachers	115	5	21	9

In order to increase the efficiency of students' work, the electronic manual "Information-communication technologies in mathematics classes at primary school" was created alongside with manuals "Development of learning resources by the help of FLASH technology" and "Development of learning resources using HTML5-technology".

The special course, "Methodology of using computer technology in lessons in primary classes" with comprising 10 lectures and 5 practical classes, was designed aiming to teach students technologies of developing EER.

In 2012-2015, the special course was designed covering basics of Flash technology in conjunction with the ActionScript programming language.

In 2016-2017, the special course was based on the study of HTML5 technology in conjunction with the CSS3 and JavaScript. It consisted of the following sections:

1. A general model for developing EER to teach mathematics, and goals and objectives of interactive platforms at primary schools.
2. Introduction of HTML5 as a markup language. Page frame.
3. Introduction of Canvas.
4. Introduction of CSS.
5. Interaction with Canvas.
6. Collision detection.
7. Using variables, conditional expressions, and cycles.
8. One and two-dimensional arrays.
9. Online work with background and graphics, and publishing a website.
10. Introduction of the animation using SVG.

The program of forming stage of the experiment presupposed the implementation of methodology of forming the future teachers' competence in developing electronic educational resources for teaching mathematics at primary schools by means of Adobe Flash and HTML5 systems.

There were two options of conducting the forming stage of the pedagogical experiment.

According to the first option of the experimental session (1-4 years of study, E1), the professional training of students with skill profile of the "Primary education" for the use of Adobe Flash technology in teaching of mathematics to junior school children was carried out during the study of course namely "Informatics and information technologies at primary schools". In experimental groups, workshops included tasks with the aim at future primary school teachers' development of educational resources using Flash technologies. HTML5 system was not studied yet. The control group (C1) mastered the Adobe Flash technology in the process of self-education using electronic manuals "Information-communication technologies in mathematics lessons at primary schools" and

"Developing educational resources using Flash technology."

According to the second option of the experimental session (1-4 years of study, E2), the electronic manual was used namely "Developing educational resources using HTML5-technology", and the author's integrated special course, "Methodology of using computer technologies in lessons at primary schools", was studied. The control group (C2) mastered HTML5 technology in the process of self-education using the training manual "Developing educational resources using HTML5-technology". Adobe Flash system was not studied. Different groups of students were not divided.

Training students was classified into three stages: the theoretical stage was connected with mastering issues of the theory of developing and methods of applying EER in teaching; the practical stage included the formation of skills of EER development; the approbation stage was connected with the acquisition of experience in the activity aimed at preparation and conduct of training classes by the use of developed training tools, self-evaluation and the expert evaluation of the experience of implementing results of the EER development in the teaching process, preparing publications on EER development results, involving students in seminars and conferences.

Processing results of the experiment and evaluation of effectiveness of developed methodology was carried out by mathematical statistics methods that were introduced by Miller and Salkind (2002) Tables 2 and 3 present results of experiment stage in determining levels of future primary school teachers' competence in developing electronic educational resources.

Table-2. Levels of formation of future primary school teachers' competence in the sphere of developing electronic educational resources by means of Adobe Flash in the experimental (E1) and control groups (C1) (Varian 1) at the end of experiment

Experimental group (E1)		Control group (C1)	
Level	Number of students, %	Level	Number of students, %
Sufficient	11	Sufficient	27
Medium	51	Medium	58
Low	38	Low	15

Table-3. Levels of formation of future primary school teachers' competence in the sphere of developing electronic educational resources by means of HTML5 in the experimental (E2) and control groups (C2) (Varian 2) at the end of the experiment

Experimental Group (E2)		**Control Group (C2)**	
Level	Number of students, %	Level	Number of students, %
Sufficient	8	Sufficient	26
Medium	48	Medium	54
Low	44	Low	20

In general, quantitative and qualitative data analysis allows drawing a conclusion about positive dynamics of forming the future primary school teacher's competence in developing EER in mathematics for primary schools using Adobe Flash and HTML5 systems that prove the effective methodology of development.

The experimental verification has proved advantages of this method of teaching future teachers to develop electronic educational resources.

The analysis of scientific-methodological approaches to the training of future primary school teachers indicates the underestimation of the importance of developing and using electronic educational resources that require the development of a teaching methodology and authentic teaching courses reflecting individual approaches of teaching mathematics learning material at primary schools (Miller and Salkind, 2002).

It is found that the task of computerizing primary schools, and the introduction of modern electronic educational resources in academic disciplines in its teaching process, particularly mathematics, requires the development of theoretical and methodological foundations by future teachers (Moreno *et al.*, 2008).

A comprehensive model is present as follows for developing electronic educational resources for teaching mathematics at primary schools using Adobe Flash and HTML5 systems as well as models for developing EER for teaching mathematics at primary schools using Adobe Flash and HTML5 systems: developing presentations, interactive spreadsheets, and mathematics at primary schools, didactic game programs, developing test tasks, developing electronic manuals using Adobe Flash / HTML5 systems that are bases of creating electronic educational resources for teaching mathematics at primary schools (Salpykova, 2016).

Advantages of Adobe Flash are obvious: The system contains built-in interactive educational components as means of developing author electronic educational resources. This tool is a powerful environment for development of authentic electronic teaching aids that are provided future teachers with the opportunity of designing presentations for lessons, interactive spreadsheets, didactic game programs, test tasks and e-learning manuals. The built-in graphical tools of the Adobe Flash system provide endless opportunities for developing electronic educational resources, and the ActionScript programming language ensures the implementation of effective management of the software product (Salpykova *et al.*, 2016) (Tepla and Klimova, 2015).

4. Summary

According to the present research, it can be concluded that ready-made software products cannot be fully adapted to a methodological process for each teacher since it is impossible for developers to foresee the unique teaching approach of every individual teacher and the class in which they will work (Weinstein, 2013).

Research results indicated that the Adobe Flash technology largely determined the face of modern online video education creating the whole new content for classes. However, it seems that Adobe Flash is far from the complete disappearance, but according to many experts, this technology will completely disappear in the near future as there has been a necessity of restructuring the teacher training system in creating and using both Adobe Flash and a more modern HTML5 technology.

In the present research process, our own technology was designed for developing interactive spreadsheets using Adobe Flash and HTML5 alongside the guidance for their use. Due to this technology, the future teacher can conduct a curriculum, and actively communicate with junior students during the acquisition of new learning materials or at the stage of consolidating studied materials (World Wide Web Consortium HTML5 is a W3C recommendation, 2017).

5. Conclusion

The study did not offer a complete solution to the whole range of problems associated with the development of electronic educational resources for teaching mathematics at primary schools. The use of proposed methodology was considered for developing EER promising for teaching mathematics in preschool educational organizations and in educational institutions with the inclusive education. The offered methodology of developing electronic educational resources can be also utilized for teaching other subjects at primary schools creating web-resources for teaching mathematics and other disciplines using Adobe Flash and HTML5 systems at primary schools.

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