Some possibilities of using Flash animations and Applets in increasing the effectiveness of teaching

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Abstract. The paper presents aspects related to the creation of Flash animations and their applications in the teaching of natural subjects. The authors of the post are also presenting Flash animations that they created and applied in the natural learning process. It also emphasizes the importance of didactic and professional teacher learning in the learning process through Flash animations and Java applets.

Keywords: Natural Science, Flash animations, Effectiveness of teaching

Introduction

Computer technologies have importantly influenced almost every aspect of our lives. They have also had a great impact on education. Our challenge is to make effective *use* of new technologies in the educational environment. This powerful tool helps advance the transformation of the teaching and learning process. It has brought new prospects for the introduction of computer simulation and animation into the pedagogical process. The aim of this paper research is to demonstrate the inevitability of creating a high quality platform for visualisation of objects, processes and phenomena in the teaching of natural and technical sciences. The authors attempt to prove that simulation may become a powerful teaching and learning tool in educational subject (Natural Science) for teacher education.

A lot of dynamicity and evolution have been noticed in computer terminology and its translation. In the past years new technical terms have been coined or the meaning of already existing terms has been completely changed or made more exact. Sometimes it has resulted in creating a number of definitions of the same phenomenon. There are a number of definitions characterising an applet. The following one is chosen from Wikipedia. In our view, it gives relevant and sufficient information about the investigated object [1].

An applet is a software component that runs in the context of another programme, for example a web browser. An applet usually performs a very narrow function that has no independent use. Hence, it is an application -let. The term was introduced in AppleScript in 1993. An applet is distinguished from 'subroutine' by several features. First, it executes only on the 'client' platform environment of a system, as contrasted from 'servlet'. As such, an applet provides functionality or performance beyond the default capabilities of its container (the browser). Also, in contrast with a subroutine, certain capabilities are restricted by the container. An applet is written in a language that is different from the scripting or HTML language which invokes it. The applet is written in a compiled language, while the scripting language of the container is an interpreted language, hence the greater performance or functionality of the applet. Unlike a 'subroutine', a complete web component can be implemented as an applet.

This long definition, however, needs to be appended by another short description which characterises a Java applet from the didactics point of view. In our view, an applet is a 'small' special mono-functional application programme used for example for interactive animations or calculations made by a client himself without the need of cooperation with a server. Being applied in the pedagogical process a Java applet enables a teacher to create texts with simulations. Thus, it becomes an instrument for creating interactive teaching materials.

The main goal of this research is to create Flash animations and Java applets for improving natural (and technical) sciences teaching. Our intention is to create an innovative system in educational subject (Natural Science) for teacher education. For this purpose we created over two hundred Java applets in the Java environment. The applets are made in the following way:

- the individual static pictures and figures from traditional printed text books are animated (or simulated);

- schemes included in the instructions manual for didactic construction kits are animated (or simulated).

Our final aim is to create a virtual visualisation 'supplement' that would enlarge the range of visualisation potentials of traditional printed text books (and didactic construction kits). We attempt to maximise existing tools and platforms and thus maximise the power and efficacy of visualisation.

Moreover, on one of the applets we demonstrate the way of its creation and its didactic application. The creation principles, strategies and tactics of the other applets are analogical. In general, the key point of the application of visualisation may be explained as follows:

- the phenomena, processes and objects such as a) pictures or figures in a traditional textbook, b) model construction kits, c) other three-dimensional models are to be visualised in a traditional (static) way;

- the phenomena, processes and objects that go beyond the boundaries of traditional and conventional ways of visualisation are to be visualized by means of Flash animations and Java applets ('enlargement of a hand of knowledge').

Strategy and tactics of creating experimental way of visualization

"The principled essence" of the difference between experimental and traditional way of visualization of natural processes in our research is that the traditional way of visualization was using "static" techniques of visualization of natural and technical system and the experimental way of visualization was furthermore using "dynamic" techniques of visualization (computer modeling and simulation and their results presented by computer graphics - Fig. 1).

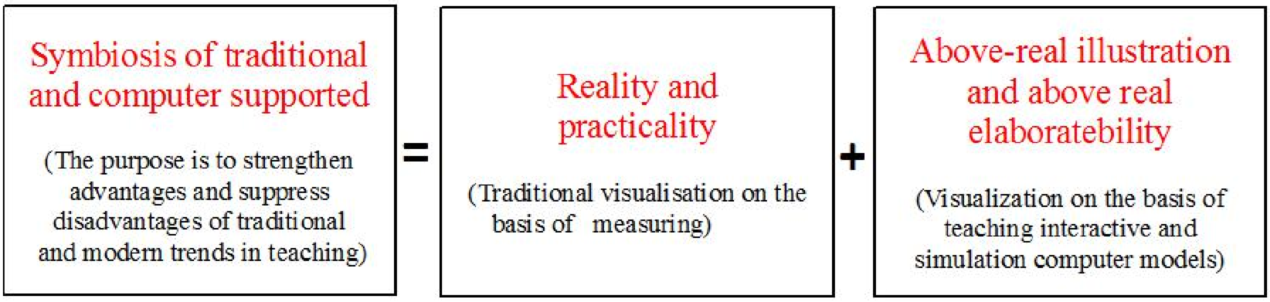

Fig. 1 Scheme of strategy and tactics of creating experimental way of visualization

The innovative experimental system (called NIESVA) was designed to eliminate the above-mentioned drawbacks of the existing (traditional) ways visualization of natural processes for didactic purposes. The experimental way of visualization applied in the NIESVA, enables among other things, to accelerate, decelerate, run the action; this was the drawback of the physical measuring; further, it enables us to interactively enter into the course of visualization process and change the model parameters, which has been the drawback of the video-animation; and finally, the experimental way of visualization is practical and pragmatic and the visualization through computer simulation lacks these features. These NIESVA attributes (including multimedia and the synergic effect of mutual intersection) also extends both quality and quantity dimensions of the degree of didactic visualization demonstrativeness beyond the possibilities of all the above-mentioned traditional forms of visualization. We have been also concerned with the issues of effectiveness of teaching in the NIESVA in comparison with the traditional teaching system (see the section – the experimental research).

Applet set designed for thematic teaching in natural subjects begins with "Do you know why/how…?"

On the contrary, the visualization by means of a computer model may be improved by a practical and real attribute that is contained in a textbook or a model construction kit but not in a computer model.

The created collection of computer models was called : The world of natural and technical sciences (of younger pupils) in computer models (educational models designed for teaching natural sciences, technical work and essentials of ecological education at the first level of primary schools).. In order to strengthen the didactic application of the computer model the names of the individual computer models begin with the words. The individual applets of the packet start with the following words: How does it work/function? or Do you know why/Do you know how…?

Natural Science: How does the human body work? Do you know your digestive system? Do you know how it works? Do you know how your heart works? Do you know how the respiratory and circulatory systems work? Do you know how the musculoskeletal system works? Do you know how the nervous system works? Do you know how the endocrine system works? What do you know about human reproduction? How does the reflex arch work? How does the sense of sight work? How does the sense of smell work? How does the sense of touch work? How do we affect the environment? How does the hydrological cycle work? – (Fig. 2.1), How does the nitrogen cycle in the nature work? How does the nitrogen cycle in the nature work? How does the feeding network in nature work? How is electric energy made in nuclear station? How is electric energy made in hydroelectric power station? How is electric energy made in thermal power station? How does production and energy distribution work from the power station to consumer? Understand why the alternate phases of the Moon?, Want to know why the alternate seasons ?, Want to know why there is a rotation of day and night ?

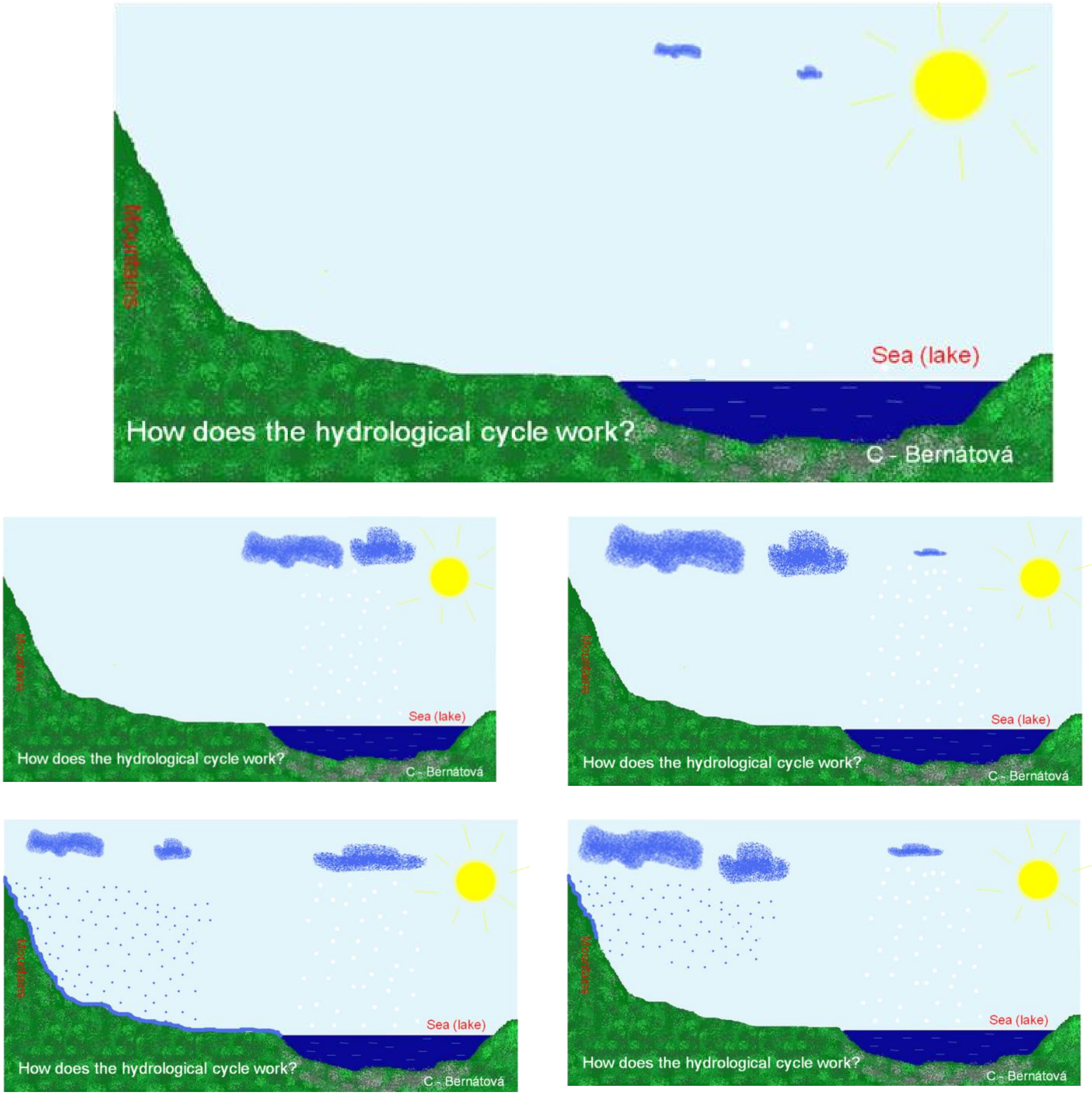

Fig. 2.1 The applet (key sequence) - How does the hydrological cycle work ? [2]

Fig. 2.2 **The applet (key sequence) - Want to know why the alternate seasons ?**

Fig. 2.3 The applet (key sequence) - Want to know why there is a rotation of day and night ? [2]

Fig. 2.4 The applet (key sequence) - Understand why the alternate phases of the Moon ? [2]

Experimental Research of Java Applets Utilization in Teaching

We made a database of Java applets that served as a platform for the creation of the experimental innovative teaching system called NIESVA. It was designed for visualization of teaching processes and phenomena through applets. In the process of our research the NIESVA system (in the form of concrete models designed for teaching selected thematic sections in teaching (pedagogical) faculties) was also experimentally verified.

Experimental verification of their didactic effectiveness in the conditions of real school

The method of pedagogical experiment was used to compare the two teaching systems in the experimental group (the NIESVA system) and the control group (traditional teaching system). The principle of the pedagogical experiment is demonstrated in Fig. 3. The concrete teaching system is demonstrated.

Common Features	
In both the experimental and control groups an identical technical object, phenomenon, or process were visualised	
Different Features	
The control group	The experimental group
- a traditional technique of visualisation using static pictures in a textbook, transparencies (an overhead projector)	– an experimental technique of visualisation by means of a Java applet using computer animation and simulation (an LCD projector)

Fig. 3 The principle of the pedagogical experiment [1]

The main aim of the experimental research was to investigate the possibilities of the NIESVA system application in order to increase the effectiveness of the teaching process.

Initial Hypothesis of the Research

H: The initial hypothesis: the proposed experimental teaching system (hereinafter NIESVA) will be more effective than the traditional teaching system. In order to be able to conduct successful quantitative and qualitative verification we divided the initial hypothesis into the following subhypotheses:

H1: The cognitive learning performance (the results of the output didactic test) of the students taught by means of NIESVA will be better than of those taught traditionally.

H2: At the end of the experimental period the students taught by means of NIESVA will achieve better or the same level of memory performance in comparison with the students taught in a traditional way (in the subtest N1 of the output didactic - test the learning taxonomies of Niemierko).

H3: At the end of the experimental period the students taught by means of NIESVA will achieve better or the same level in knowledge comprehension (in the subtest N2 of the output didactic test - the learning taxonomies of Niemierko) compared with the students taught in a traditional way.

We present here only the central subhypotheses in the cognitive area.

The effectiveness of the NIESVA application in the natural teaching process at (teachers) faculties was verified during a continuous series of long-term empirical research in 2015 – 2016.

The research sample consisted of 64 research samples were in educational subject (Natural Science) for teacher education. The basis of results achieved in the input didactic tests divided into experimental and control group. 33 students were placed in the experimental group and 31 students in the control group. Pedagogical experiment was carried out from January to June (2015-16).

In the process of our research the following methods (the method of pedagogical investigation and psychological-pedagogical method) were used:

1/ the pedagogical experiment the main method, a two-group model of the experiment (an experimental and a control group) conducted synchronously and simultaneously;

2/ didactic tests,

3/ the questionnaire method,

4/ the method of dialogue,

5/ the method of observation,

6/ statistical methods of research data analysis.

The Major Experimental Research Analyses Results

The statistical interpretation of the research analyses findings is concise as the graphs are explicatory enough – Fig. 4 and Fig. 5. They include the digital data related the values in question as well as the basic characteristics of the statistical ensembles arranged into the tables. As we find them sufficiently descriptive we do not provide any additional verbal explanations – Tab I.

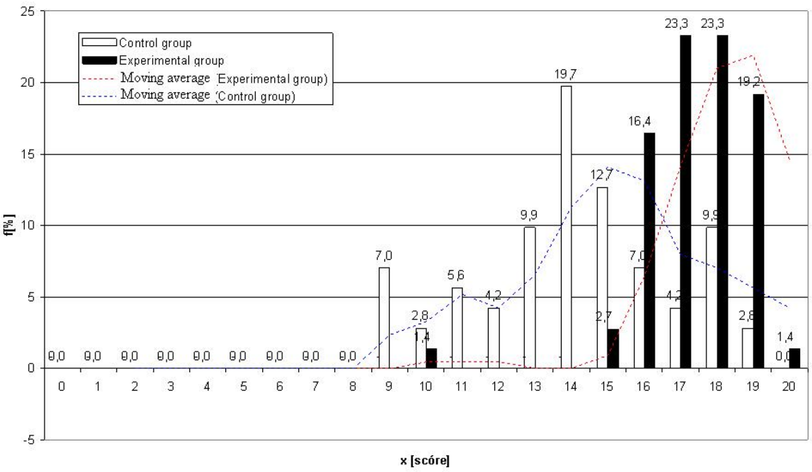

Fig. 4 Frequency distribution of learners' performances achieved in the final didactic test within the pedagogic experiment

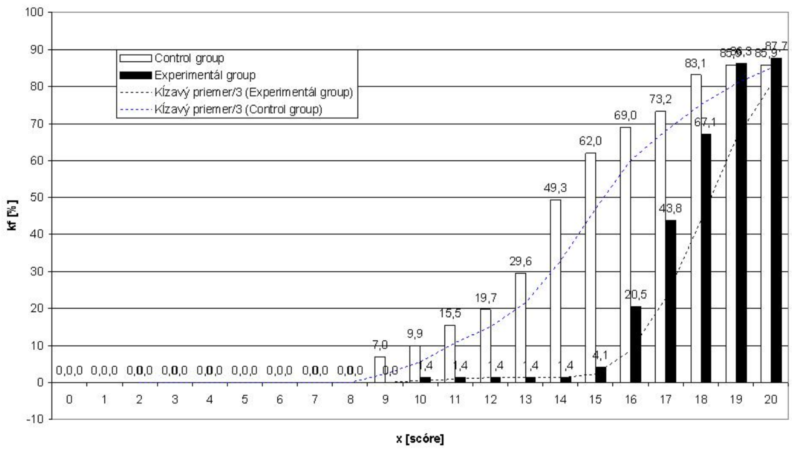

Fig. 5 Distributive function of learners' (scores) achieved in the final didactic test within the pedagogic experiment

TABLE I

DESCRIPTIVE AND INDUCTIVE STATISTICS

Descriptive Statistics						
TAB 1.1E	XmaxE =	20	XminE =	11	AverageE =	17,35484
EXP	test.norm.	yes	MedianE=	17	Mode E=	17
0.quartile =	11	1.quartile=	16	2.quartile=	17	
3.quartile =	18	4.quartile=	20			

Descriptive Statistics						
TAB 1.1C	XmaxC =	19	XminC =	9	AverageC =	14,42188
CON	test.norm.	yes	Median C=	14	Mode C=	14
0.quartile =	9	1.quartile =	13	2.quartile=	14	
3.quartile=	16	4.quartile=	19			

Inductive Statistics						
Stat. confid. (E-C)		k = 2	ni1 =	1	ni 2 =	62
Fkr [95%] =	6,8	Fvyp =	94,14889	signifik =	áno	
Fkr [99%] =	3,9					

Some results of the structural statistical analysis on the level of subtests system created on the basis of Niemierko's taxonomy levels of teaching

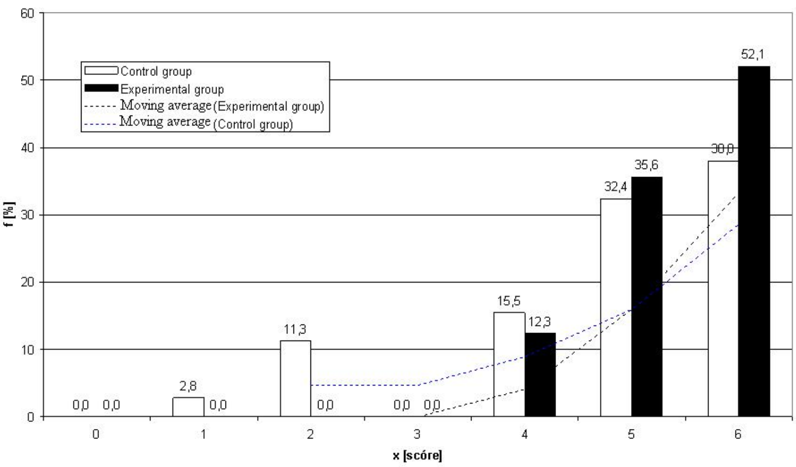

Fig. 6 Frequency distribution of learners' performances achieved in subtest N1 (remembering) of the final didactic test within the pedagogic experiment

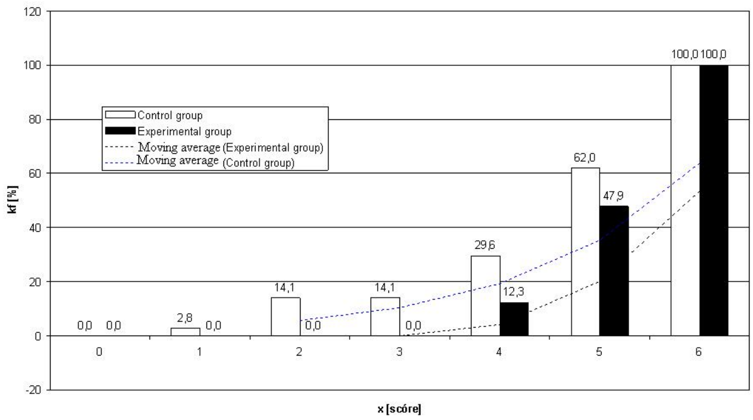

Fig. 7 Distributive function of learners achieved in subtest N1 (remembering) of the final didactic test within the pedagogic experiment

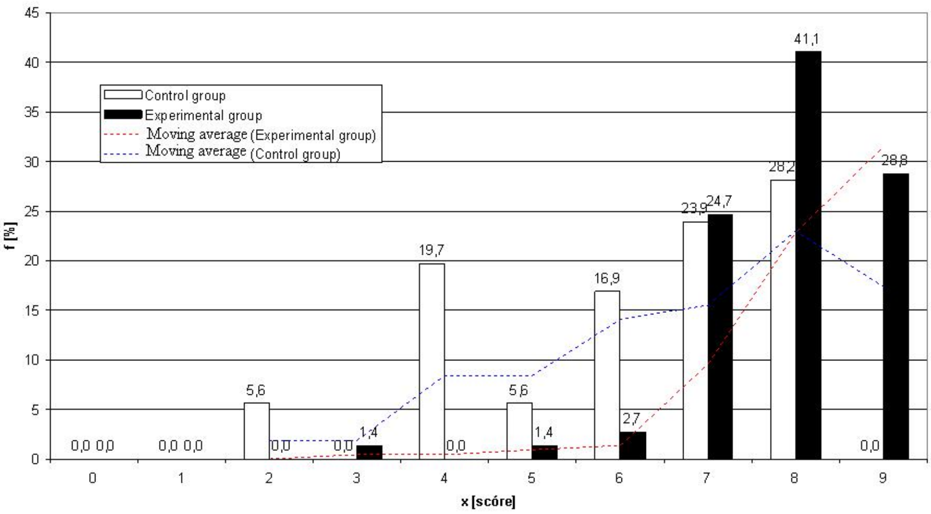

Fig. 8 Frequency distribution of learners' performances achieved in subtest N2 (comprehension) of the final didactic test within the pedagogic experiment

There are frequency distribution graphs (Fig. 6, Fig. 8 and Fig. 10) of subtests N1, N2 and N3 together with their distribution functions (Fig. 7, Fig. 9 and Fig. 11)

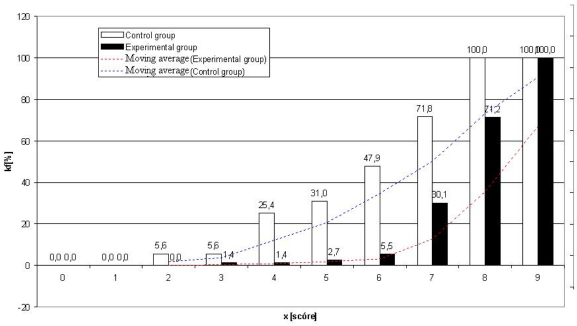

Fig. 9 Distributive function of learners' scores achieved in subtest N2 (comprehension) of the final didactic test within the pedagogic experiment

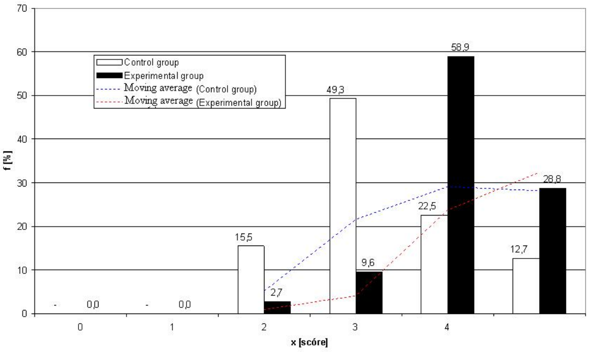

Fig. 10 Frequency distribution of learners' performances achieved in subtest N3 (application) of the final didactic test within the pedagogic experiment

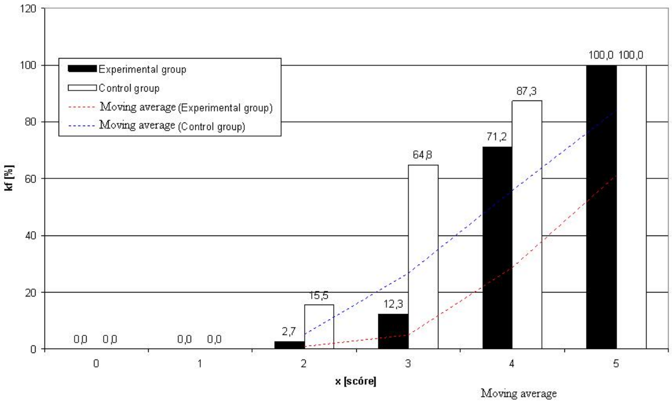

Fig. 11 Distributive function of learners' scores achieved in subtest N3 (comprehension) of the final didactic test within the pedagogic experiment

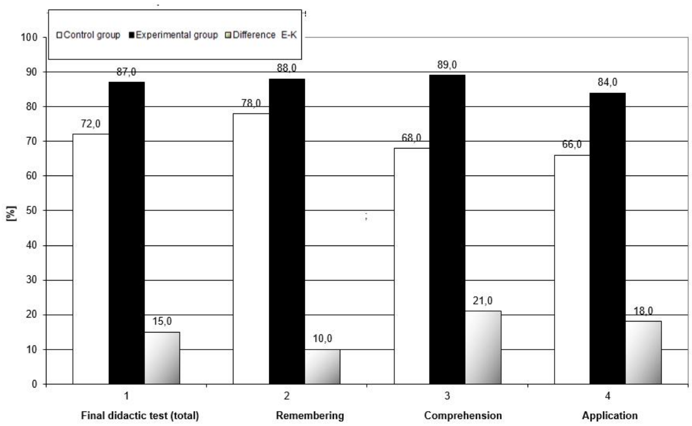

Fig. 12 The comparison of the success rate of the individual subtests assessing the learning objectives (remembering, comprehension, application) in the experimental and control group in the final didactic test

Results of the quartile and cluster statistical analysis are shown in Fig. 13

I.1. Some results of the quartile and cluster statistical analysis

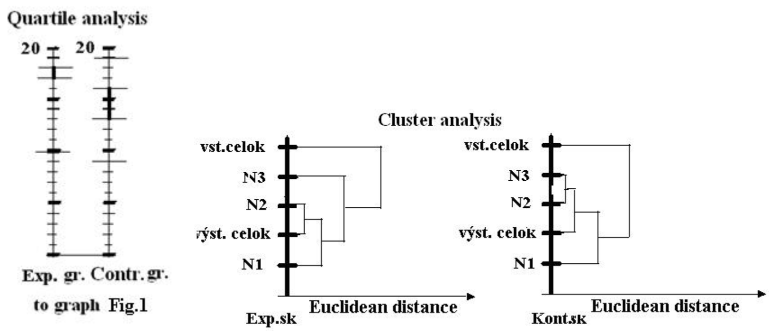

Fig. 13 Results of the quartile and cluster statistical analysis

Conclusions and Recommendations Resulting from Research Results

Our arguments are primarily strengthened by the results presented in Fig. 12. They demonstrate the comparison of success rate of the individual subtests assessing the learning objectives (remembering, comprehension, application) in the experimental and control group in the final didactic test. The results show that the differences in the success rate of individual subtests between the experimental and control group are as follows: 10,0 % in remembering, 21,0 % in comprehension, 18,0 %, in application and 15,0 in final didactic test application in favour of the experimental group (see Fig. 12, Fig.13).

Our statements are supported by the results shown in the Table I (Descriptive and inductive statistics). The statistical significance of the performance difference between the experimental and the control group achieved in the final didactic test is demonstrated as a whole in the TABLE I Descriptive and inductive statistics (by the analysis of variance – F test). Calculated F was 94,14, Fkr = 6,8, Since F > Fkr, we can say that in the student’s performance achieved in the final didactic test there is statistically significant difference between the experimental and control group at the significance level of 0,05. The interpretation of the subtest results N1 (remembering), N2 (comprehension), N3 (application) is analogical to the previous. (See Table 1 Descriptive and Inductive statistics).

Finally, we dare to say that the proposed experimental teaching system NIESVA used during this research appears to be more effective than a traditional teaching system. The students who participated in the experiment showed better performance in cognitive learning as well as in all the other observed parameters (remembering, comprehension, application).

The most encouraging is the fact that the present innovative system may be introduced into the teaching process (of our research) without any radical transformation of the traditional teaching system (and this is, in our view, its crucial advantage) as it is fully mentioned in [1].

The overall analysis of the application of the present innovative teaching system utilizing computer animation and simulation of natural and technical processes and phenomena by means of Java applets proves the good prospective of the introduction of the innovative system into school practice. Moreover, it proves the system to become a valuable tool for increasing the effectiveness of the teaching of teacher faculties. Furthermore, it provides evidence to be a helpful means for achieving positive qualitative changes in students' knowledge structure. The most encouraging is the fact that the present innovative system can be introduced into the teaching process without any radical transformation of the traditional teaching system (and in our view it is its crucial advantage) as it was fully mentioned in [4].

In addition, the NIESVA system is considered to be a lot more attractive and motivating than the traditional system for the participants of the present research. What is more, the members of the experimental group stated that they were looking forward to being taught by means of the NIESVA system.

The research findings confirmed that the Java applet application in teaching in natural and technical subjects is of great didactic importance. It broadens the horizon of visualization, application, didactic and educational possibilities which cannot be made available by traditional techniques of visualization of objects, processes and phenomena in the electrical engineering teaching process.

Acknowledgements

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