



The Effectiveness of Interactive Whiteboard using NIESVE System for Electrical Engineering Students

Milan Bernát¹, Ján Pavlovkin², Jaroslav Džmura³, Ľubomír Žáčok*²,
Renáta Bernátová⁴, Jaroslav Petráš³, Ladislav Rudolf⁵, Michaela Sepešiová⁶

¹University of Presov in Presov, Faculty of Humanities and Natural Sciences, Ul. 17 novembra č. 1, 081 16 Prešov, SLOVAK REPUBLIC

²Faculty of Natural Sciences, Matej Bel University, Tajovského 40, 974 01 Banská Bystrica, SLOVAK REPUBLIC

³Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Mäsiarska 74, 042 00 Košice, SLOVAK REPUBLIC

⁴University of Presov in Presov, Faculty of Education, Ul. 17 novembra č. 15, 081 16 Prešov, SLOVAK REPUBLIC

⁵University of Ostrava, Faculty of Education, Fráni Šrámka 3, 702 00 Ostrava, CZECH REPUBLIC

⁶University of Presov in Presov, Faculty of Arts, Ul. 17 novembra č. 15, 081 16 Prešov, SLOVAK REPUBLIC

*Corresponding Author

DOI: <https://doi.org/10.30880/jtet.2020.12.01.022>

Received 31st August 2019; Accepted 11st November 2019; Available online 31st March 2020

Abstract: The article describes possibilities of increasing the effectiveness of teaching technical subjects using an interactive whiteboard. The basic research method is a pedagogical experiment by which we compare the effectiveness of teaching in the experimental and control group. In the experimental group was used experimental teaching with the support of an interactive whiteboard (on the platform of targeted use of the virtual way of visualising the course of processes and phenomena using an interactive whiteboard overlapping the natural possibilities of other ways of visualising these processes and phenomena). The control group was teaching traditionally taught without an interactive whiteboard. Research results (based on test results) have shown that the experimental teaching system we have used during this research is more effective than the traditional teaching system. By learning with an interactive whiteboard, we found that it was easier for students to acquire new knowledge. Students were able to use the acquired knowledge to solve practical tasks.

Keywords: interactive whiteboard, technical education and training, electricity, generation of electricity

1. Introduction

The Interactive whiteboard is a touch-sensitive area where interactive communication between the user and the computer takes place in order to ensure the maximum possible level of clarity of the displayed content. Using an interactive whiteboard, we can, share information and educational materials, control computer programs with an electronic pen or finger, add or delete notes or overwrite them, use the Internet and computer program capabilities. Visualisation of processes and phenomena through an interactive whiteboard beyond the natural possibilities of other methods of

*Corresponding author: lubomir.zacok@umb.sk

visualisation of these processes and phenomena (deceleration, acceleration, penetration over time, processes under other parameters of process conditions).

Working on an interactive whiteboard moves learning forward as it engages both the student and the learner. From this, we can conclude that (Brestenská, et al., 2009): "The Interactive whiteboard is a modern learning tool that helps us streamline the learning process through presentations with a thorough use of ICT. Whiteboard is an electronic device that lets you interact live with your PC or Notebook directly from the board by clicking on the projected image using an interactive pen. Using it, is possible to control learning programs, office applications as well as teaching aids and teaching texts about subjects that the educator himself prepares in external graphic or text environments, teaching pictures or videos, all directly from the board.

Some of the didactic benefits of using an interactive whiteboard are such as leads to motivation to learn, increase attention and active involvement of students and pupils in teaching, and suppress the use of real aids and experiments (Pavlovkin & Novák, 2013).

The fundamental difference between the experimental and traditional way of visualising natural processes in our research is that the traditional way of visualisation uses "static" techniques of visualisation of the natural and technical system and the experimental visualisation method uses for example such as computer modelling and simulations, dynamic visualisation techniques their results presented by computer graphics - Fig. 1.

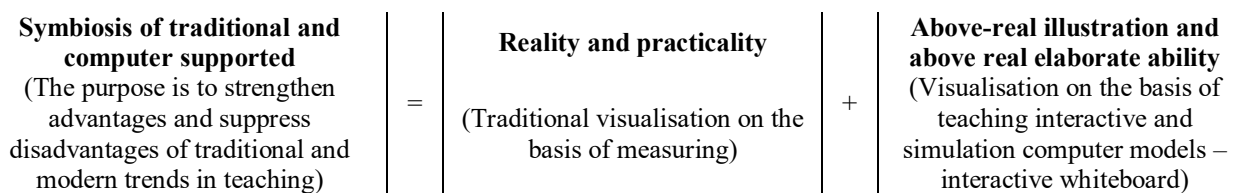


Fig. 1 - Scheme of strategy and tactics of creating experimental way of visualisation

Was designed the innovative experimental system (called NIESVE) to eliminate the above-mentioned drawbacks of the existing (traditional) ways visualisation of natural processes for didactic purposes. The experimental visualisation method applied in the NIESVE system enables, among other things, acceleration, deceleration actions. Acceleration and deceleration of the action was a disadvantage of physical measurement. Another advantage is that we have the opportunity to interactively enter the visualisation process and change the model parameters, which was a disadvantage of video animation. Experimental visualisation is practical and pragmatic and visualisation via computer simulation lacks these features. These NIESVE attributes (including multimedia and the synergic effect of mutual intersection) also extends both quality and quantity dimensions of the degree of didactic visualisation demonstrativeness beyond the possibilities of all the above-mentioned traditional forms of visualisation. We have been also concerned with the issues of effectiveness of teaching in the NIESVE in comparison with the traditional teaching system (see the section – the experimental research).

2. Interactive whiteboard in the technical education and training

The differences between the individual types of whiteboard consist mainly of the way of transferring the changes made on the board to the digitized dimension. Active Inspire software is a program specially designed for the school environment. The main workspace is the presentation of a workbook in which we can create presentation content using interactive tools. The number of pages is unlimited, there are several open ones, and we can export the content to other formats or print it out. One main toolbar allows you to control the entire software and choose the features we need use; all other tools are clearly arranged and described in the appropriate panels.

Writing and highlighting on the interactive whiteboard allows the user to write on their desktop, Change colours, use the highlight feature to create notes for text and images, charting, and write simple notes on a blank page. The pen allows you to change the size, colour, and line properties, e.g. add the arrow to the beginning and end of the line. To remove text from the screen, interactive whiteboard software includes a digital eraser.

Moving objects and joining them is the easiest operation on an interactive whiteboard, on the screen by dragging the mouse or directly onto the desktop that has a wide use.

Text tools allow you to add blocks of text, words, or longer text to the screen. They include all common word processor tools that can change size, fonts, and highlight parts of text by colouring or highlighting. Hide and uncover text, e.g. write the word the same colour as the background of the screen and then change the colour to make the word visible.

Spotlight/Spotlight allows the user to explore individual parts or object properties on the screen. The user can change the size of the surface or change its shape - to a square or rectangle, e.g. when viewing pictures or text.

Hidden and uncovered tools/shades, blinds are a simple screen cover that a teacher can to use completely or partially cover it, respectively. The gradual discovery of individual points or activities during teaching, e.g. as a roller shutter that can also be used horizontally.

Handwriting recognition enables you to write a pen on an interactive plaque and automatically convert the handwriting to text. Typically, the software offers multiple transcript alternatives that take into account different handwriting styles, converting hand-written text into a specific target language (Novacká, Hnatová, & Fryková, 2011).

Creating Object Copies/Cloning and Duplication is a simple feature that allows you to create multiple copies of one object. With cloning and duplication, a user can quickly create an unlimited number of copies of the same word or image within a single lesson. The user selects the object and sets its properties so that it automatically copies. Individual parties and advanced users can use duplicates to prepare educational materials to save time.

Timer devices/clocks and clocks allow the teacher to control the length of the individual parts of the clock and set the playback of the sound or melodies that mark the end of the activity. The clock can use instead of the traditional clock, and can be set to display the time in either 12 or 24-hour format. The interactive whiteboard software, in addition to the timer, also includes a calculator and a thermometer.

Uploading a screen or page is a tool that teachers use to record activities on an interactive whiteboard during a lesson. You can record a whole screen or just a certain area. The resulting video can be saved in various formats and viewed with most players. Teachers can use it to upload, for example, a lecture they delivered during a lesson.

Layering/Rubbing and Uncovering allows you to place objects on the screen in the desired order in the so-called Layers, e.g. to create different tasks in which students reveal hidden images, covered texts, etc. The user hides an object, e.g. Text or image, under the colour layer. Colour can be the same colour as the background of the page or create colour contrast. The user simply uses the rubber to remove the colour to expose the word or image below it.

Animation allows animation of objects on the screen in different ways, Create a page and the amount of a copy of it, move each object slightly, similar to the animator block, if it scrolls, the object moves or changes. This feature can be used well in explaining processes or cycles. The second animation technique used is to program objects on the screen to move, disappear, or change (Bernát, 2015).

Advantages of an interactive whiteboard against the classic blackboard. The Interactive whiteboard unifies the classroom instruction with a computer-aided instruction, enabling the creation of dynamic content. The interactive whiteboard area provides plenty of space for work while teaching, with tools on the main toolbar being used when the teacher can use, for example, the width of the pen and the colour it needs. Students do not have to distribute their attention to the computer monitor and the teacher's interpretation. Mimics and teacher gestures are an important part of teaching, and important knowledge escapes with distant attention. An interactive table offers the possibility to work with an inexhaustible amount of images that can be accessed, edited, saved with the changes captured during the classroom. Interactive whiteboard means more in one, e.g. includes a recorder, player, video recorder, and the like. We can animate the lesson with video, sound effects, and so on.

2.1 Teaching of the Thematic Unit Production and transmission of electricity by application of an interactive board

The subject of Electrical Engineering for Teaching-oriented Faculties provides students with knowledge from the field of electrical engineering and technology that deals with the transformation of other types of energy into electricity, transmission of electricity and transformation of electricity into other types of energy. In the acquisition of heat, light and motion, as well as its use for electrochemical, information and communication purposes. The authors (Biose, Masek & Yamin, Daniels, 1998, 2010, 1998) describe these topics.

The aim of the subject is to teach students how to characterize the technological equipment of each type of power plant, to identify what it consists of, to explain the principle of electricity transmission, to explain the function of the transformer in electricity transmission, to explain the principle of electricity consumption measurement and to define basic principles. Which must be observed in electrical installations.

Students will learn about basic forms of energy conversion to electrical energy and its use in practice. They learn how to solve electrical circuits. The methods, forms and means of teaching the subject should stimulate the development of cognitive abilities of students; promote their aim, autonomy and creativity. The laboratory in which practical training takes place is equipped with technologies that provide students with the appropriate environment in the process of learning. The learning material contains (Ritter & Lemke, 2000) all the principles of transforming different forms of energy into electricity. In Figures 2 to 4, there is a demonstration of the energy conversion to electricity, its transmission from the power plant to the point of consumption and utilization. Figure 4 is a repetition task. In repeating tasks, if a student chooses the correct answer, he or she will get another job, and if he/she chooses the wrong answer, he/she automatically gets into the text to find the correct answer. After pointing to numbers 1 through 10, the student will see the explanatory text in the bubble, e.g. by placing the cursor on the number 1 in Figure. 2 shows the information of generator. Figure 2 to 5 illustrate the graphical interfaces of the key sequences in animation on a system of interactive animation simulation models presented by the interactive chart, which the authors of the article use in the subject of the thematic unit Electricity Distribution and Use of Electricity in the subject Electrical Engineering for Teaching Study. The interactive whiteboard presents in particular the complexity of the view of the production, distribution and use of electric energy, but also the so functional dynamics of the individual processes of the mentioned topic.

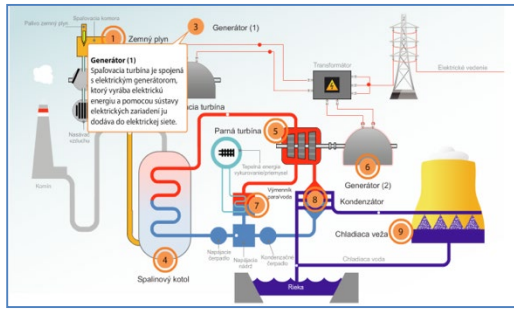


Fig. 2 - Scheme of a thermal power plant for gas

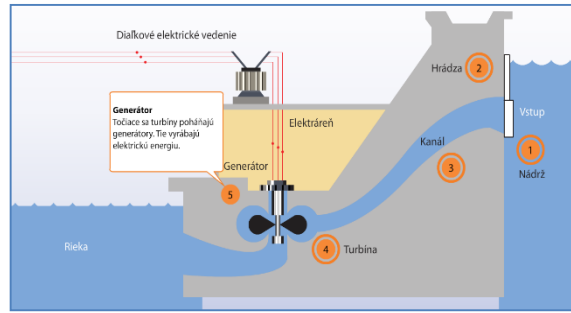


Fig. 3 - Hydroelectric diagram

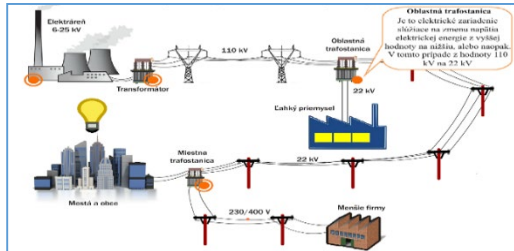


Fig. 4 - Transmission of electricity

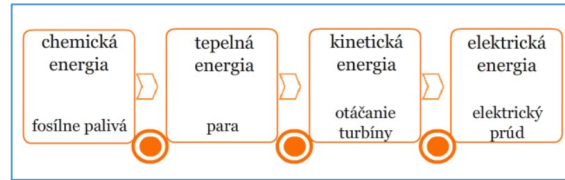


Fig. 5 - Conversion of energy into electricity

A particularly didactically efficient use (based on the conclusions of our didactic experiments in order to determine the didactic efficiency of teaching) has the use of an interactive chart in the subject of home electrical homework. The authors for this purpose suggested the innovative experimental teaching system (hereinafter referred to as NIESVE). The innovative innovation part of NIESVE is the application of a virtual way of visualising processes and phenomena based on an interactive whiteboard.

2.2 Teaching of the thematic unit the basics of home electrical installation by application of an interactive whiteboard

The teaching of the thematic group takes place in four consecutive phases:

Phase one on the platform of traditional visualisation methods and techniques for visualising processes going on in the electro physical systems (characteristic of the traditional teaching system). Visualization of the course of electromagnetic processes at this stage in a real model of the electro-physical system (based on the use of Electro-Assembly Kits for primary and secondary schools): see Figure 6.

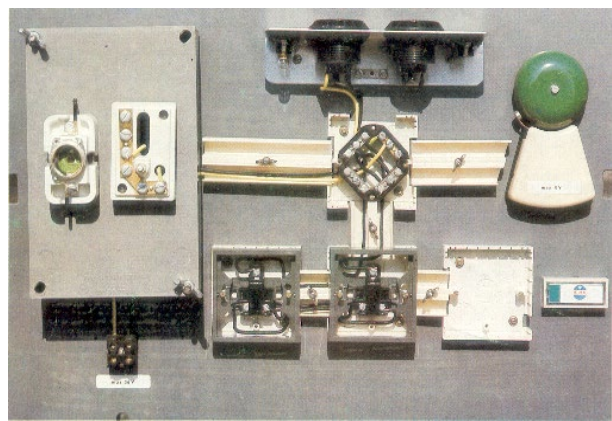


Fig. 6 - Electrical installation kit for primary and secondary schools

Phase two is the dominant application of an interactive whiteboard on the platform of innovative methods and visualisation techniques (characteristic of NIESVE). For NIESVE, it is a typical symbiosis of visualisation on the real model (traditional visualisation techniques and technology's) and on a computer model of the same electro-physical, system (based on interactive graphic, animation and simulation computer models).

It should be reminded that the essence of the strategy of access to our design of the innovation of traditional systems of visualisation of processes and phenomena in the curriculum is not to "duplicate" in practice didactically proven ways of visualisation (e.g. demonstration by measuring on an electro technical kit or a measuring instrument) and to replace them with new. But on the contrary - to keep them and only to enrich them organically with new innovative elements in an

innovative base. Thus, in the concrete, it remains to be a priority that what is possible and appropriate to demonstrate by measuring on a traditional real-world measuring device or an electro technical kit can do so and what extends the visualisation possibilities of the preparation or the kit to be realize virtually. In other words, the use of so- Intelligent computer graphics allows the visualisation of the subject to a degree of clarity that is otherwise unreachable (traditional visualisation, e. g on a circuit-based demonstration).

The aim of this experimental lesson is to deepen and expand the knowledge inter thematically causal and application. The computer models described in this part of the work are synthesize on a schematic basis, which contains instructions for use with a pupil electrical kit – a wiring kit designed for primary and secondary schools.

In the didactically oriented simulation of the "basic" types of electrical circuits of residential electrical installation, certain didactic priorities, principles and didactic demonstration sequence must respected.

First of all, it is necessary to highlight in particular the differences in the working patterns of individual electrical contact systems forming the serial, alternating and crossover switches and, secondly, the connection of these "differences" to the way of controlling the electrical lighting elements. A high degree of comprehensibility in explaining the essence of this problem is achieve by simultaneous simulation on the functional submodule and on the assembly submodule of the individual basic circuits of the residential electrical installation. At first, however, students' attention should focused on the processes running in the functional submodule, and then, when these processes are readily understood, it is possible to demonstrate the design and assembly features of the individual basic types of switches and switches in the electrical distribution system. The basis of this didactic activity with high degree of clarity is capture in Figure 6.

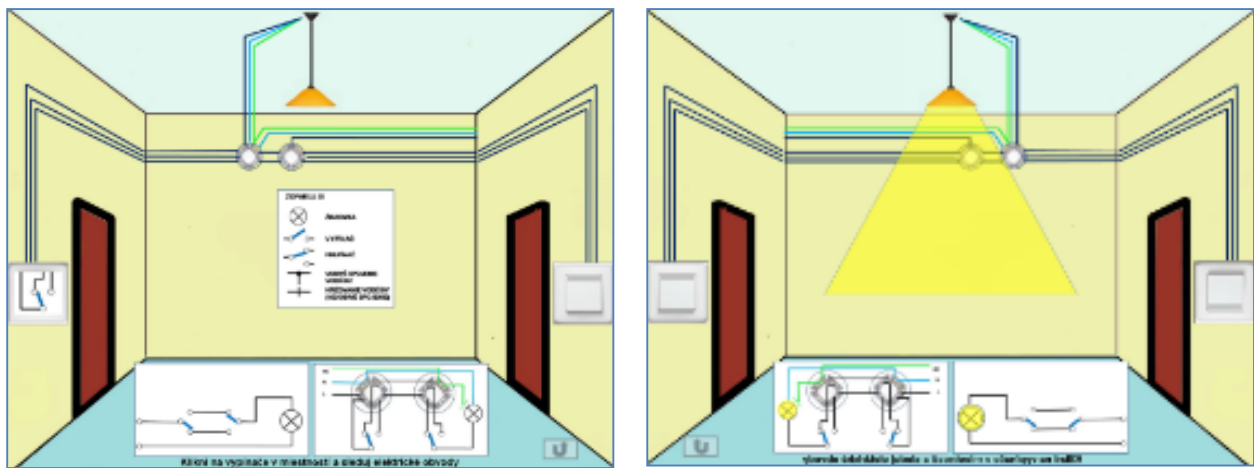


Fig. 6 - Key sequence visualisation interactive whiteboard platform and interactive applet "How does the wiring long hallway"

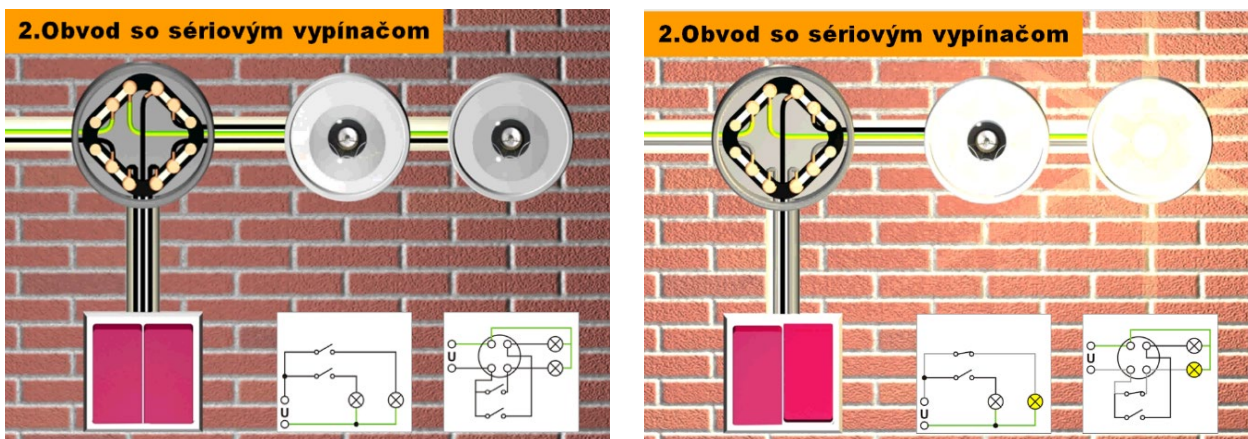


Fig. 7- Demonstration of symbiosis of virtual visualisation and visualisation on real models of housing distribution of cottage (small house)

Phase 3 is project-applied teaching. The NIESVA support pillar is also the use of elements of the project-application teaching in comorbidity with the inquiry-best instruction, whose purpose is to give the teaching pragmatic-practical and, in our case, mainly application sense. The above-mentioned concept represents educational projects "Electrical installation of cottage (small house)" (see Figure 7).

The specifics of didactic strategy and learning tactics using computer models of residential electrical installation are that the teacher conducts a demonstration on computer simulation models to first deepen and extend the familiar

knowledge of the students, e.g. knowledge related to the basic circuits of this installation, and then demonstrated. The operation of complex systems of these basic circuits (e.g. on the home electrical wiring model or cottage).

The teacher should emphasise before demonstrating the computer model of home electrical wiring that although this installation looks like a very complicated system at first glance, it is nothing else, it only knows how the system of basic circuits (already demonstrated, which students should already have mastered) To a larger unit.

Teacher of his previous claims (after initial acquaintance of the students with the scheme of the housing distribution of the cottage) subsequently demonstrates the demonstration of his statement by sharing with the students in detail the whole residential electrical installation of the cottage on the above mentioned individual elementary circuits. The presentation of the models from the previous section may reinforce the presentation of the deduction from general to specific whole.

The didactic importance of the strategy and tactics of the above didactic procedure is also that in the broader context, students are systematically involved in the analysis of residential electrical wiring circuits and that in the above-mentioned context, the computer model of the electrical installation cabinet is a sensible application unit composed of known basic circuits. Computer simulation as a method of didactic visualisation gives an illustration of the teaching of home electrical wiring circuits, compared to the simplicity realized by traditional methods, an unachievable dimension. Its benefits, which are already beyond the scope of traditional visualisation, can summarize in the following paragraphs. The foregoing relates to another didactic aspect of said computer simulation of electrical circuitry of residential electrical installation, namely, that the electrical processes running in the above-mentioned models can be slowed or even divided into steps. Furthermore, on the models there are preserved the colour differentiation of the drivers according to the valid standards, but at the same time it is also possible to "highlight" the colour of the driver if the live conductor is under tension. Such indication of the driver, if under voltage, is also important in didactic training of diagnostics, while such "extensive" visualisation cannot be achieved in traditional ways.

Phase 4. of the test, by means of feedback whiteboard.

3. Methodology

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.

We made a database of Flash animations that served as a platform for the creation of the experimental innovative teaching system called NIESVE. It designed for visualisation of teaching processes and phenomena through applets. In the process of our research the NIESVE system (in the form of concrete models designed for teaching selected thematic sections in teaching) was also experimentally verified. The method of pedagogical experiment used to compare the two teaching systems in the experimental group (the NIESVE system) and the control group (traditional teaching system). The principle of the pedagogical experiment is demonstrated in Fig. 8.

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

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 textbook, transparencies (an overhead projector)	an experimental technique of visualisation by means of Flash animations computer animation and simulation (interactive whiteboard)

Fig. 8 - The principle of the pedagogical experiment

H: The initial hypothesis: the proposed experimental teaching system (hereinafter NIESVE) 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 sub hypotheses:

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

H2: At the end of the experimental period the students taught by means of NIESVE 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 NIESVE 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 sub hypotheses in the cognitive area.

The research sample consisted of 64 research samples were in educational subject Electrical engineering 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 carried out from January to June (2016 - 17). In the experimental group, there was applied the computer supported (using the computer visualisation of sing an interactive whiteboard in teaching the theme of production, distribution and use of electricity, there was education carried out without computer support (using traditional way of teaching).

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

- a) the pedagogical experiment, the main method, a two-group model of the experiment (an experimental and a control group) conducted synchronously and simultaneously,
- b) didactic tests,
- c) the questionnaire method,
- d) the method of dialogue,
- e) the method of observation,
- f) statistical methods of research data analysis.

4. Results

The statistical interpretation of the research analyses findings is concise as the graphs are explicatory enough – Fig. 9 and Fig. 16. 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 – Table 1, Table 2 and Table 3.

	XmaxE =	20	XminE =	11	AverageE =	17,35484
EXP	test. norm	yes	MedianE =	17	ModeE =	17,00000
0.quartile =	11	1.quartile =	16	2.quartile =	17	
3.quartile =	18	4.quartile =	20			

	XmaxC =	19	XminC =	9	AverageC =	14,42188
CON	test. norm	yes	MedianC =	14	ModeC =	14,00000
0.quartile =	9	1.quartile =	13	2.quartile =	14	
3.quartile =	16	4.quartile =	19			

Stat. confid. (E - C)	k = 2	nil1 =	1	nil2 =	62,00000
Fkr [95 %] =	6,8	Fvyp =	94,14889	signifik =	áno
Fkr [99 %] =	3,9				

For a more detailed and targeted analysis of students' performance in the research didactic test (NIESVE), we divided the tests as a whole into mutually disjunctive subtests. On this platform, we carried out structural statistical analysis at the level of a system of subtests created based on the taxonomy of educational objectives according to Niemierka (remembering, understanding, application). The student achievements achieved in the N1 subtest in tasks for memorizing the final didactic test in the educational experiment are expressed in the graphs in Fig. 9 and Fig. 10. The students' achievements in the N2 subtest in tasks for understanding the final didactic test in the educational experiment are expressed in the graphs in Fig. 11 and Fig. 12. The student achievements achieved in the N3 subtest in tasks for the application of the final didactic test in the educational experiment are expressed in the graphs in Fig.13 and Fig. 14.

We have approximated all of these differences in subtests applied in the pedagogical experiment (NIESVE) using a moving average (n = 2 and above), (by abrasion technique) iterates well in the case of $n \rightarrow \infty$ to Gaussian distribution, which allows us to use inductive statistics (to determine the statistical significance of the difference).

The divergence in the form of distributions for the experimental and control groups presented in the graphs on the Fig.9, Fig.10, Fig.11, Fig.12, Fig.13, Fig.14 can be described as a transformation in the direction of frequency of higher power occurrence in favour of the experimental group. We attribute the changes mainly to the influence of the purposeful effect of the experimental teaching system (NIESVE) (because we tried to follow all principles of realization of the valid experiment).

In addition to the normality criteria applied previously, based on the visual evaluation of the distribution shape in graphical form (especially the visual comparison of mean values and variance, moving average), we also classified the normality of statistical distribution of data using numerical distribution normality criteria (Shapira-Wilka, Agostina).

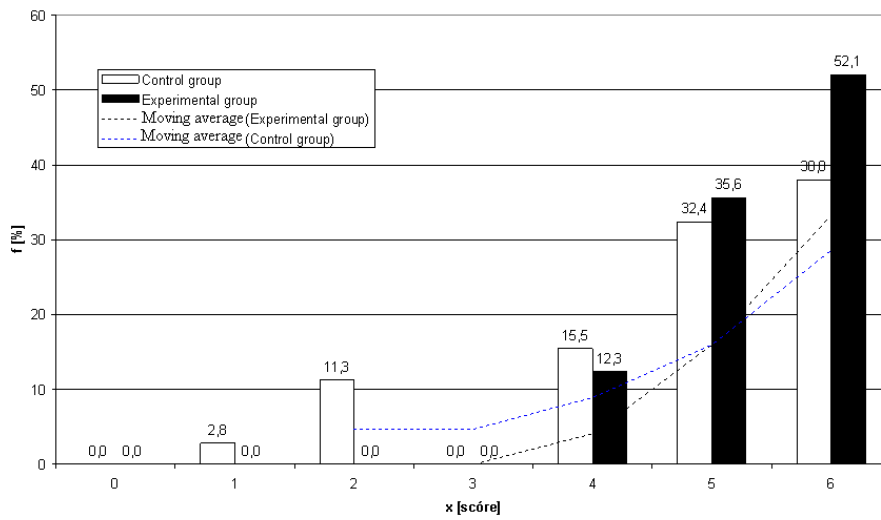


Fig. 9 - Frequency distribution of learners' performances achieved in subtest N1 (remembering) of the final didactic test within the pedagogic experiment

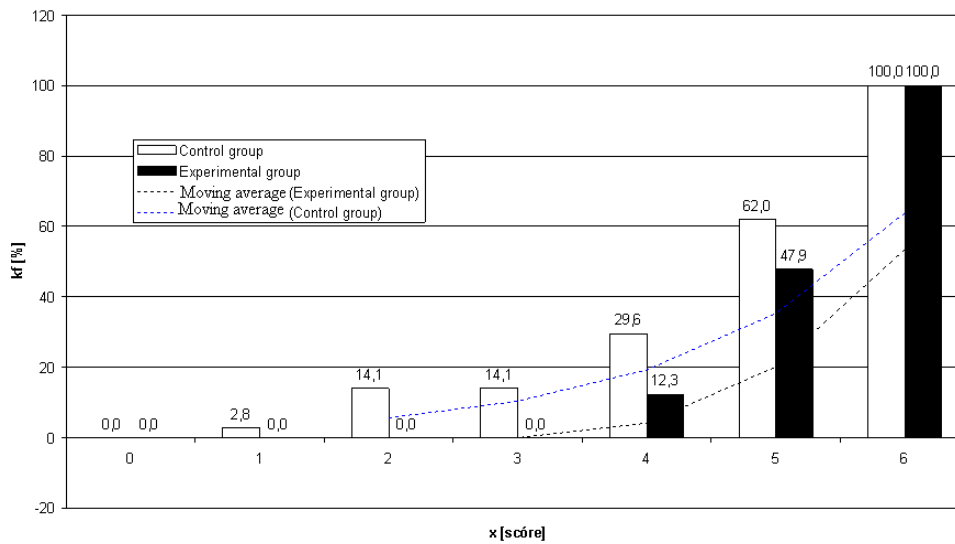


Fig. 10 - Distributive function of learners achieved in subtest N1 (remembering) of the final didactic test within the pedagogic experiment

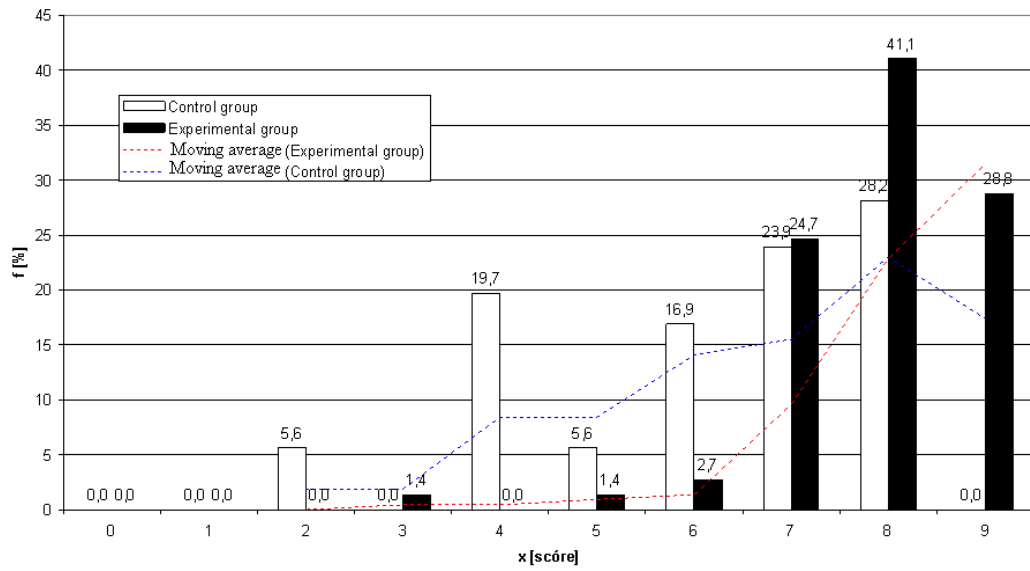


Fig. 11 - Frequency distribution of learners' performances achieved in subtest N2 (comprehension) of the final didactic test within the pedagogic experiment

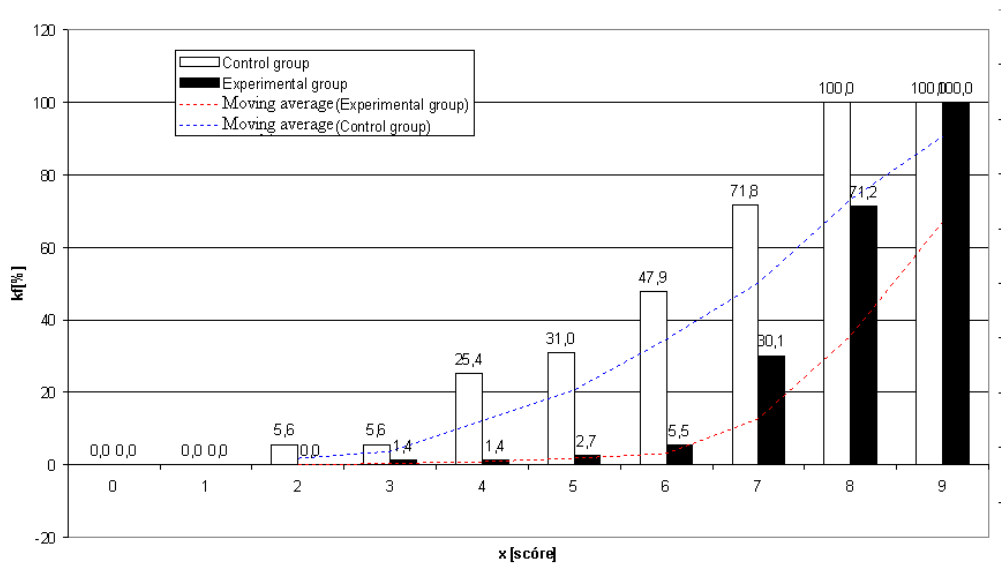


Fig. 12 - Distributive function of learners' scores achieved in subtest N2 (comprehension) of the final didactic test within the pedagogic experiment

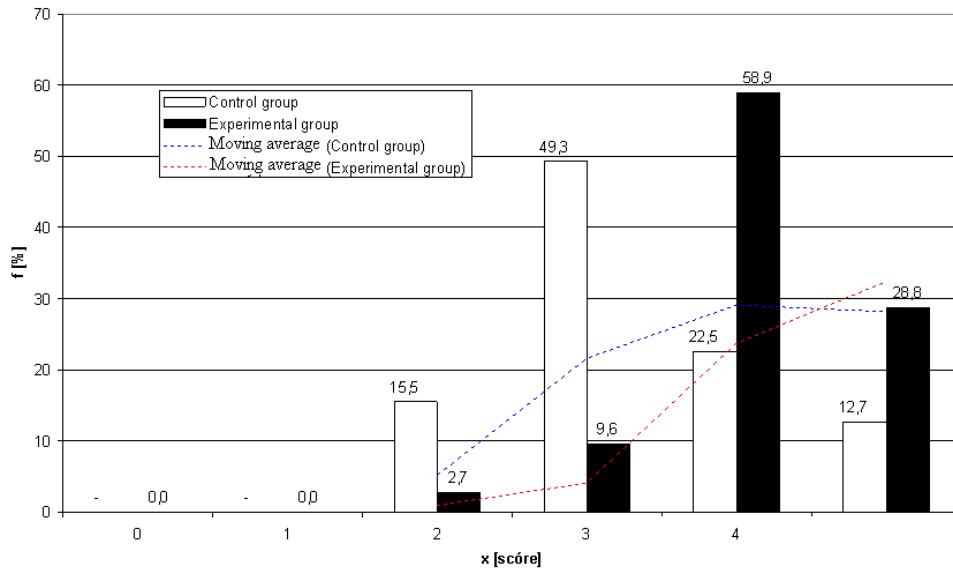


Fig. 13 - Frequency distribution of learners' performances achieved in subtest N3 (application) of the final didactic test within the pedagogic experiment

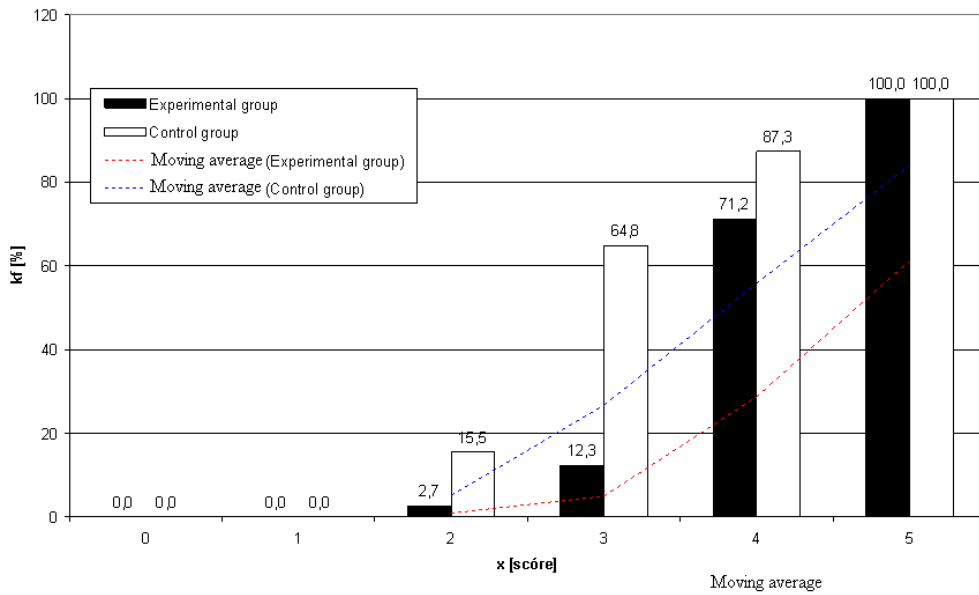


Fig. 14 - Distributive function of learners' scores achieved in subtest N3 (comprehension) of the final didactic test within the pedagogic experiment

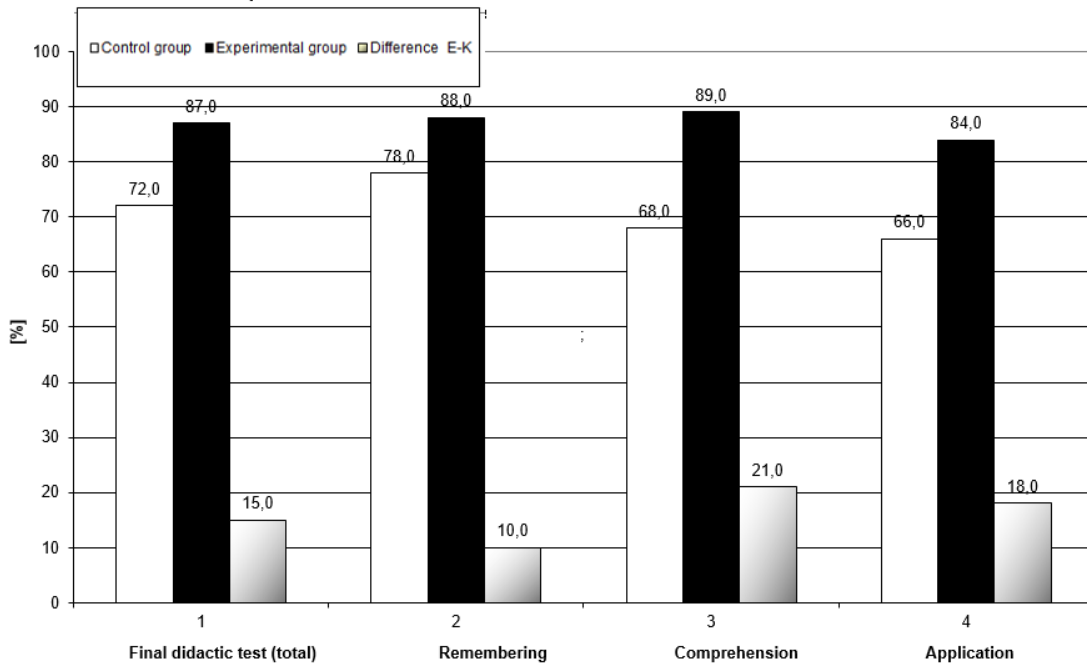


Fig. 15 - The comparison of the success rate of the individual subtests assessing the learning objectives (remembering, comprehension, application) in the experimental and control group in the final didactic test

Our arguments are shown in particular by the results presented in Fig. 15. The findings 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. 15, Fig.16).

Our statements are listed the results shown in the Table 1, Table 2 and Table 3 (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 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 $F > F_{kr}$, 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, Table 2, and Table 3 Descriptive and Inductive statistics). The results shown in the graph Fig. 16 were processed based on the data in Table 1, Table 2, and Table 3 by Stat Direct software.

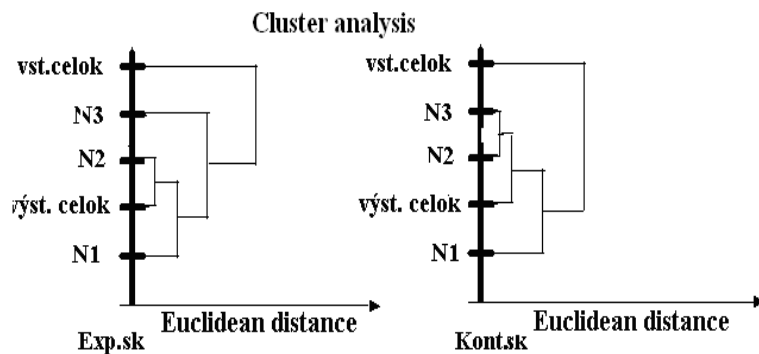


Fig. 16 - Results of the quartile and cluster statistical analysis

5. Analysis of Phenomenon and Discussion

Finally, we dare to say that the proposed experimental teaching system NIESVE 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).

Subtest N1 (memorizing). The individual tasks forming the subtest for memorizing knowledge have tested mainly knowledge of schematic symbols and knowledge of basic concepts and terminology. They solved were well in both the experimental and control groups and the difference in performance in the E (experimental) and K (control) groups was not significant in our opinion.

Subtest N3 (application). Regarding the tasks for applying knowledge, the analysis of the responses of this subtest shows that there were significantly more pragmatic and realistic responses in the experimental group compared to the control group. Furthermore, there were no answers very detached from the application reality, and in the answers, one can observe the application overview up to the perspective.

Subtest N2 (Understanding). In the solving tasks of the subtest for understanding has been achieved the largest difference between the experimental and control group of all subtests created on the platform of Niemierko taxonomy (18.0 %). We explain this by using the visualisation of processes and phenomena using an interactive whiteboard. In the experimental group was achieved a high degree of clarity. Experimental group has initiated a platform primarily the knowledge of understanding. We can conclude that based on the results of our research, a high degree of visualisation of the processes and phenomena was achieved by the application of concurrent animation of processes and phenomena taking place in the functional and assembly model electrical installations circuits of flat and house. Moreover, that these processes could be slowed down and stepped. To put it simply, the interactive whiteboard made it possible to simultaneously “more dynamic” the functional and installation scheme electrical installation of a flat and house.

Finally, we dare to say that the proposed experimental teaching system NIESVE 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).

In conclusion, we would like to say that we present only partial results of the continuous pedagogical experiment in the article, which we implement in educational subject Electrical engineering for teacher education. The current results described in our article show that computer-supported learning of technical science subjects in has a positive impact on the acquisition of the educational contents of the technical sciences by school students.

The interactive tab, operating on the principle of electromagnetic sensing, which is controlled by an electronic pen, also offers the possibility of dual control. This interactive table use be can also as a classic tab, we can write it with erasable fixes. We can say that a teacher of a subject working on an interactive whiteboard should be creative and creative to be able to capture the most important feature of interactive boards, and that is the simplicity. In particular, this didactic principle can help pupils to motivate new curricula and help them understand the curriculum. In addition to working on an interactive whiteboard, both teachers and students are expanding their knowledge of computer literacy and IT skills. Another important factor is that teachers themselves try to educate themselves in the field of information and communication technologies. This article describes some of the options offered by interactive whiteboard software. The slideshow contains all of the illustrative elements such as, for example, Pictures, videos and animations, just need an Internet connection and speaker connections to play audio from videos and sound effects. In its proper use, teachers should have in the learning process more effective educational goals. Finally, we can summarize that the interactive table is a modern didactic tool that use be cannot in all the topics that are taught in schools. Certainly, it will contribute to the professional subjects to improve and make more effective the acquisition of pupils' knowledge, skills and habits in the teaching process and is a very good means of motivating pupils and students.

In conclusion, we would like to say that we present only partial results of the continuous pedagogical experiment in the article, which we implement in educational subject Electrical engineering for teacher education technical education and training.

The current results described in our article show that computer-supported learning of technical science subjects in has a positive impact on the acquisition of the educational contents of the technical sciences by school students.

Teachers with proper use should have in the learning process more effective educational goals. We can finally summarize, that the interactive table is a modern didactic tool that cannot use in all the topics that to teach in schools. It but will certainly contribute to the professional subjects to improve and make more effective the acquisition of pupils' knowledge, skills and habits in the teaching process and is a very good means of motivating pupils.

6. Conclusion

In conclusion, we would like to say that we present only partial results of the continuous pedagogical experiment in the article, which we implement in educational subject Electrical engineering for teacher education. The current results

described in our article show that computer-supported learning of technical science subjects in has a positive impact on the acquisition of the educational contents of the technical sciences by school students.

The interactive tab, operating on the principle of electromagnetic sensing, which is controlled by an electronic pen, also offers the possibility of dual control. This interactive table can also use as a classic table; we can write it with erasable fixes. We can say that a teacher of a subject working on an interactive whiteboard should be creative and creative to be able to capture the most important feature of interactive boards, and that is the simplicity. In particular, this didactic principle can help pupils to motivate new curricula and help them understand the curriculum. In addition to working on an interactive whiteboard, both teachers and students are expanding their knowledge of computer literacy and IT skills. Another important factor is that teachers themselves try to educate themselves in the field of information and communication technologies. This article describes some of the options offered by interactive whiteboard software. The slideshow contains all of the illustrative elements such as, for example, Pictures, videos and animations, just need an Internet connection and speaker connections to play audio from videos and sound effects. Teachers in the teaching process with proper use, have effective educational and learning goals. Finally, we can summarize that the interactive table is a modern didactic tool that cannot use in all the topics that is teach in schools. It will but certainly contribute to the teach professional subjects to improve and make more effective the acquisition of pupils' knowledge, skills and habits in the teaching process and is a very good means of motivating pupils.

Acknowledgement

Authors would like to acknowledge to all researchers who involved in this project.

References

- Adamek, R. et al., (2010). *Moderná didaktická technika v práci učiteľa*. Košice: ELFA, s.r.o.
- Ahmad, A. Nordin, M. K. Ali, D.F. & Nabil, A. (2015): Conducting hands – on task in vocational education: Teaching method in automotive courses . *Journal of technical and training* ISS 2229-8932., Vol 7, No 1 (2015), pp. 23-34.
- Allyn & Bacon. Melezinek A. (1986). *Ingenieurpädagogik: Praxis der Vermittlung technische Wissens techn. Wissens*. Wien, New York, Springer, 1986.
- Bannister, D. (2013). *Ako čo najlepšie využívať interaktívnu tabuľu*. [online]. Bratislava: ÚIPŠ [cit. 2015-11-22].
- Baran, I. (2011). *Interaktívne tabule vo výučbe*. [online]. Košice: TU. [cit. 2015-11-10].
- Bernát, M. (2015). *Visualisation of some electro-physical processes through computer for didactic purposes and its application in teaching electro technical subjects*. PhD. thesis, Pdf UKF Nitra 2015 (in Slovak).
- Bernátová, R. (2001). *Proposal for use of visualisation of logical foundation of subject matter and its ways of application in connection with elevating effectiveness of a teaching process*. Rokus 2001, Prešov.
- Bernátová, R., Bernát, M. & Cimbala, R (2015). On Increasing Efficiency in Teaching Technical and Natural Sciences by Means of JAVA Applets II. (Experimental Research), *Journal of Technology and Information Education*, vol. 1 issue 1, 2015.
- Biose, C.A. (1998). Industrial participation in the practical training of vocational technical education students. *The Asaba Vocational Technical and Science Education Journal*, 1(1), 79-85.
- Bitterová, M. & Mních, J. (2011). Didakticko-motivačné využitie interaktívnych tabuľových systémov z aspektu manažmentu škôl. *Moderní vzdělávání: Technika a informační technologie*. Olomouc: PU, 2011.
- Boyatzis, R. E. (1982). *The Competent Manager: A Model for Effective Performance*. New York: John Wiley & Sons.
- Brestenská, B. et al. (2009). *Premena školy s využitím informačných a komunikačných technológií*. Košice: ELFA, s.r.o., 2009.
- Cuban, L. (1986). *Teachers and Machines: The Classroom Use of Technology Since 1920*. Amsterdam: Teacher College Press, 1986.
- Daniels, H. & Bizar, M. (1998). *Methods that Matter: Six Structures for Best Practice Classrooms*. York, ME: Stenhouse.
- Federal Republic of Nigeria. (2013). *National Policy on Education*. Lagos: NERDC Press.
- Dostál, J. 2009. Interaktívna tabuľa - významný prínos pre vzdelávanie. *Česká škola [online]*.
- Hedayati, M. H. and Laanpere, M. (2015). Identifying requirements for vocational information and communication technology curricula in afghanistan. *Journal of technical and training*, ISS 2229-8932., Vol 7, No 1 (2015), pp 35- 49.
- Huba, M.E. & Freed, J.E. (2000). *Learner-centred assessment on college campuses: shifting the focus from teaching to learning*.

- Masek, A. & Yamin, S. (2010). Problem based learning adapting model of monitoring and assessment towards changing to student centred learning. *Journal of Technical Education and Training (JTET)*, Vol 2, No 1 (2010), pp. 9–19.
- Novacká, G., Hnatová, J. & Fryková, E. (2011). *Interaktívna tabuľa a softvér Activstudio na hodinách prírodovedných predmetov*. Bratislava: MPC.
- Boyatzis, R. E. (1982). *The Competent Manager: A Model for Effective Performance*. New York: John Wiley & Sons.
- Pavlovkin, J.& Novák, D. (2013). Interaktívna tabuľa vo výučbe elektrotechniky. *Universitas Matthiae Belii Ser.: Technická výchova*. No 13 (2013). Banská Bystrica: FPV UMB.
- Ritter, M. E., & Lemke, K. A. (2000). Addressing the ‘seven principles for good practice in undergraduate education with Internet-enhanced education. *Journal of geography in Higher Education*. 24(1), 100-108.
- Samsuri, N.S., Mohd-Yusof, K. & Abdul Aziz, A. (2017). Preparing first year engineering students to become engineers: The impact of an “Introduction to engineering” course. *Journal of technical and training*, Vol 9, No 1 (2017), pp 45-60.