

## Use of Interactive Whiteboards in the Work of Teachers of Vocational Subjects with an Emphasis on the Effectiveness of Teaching

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### Abstract

The purpose of the presented study is to present research conducted in the conditions of vocational education in the Slovak Republic, aimed to assess the effectiveness of the use of interactive whiteboards for teaching vocational subjects. The main method of research was the pedagogical experiment; another method used was the questionnaire method. The authors' research findings give evidence that students obtained significantly better results in acquired knowledge and skills when interactive whiteboards were used for teaching than when taught traditionally. The authors also present recommendations for teaching practice in Slovakia.

*Keywords: vocational education, interactive whiteboard, effectiveness of teaching, pedagogical experiment*

### Introduction

A modern vocational school should, in the first place, teach students critical thinking, it should develop their ability to solve problems, and a more intense link to practice appears desirable. Vocational schools are influenced by technological development having, on the one hand, an impact on co-operation among schools, which is faster, more effective and less expensive in the electronic form (communication via e-mail, telebridges or other on-line transmissions of data) and, on the

other hand, also on students, the contemporary student generation being often called the “net-generation”. It is necessary to fully adapt the educational process at vocational schools to these facts, in particular, by the application of current technological possibilities including also teaching with the use of interactive whiteboards.

The subject-matter of pedagogical research was to assess the impact of the use of interactive whiteboards for teaching vocational subjects at secondary vocational schools on students’ acquired knowledge and skills, as well as to evaluate their effect on the quality of the teaching process in relation to students’ motivation for learning. Application of modern ICT-based resources consisting in examination of the technological environment from the point of view of its interactivity enables students’ active involvement in the teaching process. In this view, creation of an open environment is promoted, responding to students’ complex behaviour, so-called interactivity and also multimedia presentation of knowledge.

New possibilities in technologies have gradually made teachers’ work easier and lessons more interesting and attractive for students (Hasajová, 2014). The technology of interactive teaching by means of interactive whiteboards is the highest degree of object-teaching which is enriched by elements of interactivity. Thus, the teacher and students actively enter into the teaching process and are able to influence and adapt it to current needs. Interactive whiteboards have become a worldwide phenomenon and recently they have been increasingly applied also in the conditions of vocational education in Slovakia. There is a great number of research studies worldwide, dealing with the effectiveness, but also pitfalls, of the use of interactive whiteboards in the educational process. Since 2006, the BESA (British Educational Suppliers Association) has been putting through the idea that every classroom in British schools should be equipped with an interactive whiteboard (Kennewell, 2006). The effectiveness of the use of interactive whiteboards for teaching the subjects English Language, Mathematics and Sciences was studied by G. Moss et al. (2007). Their research concerned students’ motivation, behaviour, engagement and learning in the classroom using an interactive whiteboard. The results of the research indicated that most teachers used interactive whiteboards only as a supportive medium of traditional teaching. Only a minority of teachers perceived the interactive whiteboard technology as a possibility to innovate their own teaching methods and procedures. The most innovative teachers were those who had the most experience with the use of interactive whiteboards. The research results also showed that the use of interactive whiteboards varied also depending on the subject taught. The authors of the research explained the fact by different availability of educational interactive programs for individual subjects. Almost

78% of the teachers reported that they prepared materials for interactive lessons themselves and only 42% of the teachers used official teaching software. The effect of interactive whiteboards on students' learning and activity in the teaching process was studied by S. Kennewell and G. Beauchamp (2003). They found out that teaching with the use of interactive whiteboards intensely helped to attract and retain students' attention. Students were considerably more active at such lessons than at traditional ones. Research carried out in the USA by Dantzker (2002) showed that almost 75% of students reported that the interactive whiteboard considerably helped them in the learning process. Research results by P. Joaquin and M.I. Iglesias (2010) indicated that an interactive whiteboard in combination with students' activity aroused by problem solving and by discussion created a constructive climate in the learning process. On the initiative of the European Commission (EC), European Schoolnet and University of Liege, a survey was carried out in 2011 and 2012, focused on the use of information-communications technologies in education, preferentially at European schools (Gogová, 2014). In relation to the use of interactive whiteboards at vocational schools, the most interactive whiteboards per student are used in Norway, i. e., 28 students per interactive whiteboard. Slovakia was placed below the European average with 200 students per interactive whiteboard. According to the mentioned research, at Slovak vocational schools, interactive whiteboards are used for teaching 27% of students at least once a week. The above facts relating to vocational education in Slovakia are a good starting point for the aim of the presented research study.

## **Research Methodology**

### **Research goal**

The main goal of the research was to acquire, quantify and analyze the knowledge about the use of interactive whiteboards at selected secondary vocational schools.

### **Research hypotheses**

The following hypotheses were set up in our research:

- H1:** The teachers using an interactive whiteboard for teaching for a longer time need less time to prepare for the lesson taught using an interactive whiteboard.
- H2:** The frequency of using an interactive whiteboard is higher among the teachers who have attended training in the work with an interactive

whiteboard than among the teachers who have not attended such training.

**H3:** Students of experimental groups, where an interactive whiteboard is used for teaching, perform better in a didactic test than students of control groups, where no interactive whiteboard is used for teaching.

### **Selected sample and organization of research**

The research sample is represented by two basic groups of respondents, i.e., teachers and students of secondary vocational schools situated in three districts of Slovakia. Schools in a specific district were selected by stratified sampling. The stratification category was the number of students at the secondary vocational school above 200. The research was carried out in five secondary vocational schools in the towns: Pribenik, Kráľovský Chlmec, Michalovce and Košice. The research involved a total of 182 teachers, among whom there were 76 men (41.8%) and 106 women (58.2%) and a total of 226 students, among whom there were 167 (73.9%) boys and 59 (26.1%) girls. The research was carried out from December 2013 to December 2014; in 2015 the results obtained were processed and assessed.

## **Research methods**

The following research methods were used in the research:

- Analysis and synthesis of knowledge from the literature dealing with the use of interactive whiteboards for teaching;
- Questionnaire method – to find out students' and teachers' opinions on and attitudes towards teaching with interactive whiteboards;
- Pedagogical experiment – to compare teaching results in the control and experimental groups of students;
- Mathematical and statistical methods - to evaluate research results by the Data Analysis application in the Microsoft Excel program.

## **Research methodology**

Within the pedagogical experiment, two groups of respondents were formed: a control group and an experimental group. The control group consisted of 23 students and the experimental one of 22 students. The control group was taught traditionally, without the use of an interactive whiteboard, and in the experimental

group, an interactive whiteboard was used at lessons. The extent of the subject matter learnt of the thematic unit “Combined Transportation” in the subject Exercises in Logistics in Transportation was assessed by a didactic test.

An anonymous questionnaire was designed for the teachers, containing 20 items, 5 of which were closed-ended questions with “Other” and 15 closed-ended questions. The set of closed-ended items included three two-choice items. The other closed-ended items were multiple-choice ones. The closed-ended questions with “Other” enabled the respondents to choose one of the given options while enabling them to give their own opinion. The questionnaire contained data required for the questionnaire processing and evaluation, which were included in Item 21. Items 2 and 3 explored the teachers’ access to computers in school. Items 4, 5 and 6 explored how the school was equipped with interactive whiteboards. Items 7, 9, 10, 11, 14 and 15 explored the use of interactive whiteboards at lessons. Item 12 explored the subject where an interactive whiteboard was used and Item 19 explored the development of students’ competences. Items 13 and 18 explored how the use of an interactive whiteboard influenced the students’ attitude to the given subject. In Item 8, we wanted to get to know also whether the teachers had attended training in the use of interactive whiteboards. The advantages and disadvantages of the use of interactive whiteboards were explored by Items 16 and 17. Demands of preparation for lessons were derived from answers to Item 20.

Our self-designed questionnaire for the students consisted of 9 closed-ended items. Item 1 explored how many vocational subjects used an interactive whiteboard. Items 3, 4, 5, 6, 7 and 8 asked the students whether there was any shift in them in some indicators: it was easier for them to remember the subject matter, they had no problem to present themselves in front of the class, they were able to co-operate with their fellow students in solving tasks, they were able to concentrate better on the subject matter taught, they had no problem to ask if they did not understand something, they had to search for information more on their own to tackle tasks. Items 2 and 9 explored the frequency and demands of work with an interactive whiteboard.

## **Research Results**

### **Analysis of results of the pedagogical experiment and questionnaire survey**

To check the students’ knowledge of the subject matter taught, a didactic test was used, containing 21 tasks. The maximum score was 45.

Verification of the research hypothesis H1:

**H1: The teachers using an interactive whiteboard for teaching for a longer time need less time to prepare for the lesson taught using an interactive whiteboard.**

Processing method:

To test the hypothesis on the assumption that the basic data sets were of an approximately normal distribution, a correlation coefficient was used. The first examined data set, “the length of time of the interactive whiteboard use,” was compared with the second examined data set, “time spent to prepare for the lesson”. The values obtained by questionnaire surveys are presented in Table 1.

**Table 1.** Time spent preparing for the lesson

<i>Time spent preparing for the lesson</i>	Length of time of the interactive whiteboard use			<i>Total – ni.</i>
	Less than 12 months	13–24 months	More than 24 months	
1 hour	15	9	4	28
2 hours	24	12	11	47
3 and more hours	17	16	7	40
<i>Total – nj.</i>	56	37	22	115

Source: own processing.

After calculation and subsequent analysis, the correlation coefficient resulting value of the compared data sets was  $k = 0.741$ . Since the assumption of fulfilled conditions of a strong correlation was a correlation coefficient within the closed interval of  $0.8 \leq k \leq 1$ , with regard to the calculated value, a moderate or weak correlation between the samples was stated. No strong correlation was confirmed, thus no very close connection between the data sets studied could be confirmed.

*The hypothesis H1 was not confirmed, which means that the teachers using an interactive whiteboard for teaching for a longer time do not need less time to prepare for the lesson taught using an interactive whiteboard.*

Verification of the research hypothesis H2:

**H2: The frequency of using an interactive whiteboard is higher among the teachers who have attended training in the work with an interactive whiteboard than among the teachers who have not attended such training.**

Processing method:

To test the hypothesis, the non-parametric Wilcoxon rank two-sample test was used (and/or the Mann-Whitney U-test).

**Table 2.** Frequency of using an interactive whiteboard

Frequency of using an interactive whiteboard					
<i>Training attendance</i>	1x/month	4x/month	12x/month	20x/month	Total
Yes	18	17	19	35	89
No	8	6	7	5	26
Total	26	23	26	40	115

Source: own processing.

Values for testing the dependence of the frequency of using an interactive whiteboard on training attendance are presented in Table 2. The values were arranged in a non-descending order, thus a combined sample was obtained. The combined sample values were assigned a numeric rank. The same values were assigned the same numeric rank calculated as the arithmetic mean of the ranks the values would be assigned were they not the same. Totals were calculated of the control group’s  $T_1$  rank values and of the experimental group’s  $T_2$  ranks, respectively. Values of the  $U_1$  and  $U_2$  characteristics were calculated, where  $m$  was the number of the control group students and  $n$  was the number of the experimental group students.

$$U_1 = m.n + m(m+1)/2 - T_1 = 1691 \tag{1}$$

$$U_2 = m.n + n(n+1)/2 - T_2 = 623 \tag{2}$$

The value of the testing criterion  $U_0 = \min (U_1, U_2) = 623$ . The hypothesis  $H_0$  was rejected at the significance level  $\alpha = 0.05$ , if  $U_0 \leq U_\alpha$ , where  $U_\alpha$  was the critical value of the Wilcoxon two-sample test. The critical value for  $m=89$  was  $623 \leq 935$ . With regard to the statistical methods used and the values calculated, the validity of the hypothesis  $H_2$  was confirmed. Since the testing criterion value  $U_0$  was  $623 \leq 935$ , the tested hypothesis  $H_0$  was rejected at the significance level  $\alpha = 0.05$  in favour of the alternative hypothesis  $H_1$ , which means that the validity of the hypothesis  $H_2$  was confirmed, thus a statistically significant difference between the frequency of using IT and the training attendance was proved.

The hypothesis H2 was confirmed, which means that the frequency of using an interactive whiteboard is higher among the teachers who have attended training in the work with an interactive whiteboard than among the teachers who have not attended such training.

Verification of the research hypothesis H3:

**H3: Students of experimental groups, where an interactive whiteboard is used for teaching, perform better in a didactic test than students of control groups, where no interactive whiteboard is used for teaching.**

Processing method:

Within the pedagogical experiment, a didactic test with 21 tasks was used to check the students' knowledge of the subject matter taught. The maximum test score a student could obtain was 45. As mentioned above, the students were divided into 2 groups, according to whether or not an interactive whiteboard was used for teaching. With regard to the comparison of the observed samples, Table 3 presents selected characteristics normally evaluated in the analysis of students' performance.

**Table 3.** Summary of selected characteristics of the didactic test for the control and the experimental group samples

	Control group	Experimental group
Maximum ( $x_{max}$ )	38	39
Minimum ( $x_{min}$ )	12	16
Arithmetic mean ( $\bar{x}$ )	23	32
Median ( $M_e$ )	25	34 and 38
Mode ( $M_o$ )	12	34
Variance ( $\sigma^2$ )	91.91	37.289
Standard deviation ( $\sigma$ )	9.59	6.11
Test score in %	51.11%	71.72
Number of students with more than 70% achievement	5	15
Relative number of with more than 70% achievement	21.74 %	68.18 %
Average mark in the test	3.52	2.55
Average mark at the end of mid-year	3.48	2.41

Source: own processing.

The control group's standard deviation  $\sigma_k = 9.59$  is greater than the experimental group's standard deviation  $\sigma_k = 6.11$ . There is no evidence of a significant difference between the mark at the end of the evaluation period of the students and the mark



in the didactic test in the control and experimental groups. On the basis of the results in the didactic test and the summary evaluation, it can be stated that the students in the experimental group have a better level of knowledge.

To verify the hypothesis, the non-parametric Wilcoxon rank two-sample test (and/or the Mann – Whitney U-test) was used.

The didactic test results of the control group students and the experimental group students were verified by a method similar to the verification of the second hypothesis. Totals were calculated of the control group's  $T_1$  rank values and of the experimental group's  $T_2$  ranks, respectively. Values of the  $U_1$  and  $U_2$  characteristics were calculated, where  $m$  was the number of the control group students and  $n$  was the number of the experimental group students.

$$U_1 = m.n + m(m+1)/2 - T_1 = 394 \quad (3)$$

$$U_2 = m.n + n(n+1)/2 - T_2 = 112 \quad (4)$$

The value of the testing criterion  $U_0 = \min (U_1, U_2) = 112$ . The hypothesis  $H_0$  was rejected at the significance level  $\alpha = 0.05$ , if  $U_0 \leq U_\alpha$ , where  $U_\alpha$  was the critical value of the Wilcoxon two-sample test. The critical value for  $m = 23$ ,  $n = 22$  was  $U_{0.05} = 149$ . With regard to the statistical methods used and the values calculated, the validity of the hypothesis  $H_3$  was confirmed. Since the testing criterion value  $U_0$  was 112, the tested hypothesis  $H_0$  was rejected at the significance level  $\alpha = 0.05$  in favour of the alternative hypothesis  $H_1$ , which means that the validity of the hypothesis  $H_3$  was confirmed, thus a statistically significant difference was proved between the test results of the students in the respective groups.

*The hypothesis  $H_3$  was confirmed, thus students in experimental groups, where an interactive whiteboard is used for teaching, perform better in the test than students in control groups, where no interactive whiteboard is used for teaching.*

## **Discussion**

### **Summary of research results and recommendations for teaching practice**

The research results show that the use of interactive whiteboards does not improve students' learning outcomes rapidly. The recorded learning outcomes of the students using an interactive whiteboard were not significantly worse than the

learning outcomes of the students not using any. However, it is obvious that interactivity considerably influences the learning process of students. On the basis of the analysis of the teachers' questionnaire results, it can be established that 59.4% of the teachers use an interactive whiteboard for teaching vocational subjects. Out of the total number of teachers using an interactive whiteboard, up to 31.3% also use interactive software. Interactive whiteboards are used by the teachers at all stages of the lesson approximately evenly; most, up to 37.7% of the teachers, use them at the stage of new knowledge acquisition. The most significant advantage according to the teachers is that interactive whiteboards enable more visual presentation of the subject matter; up to 29.9% of the teachers are of the opinion. The major disadvantage according to the teachers is a shortage of interactive software; therefore up to 49.7% of the teachers develop their own teaching material. Interactive whiteboards are beneficial also for their use increasing students' motivation and interest in the subject matter taught. This opinion is presented by 23.1% of the teachers. Out of the total number, up to 63.2% of the teachers use an interactive whiteboard for teaching regularly, and out of this number, 77.39 % of the teachers have attended training in the use of interactive whiteboards. It is obvious from the results of the questionnaire for students that interactive whiteboards significantly motivate students to study vocational subjects. The results show that 42.9% of the students see advantage in the possibility to present their knowledge and skills in front of the class untraditionally, 24.7% of the students can remember the subject matter better, 26.5% report that they are led to work in groups and 32.9% of the students declare that they can concentrate on the lesson better.

## **Conclusions**

The research results show that the students of the experimental group, where an interactive whiteboard is used for teaching, have a better level of acquired knowledge and their motivation to learn is significantly higher. On the basis of our findings the following recommendations are formulated for teaching practice:

- Provide opportunities for the development of vocational subject teachers' skills in work with interactive whiteboards within their continual education, because the frequency of using an interactive whiteboard is higher among teachers who are trained in working with interactive whiteboards;
- Support teachers of vocational subjects in their use of interactive whiteboards because the research does not confirm their apprehension about greater demands and complexity of preparation for teaching;

- Increase the use of interactive whiteboards for teaching vocational subjects because the research confirms that students achieve a better level of knowledge where interactive whiteboards are used for teaching and interactivity considerably influences the students' learning process.

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