ON INCREASING EFFICIENCY IN TEACHING TECHNICAL AND NATURAL SCIENCES BY MEANS OF JAVA APPLETS II. (EXPERIMENTAL RESEARCH)

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Abstract: *This paper brings some practical experimental results of our research whose aim was to elaborate a system of teaching technical and natural subjects and a "know how" of its using which would enable us to visualize more illustratively some processes that cannot be visualized through the traditional means of visualization.*

Key words: *computer, teaching technical and natural subjects.*

K ZVYŠOVANIU EFEKTÍVNOSTI VYUČOVANIA TECHNICKÝCH A PRÍRODOVEDNÝCH PREDMETOV POMOCOU APLIKÁCIE JAVA APPLETOV II. (EXPERIMENTÁLNY VÝSKUM)

Resumé: *Príspevok prináša pragmatické výsledky experimentálneho výskumu realizovaného vo výučbe technických a prírodovedných predmetov, ktorého cieľom bolo porovnať efektívnosť systémov vyučovania kreovaných na platforme tradičných a počítačom podporovaných vizualizačných platforiem.*

Klúčové slová: *počítač, výučba technických a prírodovedných predmetov.*

Introduction, Basic Notions

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.

1. 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 NIESVA. It was designed for visualisation 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.

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. 1. The concrete teaching system (the lift operation control) is demonstrated in Fig. 1.

The main aim of the experimental research was to investigate the possibilities of the

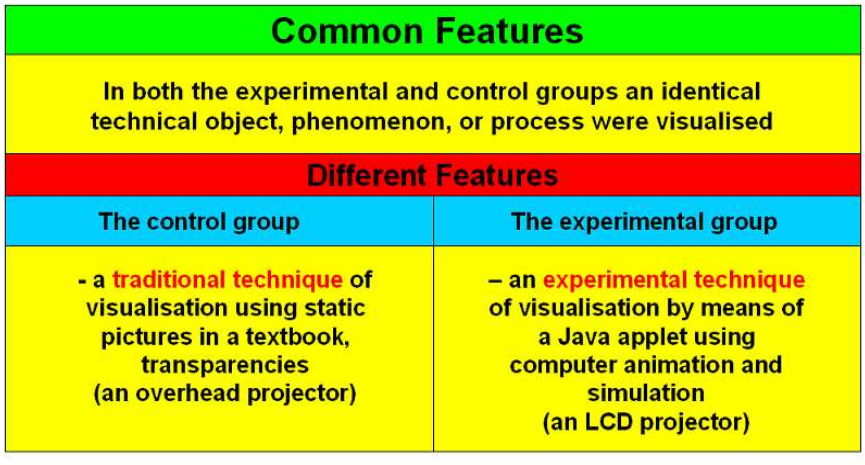


Fig. 1: *The principle of the pedagogical experiment*

NIESVA system application in order to increase the effectiveness of the teaching process.

1.1 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 thought by means of NIESVA will be better than of those thought traditionally.

H2 At the end of the experimental period the students thought by means of NIESVA 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 the learning taxonomies of Niemierko.).

H3 At the end of the experimental period the students thought 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 thought in a traditional way.

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

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

The effectiveness of the NIESVA application in **the natural and technical teaching process** at (teachers) faculties was verified during a continuous series of long-term empirical research in 1993 – 2005.

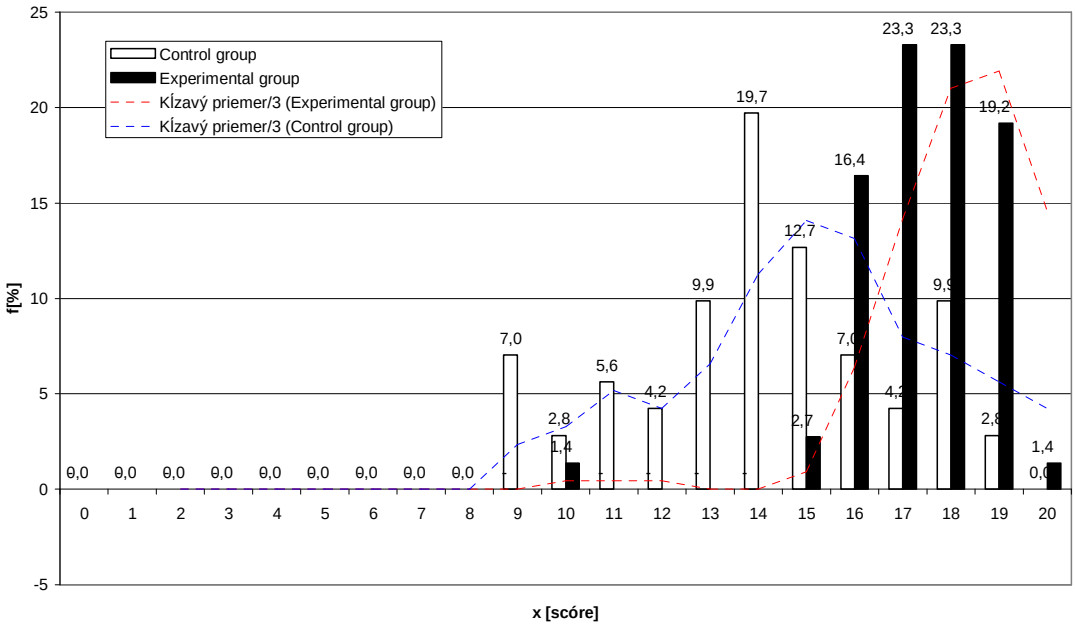
In the process of our research the **following methods (the method of pedagogical investigation and psychological-pedagogical method)** were used:

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/ **the statistical methods of research data analysis.**

1.2 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

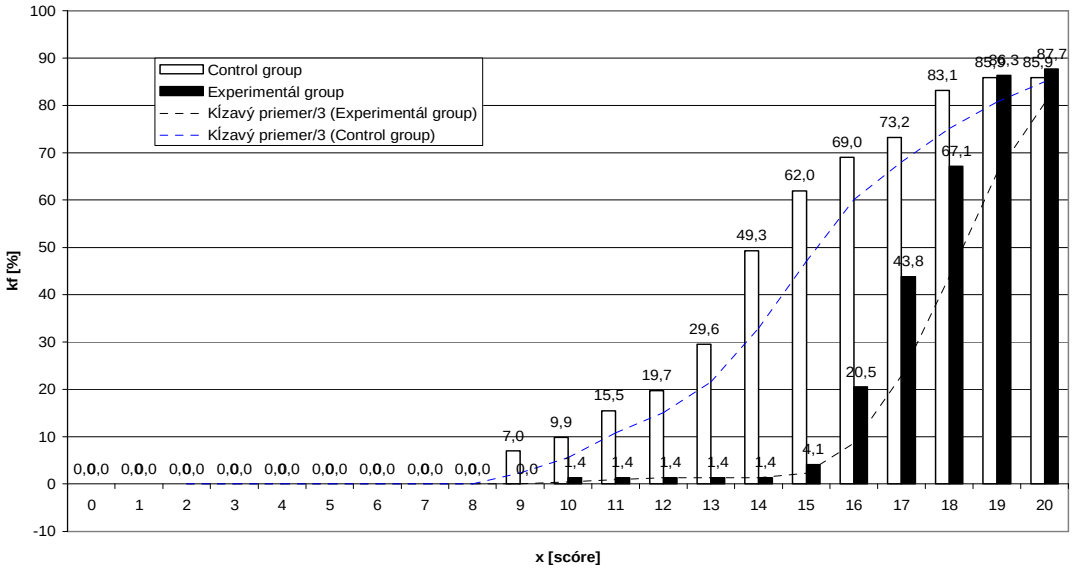


Descriptive Statistics						
TAB 1.1E	XmaxE =	20	XminE =	11	AverageE =	17,35484
EXP	test.norm.	yes	MedianE=	17	Mode E=	17
0.quartile =	11	1.quartile=	16	2.quartile=	17	
3.quartile =	18	4.quartile=	20			

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			

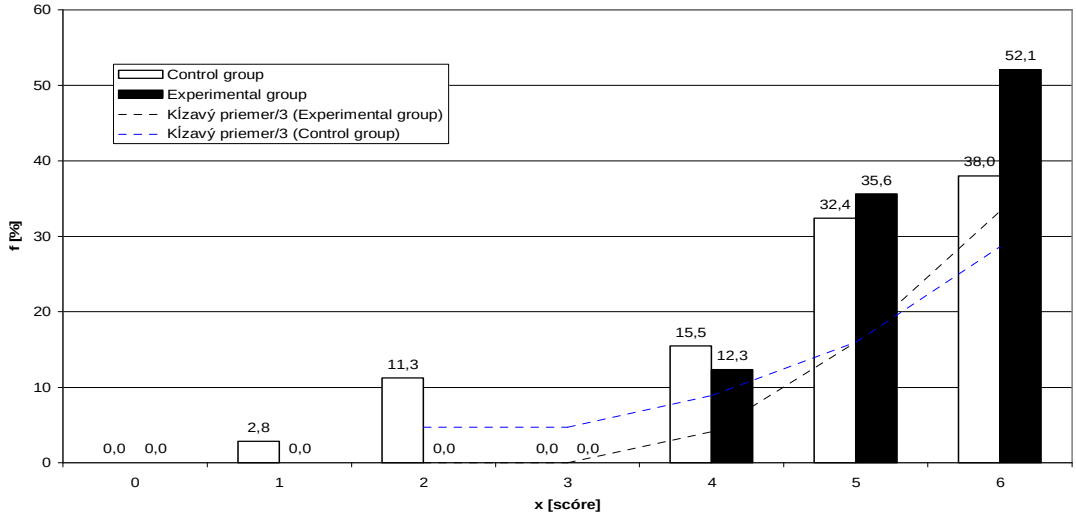
Inductive Statistics						
Stat. confid. (E-C)		k = 2	ni1 =	1	ni 2 =	62
Fkr [95%] =	6,8	Fvyp =	94,14889	signifik =	áno	
Fkr [99%] =	3,9					

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

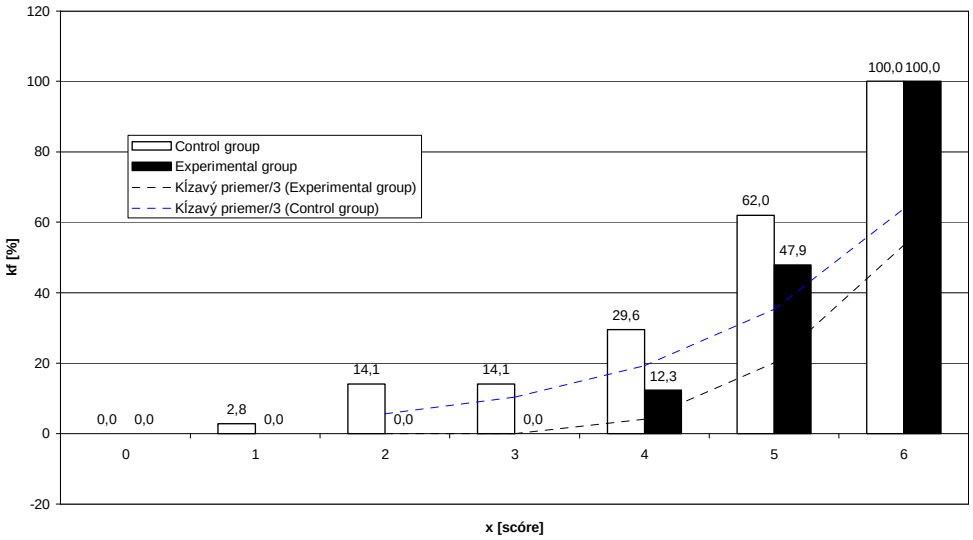


1.2.1 Some results of the structural statistical analysis on the level of subtests system created on the basis of Niemierko taxonomy levels of teaching

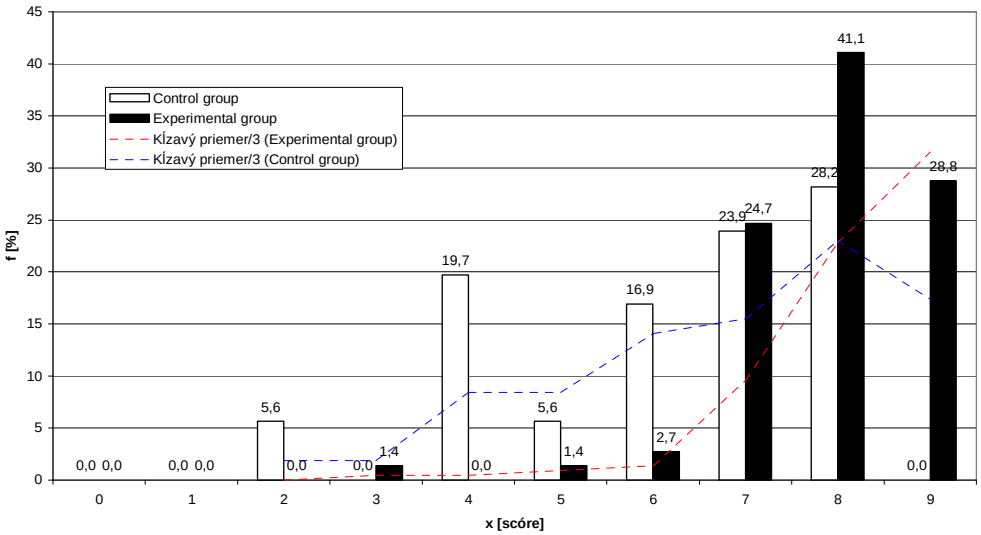
Graph G.2.1 – Frequency distribution of learners' performances achieved in subtest N1 (remembering) of the final didactic test within the pedagogic experiment



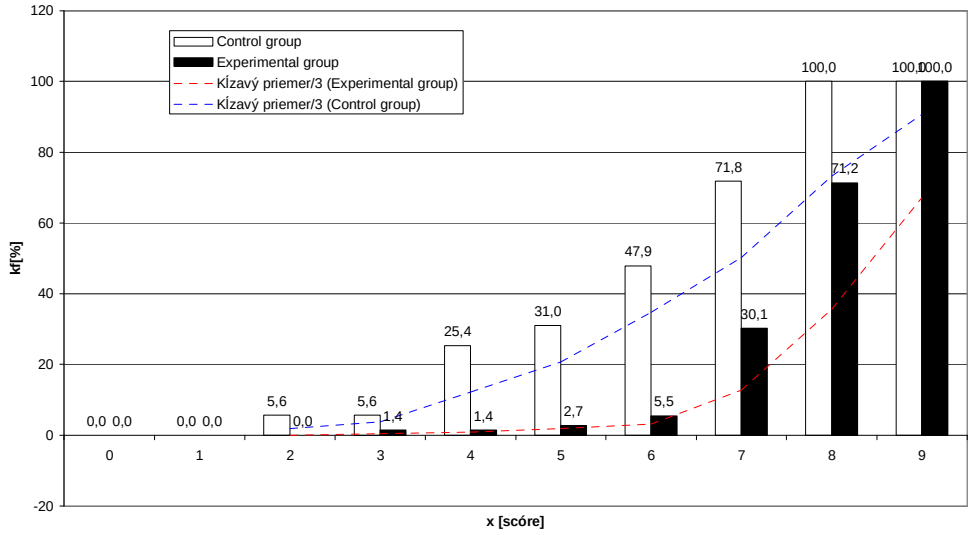
Graph G.2.2 – Distributive function of learners scores achieved in subtest N1 (remembering) of the final didactic test within the pedagogic experiment



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

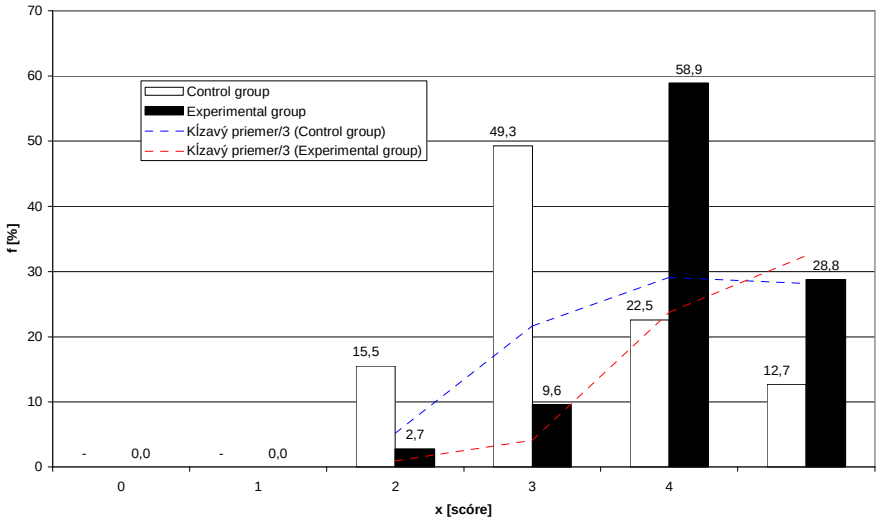


Graph G.3.2 – Distributive function of learners' scores achieved in subtest N2 (comprehension) of the final didactic test within the pedagogic experiment

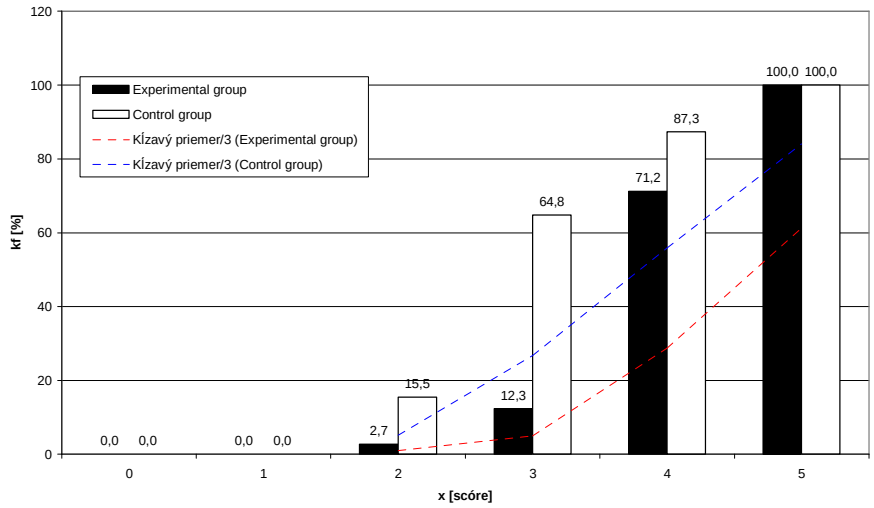


1.2.2 Some results of the structural statistical analysis on the level of the system of subtests created on the basis of particular teaching topics

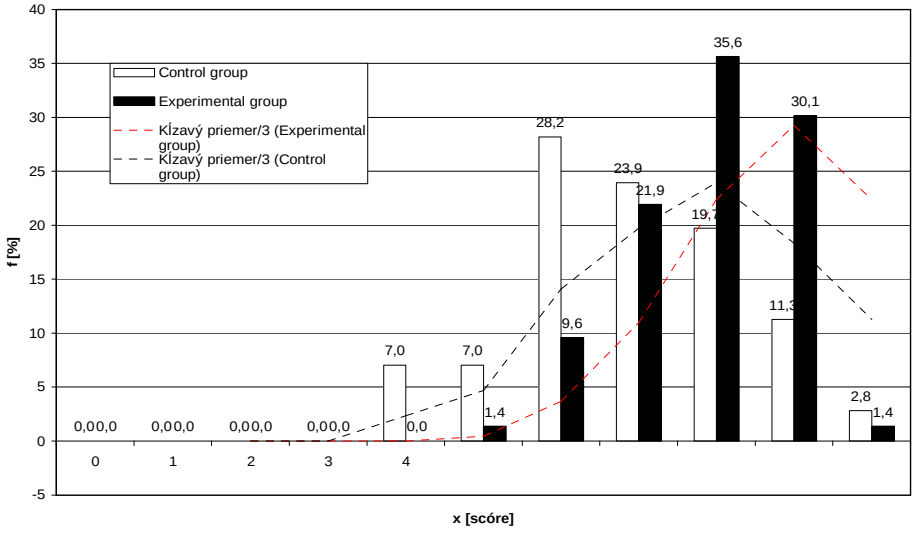
Graph G.4.1 – Frequency distribution of learners' performances achieved in subtest N3 (application) of the final didactic test within the pedagogic experiment



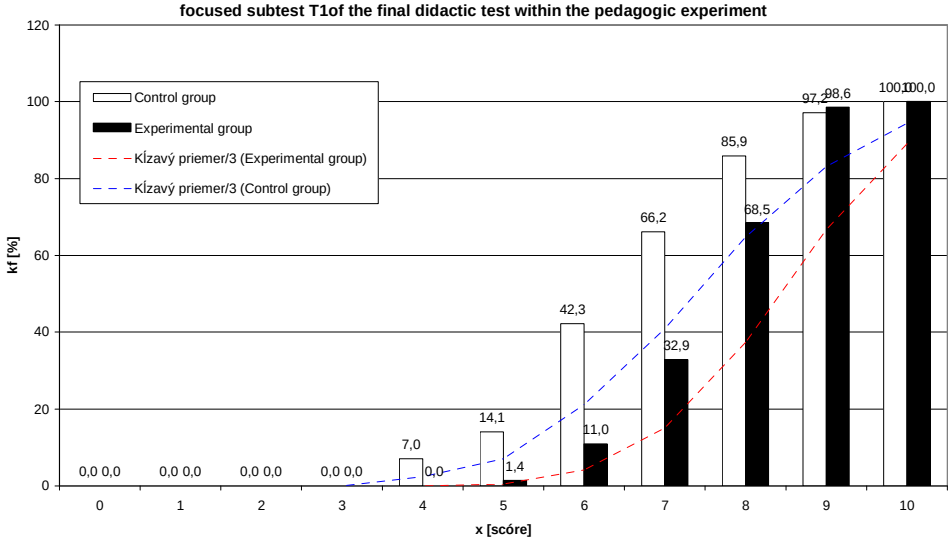
Graph G.4.2 – Distributive function of learners' scores achieved in subtest N3 (application) of the final didactic test within the pedagogic experiment



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

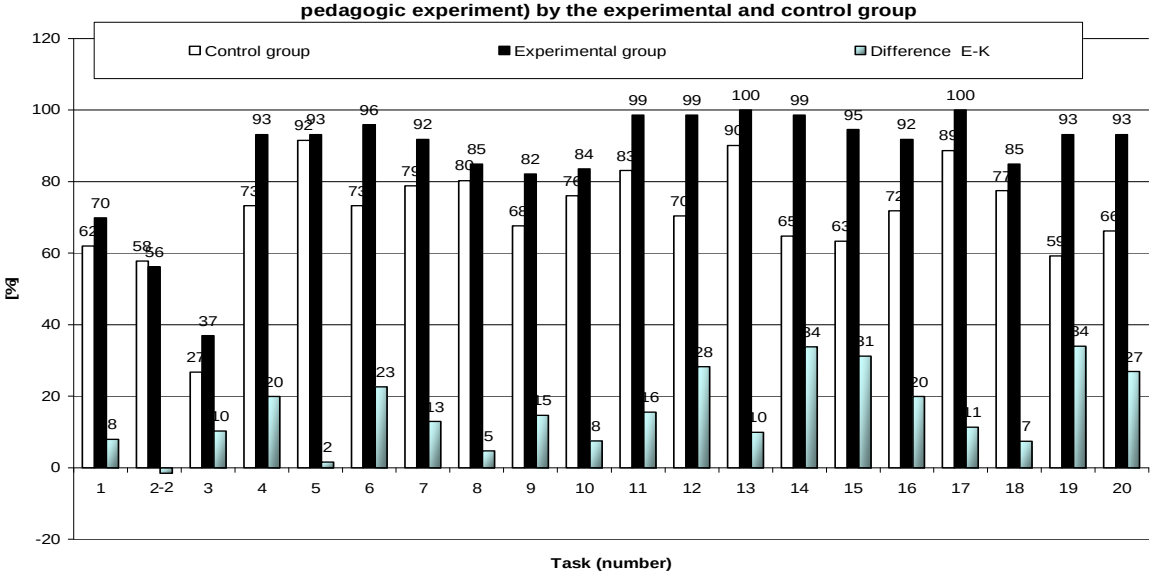


Graph 5.2 – Distributive function of lerners' scores performances achieved in the thematically focused subtest T1of the final didactic test within the pedagogic experiment

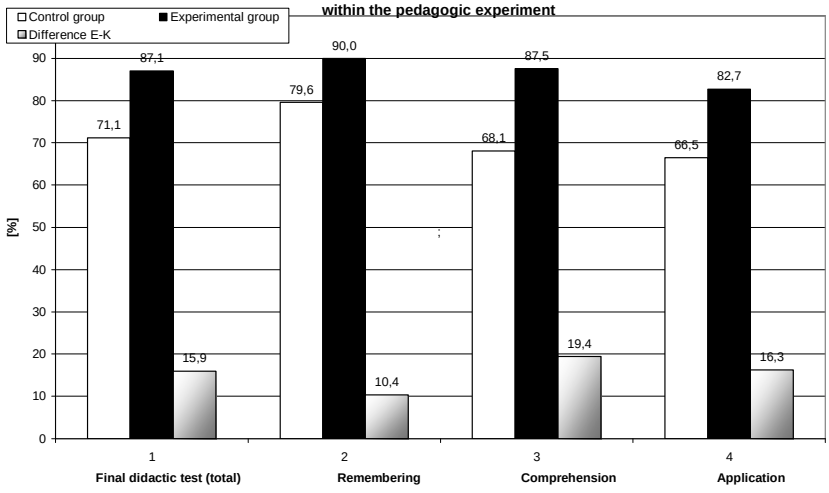


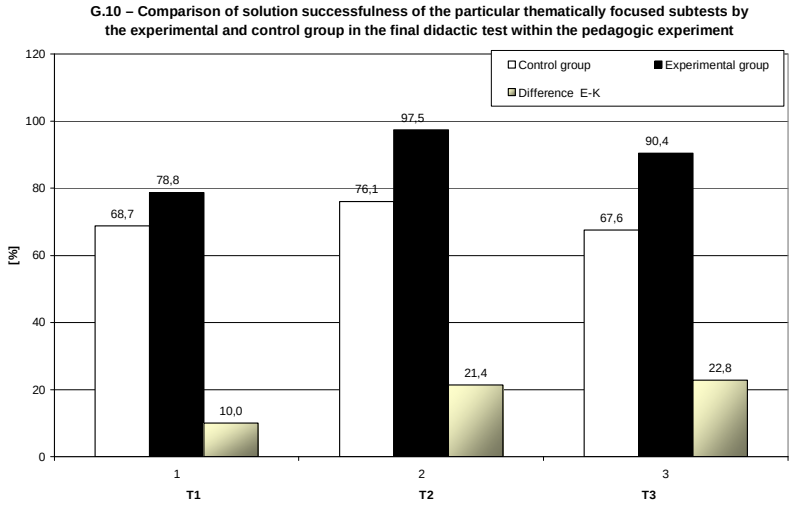
1.2.3 Some results of the structural statistical analysis on the level of system of subtests created on the basis of particular tasks in the final didactic test

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

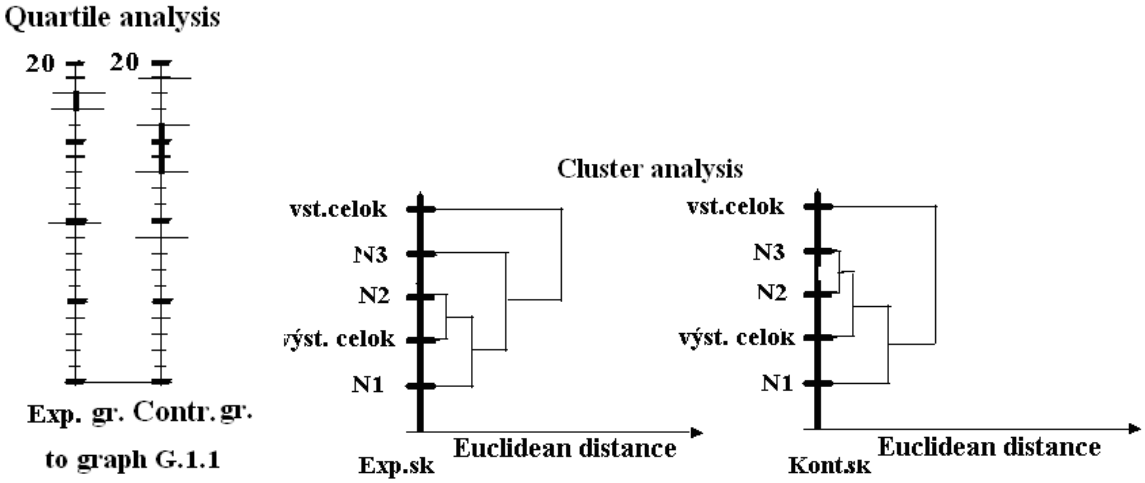


G.9 – Comparison of solution successfulness of the particular subtests (from the viewpoint of taxonomy of educational aims) by the experimental and control group in the final didactic test within the pedagogic experiment





1.2.4 Some results of the quartile and cluster statistical analysis



1.3 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 natural and technical processes and phenomena by means of Java applets proves the good perspectives 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 faculty teachers. 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 **NIESVA 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 **NIESVA.**

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 teaching process.

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