JAVA APPLETS AND TEACHING AS A NEW PHENOMENON

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Resume: *The paper reports the aspects related to Java applets creation and their application in teaching technical subjects. The author of the paper also presents the Java applets he himself created and applied in the teaching process. At the same time he emphasises the irreplaceability of didactic and professional mastership of a teacher in the teaching process using Java applet programmes.*

Key words: *teaching electrotechnical subjects, applets*

1 Introduction, Basic Notions and Terms

The arrival of computer technology has offered unprecedented opportunities for the application of computer simulation and animation in the teaching process. It has raised our awareness of the necessity of a new quality platform creation for visualisation of objects, processes and phenomena in teaching technical subjects. Our expectation as well as the goal of our research was to prove that the new visualisation platform would help increase the effectiveness in the technical subject teaching process.

It is necessary to note that in all fast-developing scientific branches (such as information technologies) a great deal of dynamics is observed also in their terminology and translation. New and new terms are continuously being coined and introduced or the content of some already existing terms is being changed, stabilized or made more precise. Due to the dynamics of computer terminology the following definition of an applet taken from Wikipedia is only one of several possible definitions [4].

An applet is a software component that runs in the context of another program, for example a web browser. An applet usually performs a very narrow function that has no independent use. Hence, it is an *app*lication *-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 requires to be appended by another short description which characterises a Java applet from the didactical point of view. In our view an applet is a "small" special monofunctional application programme used for example for interactive animations or calculations made by a client herself/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 a tool for creating interactive teaching materials.

2 Research Objectives

The main goal of our research was to create Java applets for improving technical subject teaching. Our objective was not only to **create** an innovative system of teaching electrical engineering subjects but also to verify it in the conditions of real school.

For this purpose we created over two hundred Java applets in the Java environment. The applets were created, i.e. **the individual static pictures and figures from the traditional printed text books or schemes** included in the instructions for use in **pupils' model construction kits (meccanoes) were animated (or simulated).** Our final objective was to create a virtual visualisation 'appendix' which enlarged the radius of action of traditional printed text book visualisation (as well as visualisation of instructions how to use pupils' model electro-component-construction kits) and moved it behind its natural borders.

Moreover, on one of the applets we demonstrated the technique of the applet 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 articulated as follows: those phenomena, processes and objects that can be visualised in a traditional, it means static way (a picture or a figure in a textbook, a plastic model or other three-dimensional models such as a model construction kit, etc.) are to be visualized traditionally. Those phenomena, processes and objects which go beyond the possibilities of the traditional and conventional ways of visualisation are to be visualised by means of Java applets ('enlargement of a hand of knowledge').

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

3 A Set of Selected Applets Designed for Thematic Teaching in Electrical Engineering

The created collection of applets was called *Electrical Engineering and Informatics around us in Applets*. In order to strengthen the didactic application of the applet the names of the individual applets begin with the words "How does .... operate/function? To be more concrete: "How does a digital thermometer function at measuring the human body temperature? In the process of the applets creation and application the elements of teaching project concept were used. Below some of the selected applets of the created collection will be presented (including the outline of the recommended methodology of their application in the teaching process).

3.1 The applets for teaching basic circuits of residential electrical installation

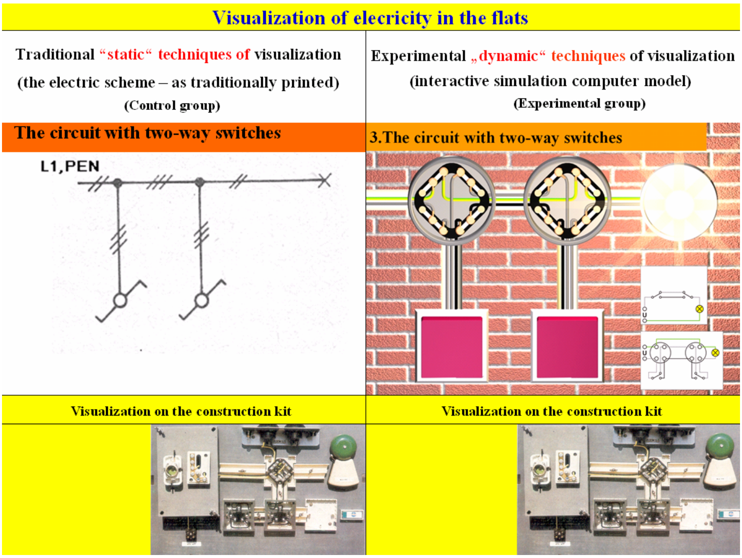


Fig. 3.1.1 The applet – How does a circuits of electrical installation function? (the outline of the applet creation principles and its application in didactics)

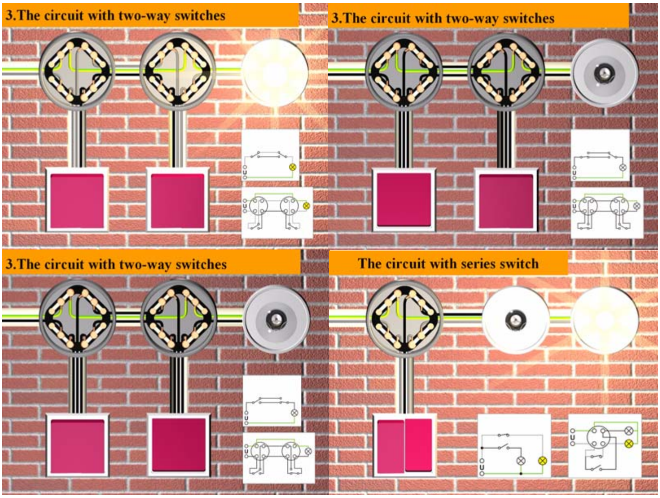


Fig. 3.1.2 The applet – How does a circuits of electrical installation function? (the selection of the key sequences of the decelerated animation process)

3.2 The applets for teaching automation technology

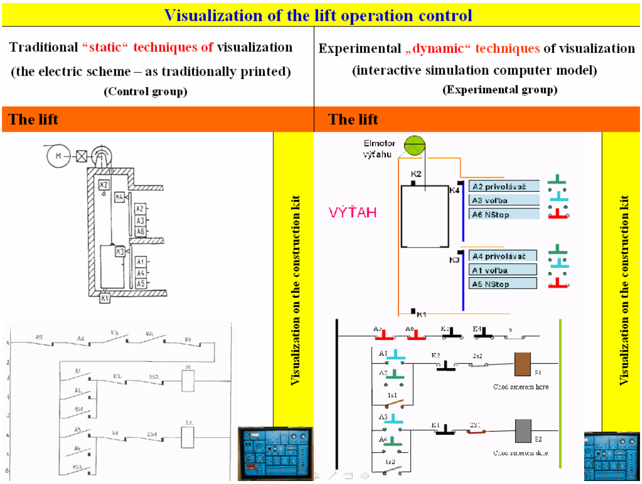


Fig 3.2.1 The Applet – How does a lift operation control function? (the outline of the applet creation principles and its application in didactics)

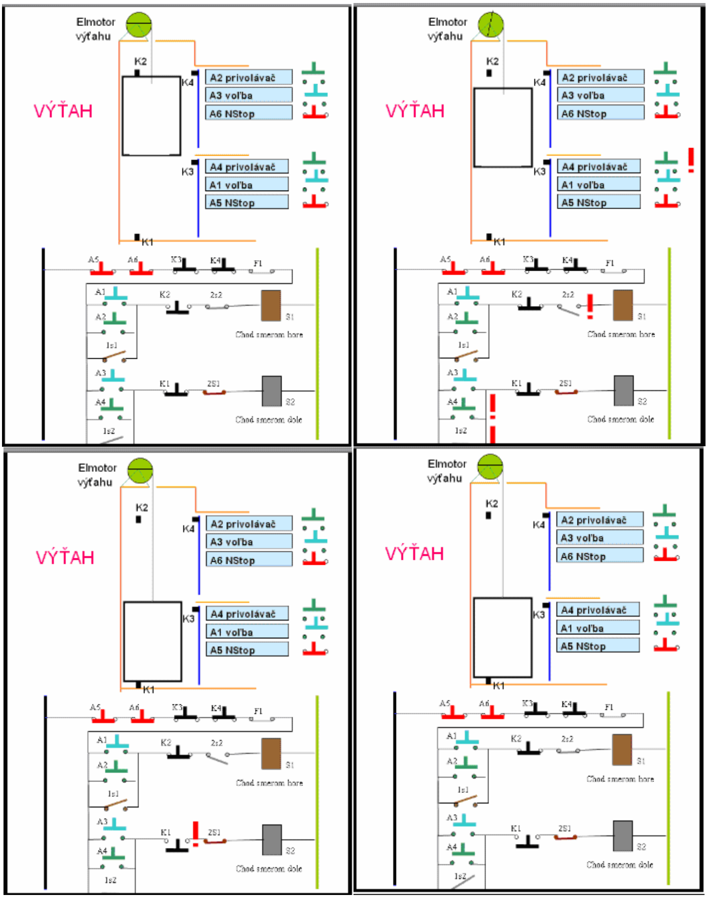
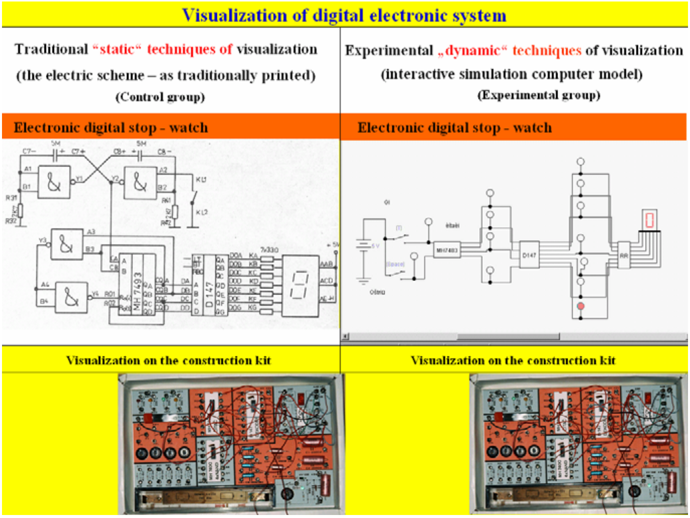


Fig. 3.2.2 The applet – How does a lift operation control function?
(the selection of the key sequences of the decelerated animation process)

3.3 The applets for teaching electronic digital systems



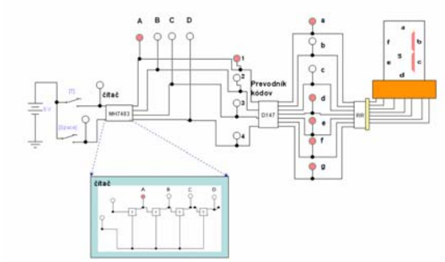


Fig. 3.3.1 The applet – How does an electronic digital stop watch function?
(the outline of the applet creation principles and its application in didactics)

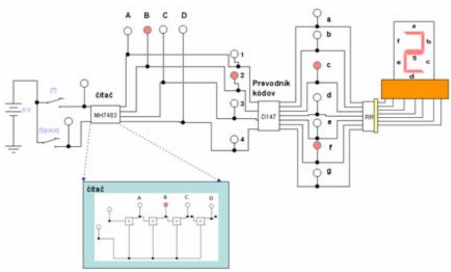


Fig. 3.3.2 The applet – How does an electronic digital stop watch function?
(the selection of the key sequences of the decelerated animation process)

4 Empirical Research Conducted into Java Applets Application in Teaching Process (Experimental verification of their didactic effectiveness in the conditions of real school)

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

The method of pedagogical experiment was used to compare the two teaching systems in the experimental group (the NIESVEA system) and the control group (traditional teaching system). The principle of the pedagogical experiment is demonstrated in Fig. 4. The concrete teaching system (the lift operation control) is demonstrated in Fig. 3.2.1.

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. 4 The principle of the pedagogical experiment

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

4.1 Initial Hypothesis of the Research

H **The initial hypothesis:** the proposed experimental teaching system (hereinafter NIESVEA) 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 thought by means of NIESVEA will be better than of those thought traditionally.

H2 At the end of the experimental period the students thought by means of NIESVEA will achieve better or the same level of memory performance in comparison with the students thought in a traditional way (in the subtest N1 of the output didactic test).

H3 At the end of the experimental period the students thought by means of NIESVEA will achieve better or the same level in knowledge comprehension (in the subtest N2 of the output didactic test) compared with the students thought in a traditional way.

H4 At the end of the experimental period the students thought by means of NIESVEA will achieve better or the same performance in the knowledge application (in the subtest N3 of the output didactic test) compared with the students thought in a traditional manner.

We present here only the central subhypotheses in the cognitive area. (For the subhypotheses in other areas see [2].) The test division into the individual subtests was made in accordance with the learning taxonomies of Niemierko.

The effectiveness of the NIESVEA application in **the electrical engineering teaching process** at non-electrical engineering faculties was verified during a continuous series of long-term empirical research in 1993–2005. **The total number of pupils and students** taking part in our research activities (in its all forms, phases and positions) was **580**.

The **selection of research samples** was conducted by means of methods of probability and mathematical statistics. Based on the F-test result (analysis of variance) we considered the selected **samples statistically equivalent.**

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

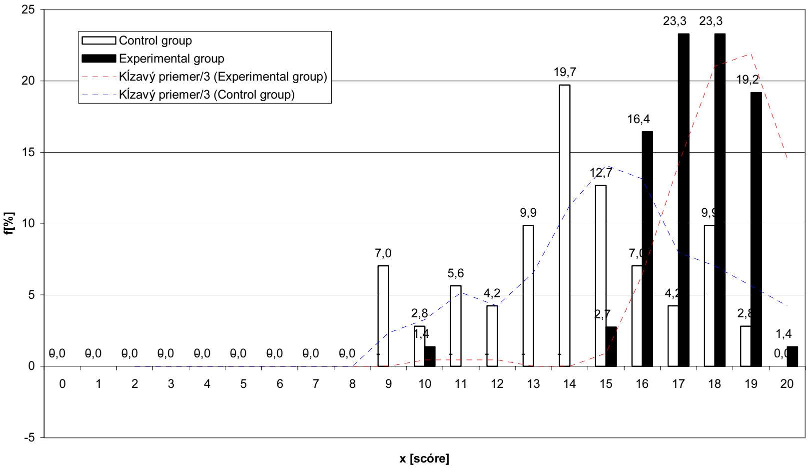
1. the **pedagogical experiment** – the main method, a two-group model of the experiment (an experimental and a control group) conducted synchronously and simultaneously;
2. **didactic tests** – for the verification of the hypotheses **H1, H2, H3, H4, H5,**
3. **the questionnaire method** – for the verification of the hypotheses **H10, H11,**

4. **the method of dialogue** – for the verification of the hypotheses **H10, H11,**
5. **the method of observation** – for the verification of the hypotheses **H13,**
6. **the statistical methods of research data analysis** – used for statistical verification of research hypotheses (descriptive statistics – basic characteristics of the research sample, correlations; inductive statistics – test of normal distribution, F-test, Chi-square test; Quartile and Cluster analyses ...).

4.2 The Major Experimental Research Analyses Findings

The statistical interpretation of the research analyses findings is concise as the graphs are explicatory enough. 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.

Graph G.1.1 – Frequency distribution of learners' performances achieved in the final didactic test within the pedagogic experiment

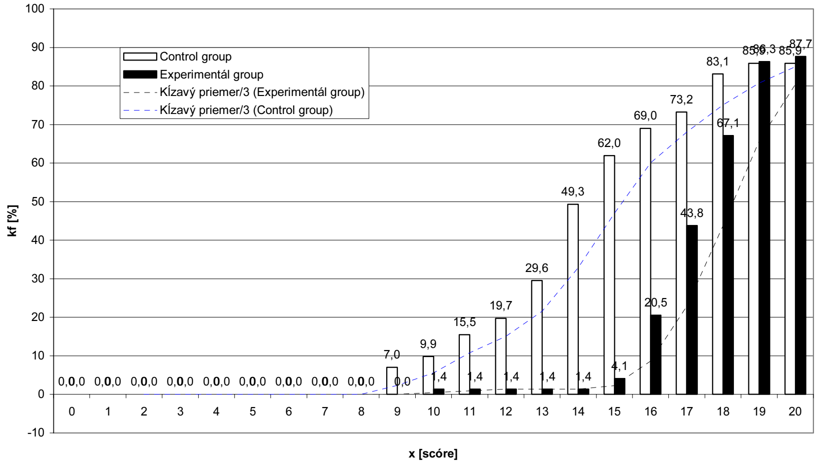


Descriptive Statistics						
TAB 1.1E	XmaxE =	20	XminE =	11	AverageE =	17,35484
EXP	test.norm.	yes	MedianE=	17	Mode E=	17
0.quartile =	11	1.quartile=	16	2.quartile=	17	
3.quartile =	18	4.quartile=	20			

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			

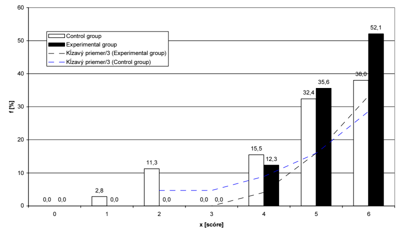
Inductive Statistics						
Stat. confid. (E-C)		k = 2	ni1 =	1	ni 2 =	62
Fkr [95%] =	6,8	Fvyp =	94,14889	signifik =	áno	
Fkr [99%] =	3,9					

Graph G.1.2 – Distributive function of learners' (scores) achieved in the final didactic test within the pedagogic experiment

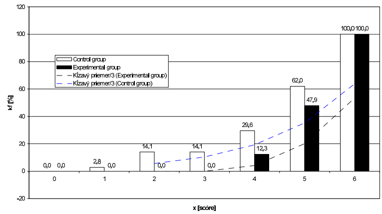


4.3.1 Some results of the structural statistical analysis on the level of subtests system created on the basis of Niemierko taxonomy levels of teaching

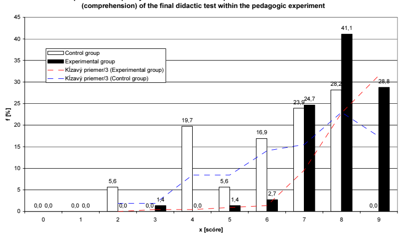
Graph G.2.1 – Frequency distribution of learners' performances achieved in subtest N1 (remembering) of the final didactic test within the pedagogic experiment



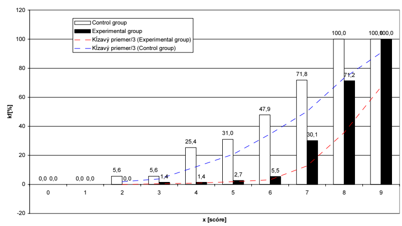
Graph G.2.2 – Distributive function of learners scores achieved in subtest N1 (remembering) of the final didactic test within the pedagogic experiment



Graph G.3.1 – Frequency distribution of learners' performances achieved in subtest N2 (comprehension) of the final didactic test within the pedagogic experiment

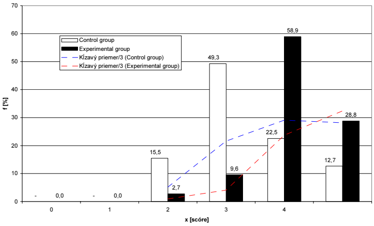


Graph G.3.2 – Distributive function of learners' scores achieved in subtest N2 (comprehension) of the final didactic test within the pedagogic experiment

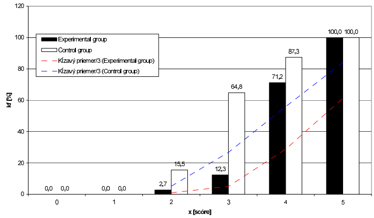


4.3.2 Some results of the structural statistical analysis on the level of the system of subtests created on the basis of particular teaching topics

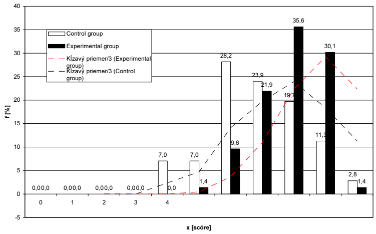
Graph G.4.1 – Frequency distribution of learners' performances achieved in subtest N3 (application) of the final didactic test within the pedagogic experiment



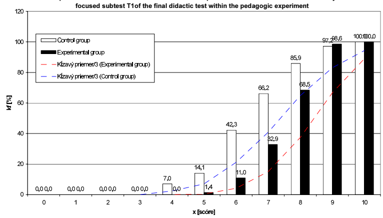
Graph G.4.2 – Distributive function of learners' scores achieved in subtest N3 (application) of the final didactic test within the pedagogic experiment



Graph 5.1 – Frequency distribution of students performances achieved in thematically focused subtest T1 of the final didactic test within the pedagogic experiment

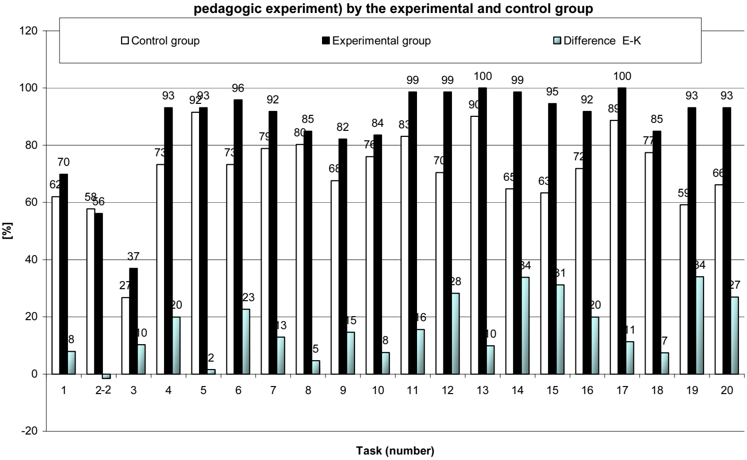


Graph 5.2 – Distributive function of lerners' scores performances achieved in the thematically focused subtest T1of the final didactic test within the pedagogic experiment

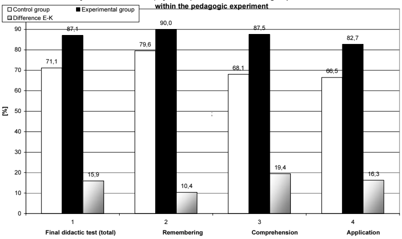


4.3.3 Some results of the structural statistical analysis on the level of system of subtests created on the basis of particular tasks in the final didactic test

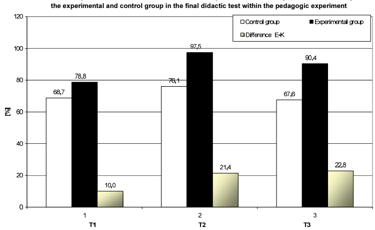
G.8 – Graph of solution successfulness of the particular tasks of the final didactic test (within the pedagogic experiment) by the experimental and control group



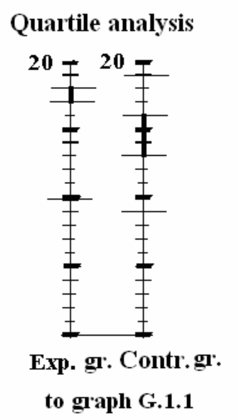
G.9 – Comparison of solution successfulness of the particular subtests (from the viewpoint of taxonomy of educational aims) by the experimental and control group in the final didactic test within the pedagogic experiment

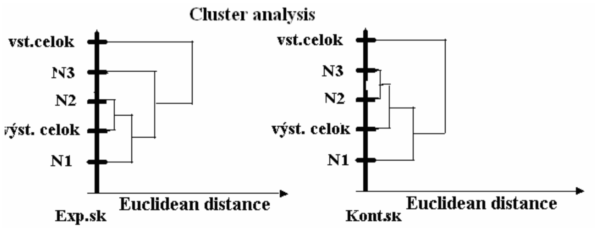


G.10 – Comparison of solution successfulness of the particular thematically focused subtests by the experimental and control group in the final didactic test within the pedagogic experiment



4.3.4 Some results of the quartile and cluster statistical analysis





4.5 The Interpretation of the Major Experimental Research Analyses Findings

The overall analysis of the application of the present innovative teaching system utilising computer animation and simulation of 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 electrical engineering at non-electrical engineering 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).

In addition, the **NIESVEA system** was regarded as much more attractive and motivating than the traditional one by the participants of the research. What is more, the experiment students said that they were looking forward to being taught by means of NIESVEA.

The research findings confirmed that the Java applet application in teaching electrical engineering 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.

[1] **BERNÁT, M.:** Dynamics of space charges in highly non-homogheneous DC and AC fields, Ph.D. thesis, FEI TU Košice 2000 (in Slovak).
[2] **BERNAT, M.:** Visualization of some electro-physical processes through computer for didactic purposes and its application in teaching electrotechnical subjects. Ph.D. thesis, PdF UKF Nitra 2005 (in Slovak).
[3] **MELEZINEK, A.:** Ingenieurpädagogik: Praxis der Vermittlung technische Wissens techn. Wissens. Wien, New York, Springer, 1986.
[4] **WIKIPEDIA:** http://en.wikipedia.org/wiki/Main_Page

Biography

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Renáta Bernátová (doc., RNDr., Ph.D.) was born in Prešov, Slovakia, in 1966. She was awarded the RNDr. degree by the faculty of Natural science, UPJŠ of Košice, in 1989. She works as a docent at Pedagogical Faculty of Prešov University.

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