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DEVELOPMENT AND VALIDATION OF MULTIMEDIA TEACHING PROGRAMS

ROZWÓJ I WERYFIKACJA MULTIMEDIALNYCH PROGRAMÓW NAUCZANIA

Slowa kluczowe: badanie, edukacja techniczna, program nauczania multimediów
Keywords: research, technical education, multimedia teaching program

Abstract

We are aware of the vastness and complexity of the issue and we know that we can and we should explore it in great detail. It is interesting for us to know if pupils achieve better learning results in the first three areas of Niemierko taxonomy (remembering, understanding, specific transfer) when Multimedia Teaching Program (other than MTP) is used in teaching, and if pupils learn more actively in the classroom, where MTP is used in comparison to teaching applying the traditional teaching methods.

Introduction

Our long-term interest was, and still is, to teach pupils the elements of RSE. New innovative approaches allow us to use multimedia and computers in teaching. We tried to profit from our skills, knowledge and potential when searching and creating new effective teaching aids, which would fully replace the momentary deficit of them for the issue, and make the education more effective. Streamlining of teaching is a very difficult and long process and it cannot be solved comprehensively. When creating new multimedia teaching aid, we focused mainly on RSE issues where computers are used as means for teacher's work, but also for pupils- traffic participants. The issues are, in particular, skills to use a bicycle in trafficsafely, basis of its maintenance and repair, traffic rules in terms of a cyclist, traffic signs, etc. Handling of these applications is the basic "equipment" of today's human society.

1. Search of Innovative Approaches and Forms of Teaching Technology in a Lower Secondary Education

A part of education, which a pupil should get during the school attendance, is also acquiring of knowledge, skills and habits of Technology. This basis is a very important condition for acquiring and developing additional knowledge of

pupils. Each of us achieves success in gaining new knowledge in a different way. The volume of information, that we can remember at once, is very small. This causes considerable problems during the education. One pupil learns everything by heart, while he or she does not understand it, the other one tries to understand the subject matter and to distinguish what is important in it. Some pupils take notes of what the teacher explains while others need to be tested immediately. Some students prefer spoken word, others visual image when obtaining information. Everyone uses a different learning process, characteristic of the individual learning style. Our long-term interest was, and still is, to teach pupils the elements of Technology. New innovative approaches allow us to use multimedia and computers in teaching. We tried to profit from our skills, knowledge and potential when searching and creating new effective teaching aids, which would fully replace the momentary deficit of them for the issue, and make the education more effective. Streamlining of teaching is a very difficult and long process and it cannot be solved comprehensively. When creating new multimedia teaching aid, we focused mainly on Technology issues where computers are used as means for teacher's work, but also for pupils.

We realize that the use of information technology and computers in the teaching process also brings certain disadvantages and complications, but we believe that when they are used properly, they are indispensable means of humanization of teaching and they significantly contribute to the creativity of pupils. The teacher is the one who must be aware that the computer is a means that can mediate information to the pupils, but emotions and love can be expresses only by the teacher.

In order to have effective education that would equally develop cognitive and affective area of a personality of the pupil, it is necessary, except for computer technology, to use various methods, contents and forms in teaching. There is no content that could be mediate without methods and there is no mediation without a medium (teaching aid). For these reasons, when we were creating and searching for effective procedures of using the new teaching aid, we tried to use, except for computer technology, synergies of other methods and procedures, particularly in the area of project and problem teaching. The role of MTA is to satisfy the pupil's needs in cognitive but also in affective areas.

2. Multimedia Teaching Aid for Teaching Technology

The core of MTA is specially made of presentations and teaching text stored in the form of CDs. MTA accepts the current situation of information technology and pedagogical-psychological processes. When we were creating it, the bases

were our skills, experience, and knowledge in the field of Technology, multimedia production, psychology and didactics of technical subjects.

The teaching aid presents a new subject matter, procedures and solutions of problem tasks in the field of Technology to students. Initially, it requires an intensive work with a computer and it is associated with a certain risk that is always present when computers are used in teaching. Teaching through MTA brings much more pleasure from teaching the subject for teachers as well as learning for students. The effectiveness of the educational process multiply exceeds traditional teaching methods. MTA helps pupils to achieve self-reliance, it encourages them to learn actively, it teaches them how to search and use information needed for their independent movement in traffic. It promotes activity and responsibility. Through MTA pupils learn how to discover, solve problems, experiment, and ask questions on this issue.

A teacher acts as a consultant and organizer when using the aid during the lesson. He or she selects a subject matter based on the needs and interests of pupils. He or she supports the open communication, solving, thinking, or ideas and leads pupils to make decisions on their own. The teacher requires from the pupils to evaluate their activities and express their opinions.

If pupils are led to any practical or intellectual skills, they have certain needs. These needs occur when pupils learn things that require a corrected practice.

3. Research of the Impact of MTA on Development of Teaching Technology at Slovak Schools

In this chapter we describe what we wanted to find out, why it was needed, and how we gained and processed various information of the educational experiment.

In general, there is an opinion that an indicator of the effectiveness of the educational process is the result of a pupil. It should be noted that when we focus on the reaching that result, we must be also interested in the time during which the pupil achieved it. There is a difference when two pupils achieved a result of the same quality, but one managed to do it in a few hours and another in three days.

The effectiveness is also predicated by the quantity of energy and effort the pupil had to make for achieving the desired result.

Currently, there are several methods and techniques, according to which it is considered to what extent the work of a teacher was effective in the teaching process. For example, time of the active work of pupils in the teaching process is measured. The effectiveness tends to be considered on the basis of knowledge or

a change of opinions, attitudes and value orientation. Neither one of these methods can be said to be a really optimal indicator of reality, since the results, which are considered, may affect a large number of factors and none of these methods considers them comprehensively.

Based on the foregoing, we state that the consideration of the effectiveness of the teaching process currently more or less depends on the ability of the teacher, i. e. to which extent the teacher uses his or her processes, methods and new teaching aids at work, etc.

Although we embarked on implementing the multiannual educational research, experience was more important than the gathered numbers and output to us. The experience was supposed to confirm that MTA is effective and helps pupils when learning.

4. Subject, Aims and Hypotheses of the Research

This chapter aims to present the actual results of the research that we gathered in the research of implementation of MTA into teaching. It ought to highlight the merits of using MTA in teaching subject Technology. We chose the method of experimental verification for the purposes of this research.

Subject of the Research

The research was made among pupils of the 2nd level of primary school. Teaching of Technical Education in selected thematic areas is supported by MTA. There is an optimum support of information and communication technologies.

Aims of the Research

The aim was to verify the success of the use of MTA in real conditions of the selected schools having Technical Education, where work with computers is also used. We examined the knowledge of the first three levels of educational objectives of Niemierko taxonomy and active learning of pupils.

We formulated the following principal and starting hypothesis from already expressed research questions:

H: The use of suggested multimedia teaching aid in teaching of Teaching Technology on the 2nd level of primary schools will statistically affect the level of pupils' knowledge.

To be able to confirm or refute and quantitatively and qualitatively verify the main and starting hypothesis, we formulated the following working hypotheses:

H1: When dealing with the tasks of the didactic test focused on the issue of road safety education, pupils from the experimental group will achieve statistically significantly better results in the first three areas of Niemierko taxonomy than pupils from the control group.

Research Sample

The basic set, suitable for our research, were pupils of the 7th year of the 2nd level of primary schools in the Slovak Republic. We can consider the results of the population of pupils of the 7th year in the Slovak Republic to be normally distributed. That is why we can process data as a selection of the normal distribution in the research. In terms of external validity of the research, we performed the sampling selection by the stratified selection. The sample was made of 214 pupils of the 7th year from five primary schools in the Slovak Republic. To be able to objectively determine whether our MTA (independent variable) affects the level of knowledge of road safety education of pupils of the 7th year of primary schools in Technical Education, we included two groups of respondents in the experiment: the control group and the experimental group. The control and experimental groups were always formed by the entire class. The control group consisted of 107 pupils. 107 pupils were also in the experimental group. We purposefully marked all control subgroups as one control group CON and all the experimental subgroups are identified as one experimental group EXP.

5. Statistical Processing and Analysis of the Collected Data

The measurement of pupils´ performances from the issue in the subject of Technical Education were provided by the final didactic test in each subgroup of experimental and control group separately. The test of 18 questions was taken by 214 pupils. The results of this test were analyzed by the methods of descriptive statistics. Its results and features are listed in the following table.

Table 1. The Descriptive Statistics of the Data Set Analyzed in the Context of Hypothesis H1

Variable	Sample Size	Mean $\bar{x}$	Root- mean-square s	Scatter S2	Modal Value	Median Value	Down Quartile	Upper Quartile	Minimum	Maximum	Variation Interval	Error Band for the Median Value $\alpha = 0.05$
EXP-1	107	29.71	3.16	9.98	33	30	28	33	20	33	13	(29.11; 30.31)
CON-1	107	28.82	3.72	13.86	28	29	28	32	14	33	19	(28.02; 29.52)

The first output from the processing of collected data in table 1, which contains basic descriptive statistics of the data set, i.e. arithmetic mean, median, modal value, variation interval and quartiles.

The following frequency tables offer the basic idea of the final didactic test results in subgroups of the statistical sample set. It is then possible to create frequency histograms (Graphs 1, 2). For this purpose, we made a table of frequency, which is sometimes called the frequency table.

Table 2 reflects values of the variable in the experimental group. Table 3 reflects values of the variable in the control group.

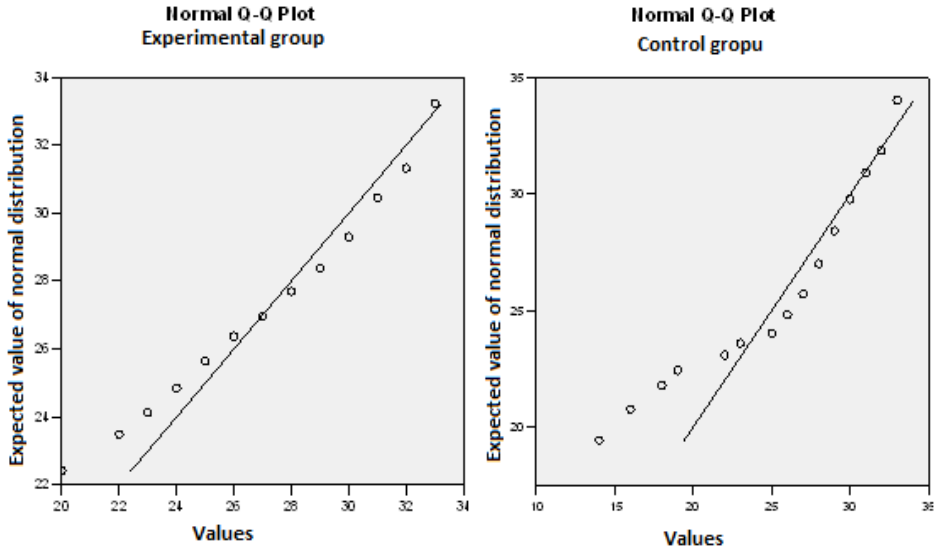
Table 2. The Frequency Table for the Experimental Group H1

	Points	Frequency	Expected Percentage	Percentage	Cumulative Frequency %
	20.00	2	0.9	1.9	1.9
	22.00	1	0.5	0.9	2.8
	23.00	2	0.9	1.9	4.7
	24.00	3	1.4	2.8	7.5
	25.00	5	2.3	4.7	12.1
	26.00	5	2.3	4.7	16.8
	27.00	5	2.3	4.7	21.5
	28.00	10	4.7	9.3	30.8
	29.00	6	2.8	5.6	36.4
	30.00	18	8.4	16.8	53.3
	31.00	13	6.0	12.1	65.4
	32.00	9	4.2	8.4	73.8
	33.00	28	13.0	26.2	100.0
	Total	107	49.8	100.0	

Table 3. The Frequency Table for the Control Group H1

	Points	Frequency	Expected Percentage	Percentage	Cumulative Frequency %
	14.00	1	0.5	0.9	0.9
	16.00	1	0.5	0.9	1.9
	18.00	2	0.9	1.9	3.7
	19.00	1	0.5	0.9	4.7
	22.00	3	1.4	2.8	7.5
	23.00	1	0.5	0.9	8.4
	25.00	3	1.4	2.8	11.2
	26.00	6	2.8	5.6	16.8
	27.00	7	3.3	6.5	23.4
	28.00	17	7.9	15.9	39.3
	29.00	14	6.5	13.1	52.3
	30.00	17	7.9	15.9	68.2
	31.00	7	3.3	6.5	74.8
	32.00	10	4.7	9.3	84.1
	33.00	17	7.9	15.9	100.0
	Total	107	49.8	100.0	

It is clear from the Frequency tables 2, 3, and then the generated histogram compared with a curve of normal distribution that the data are not normally distributed, as confirmed by the QQ plot.



Graph 1. The Approximation of the Distribution of the Variable COG Frequency to a Normal Distribution

Graph 1 shows the histogram of the variable COG in the experimental and control groups. It is covered by the ideal curve (density) of the normal distribution (the Gaussian curve). From the results, it is noted that pupils achieved in the didactic test different scores and they were placed in a variety of qualitative intervals within the same scale. The highest score of the didactic test was achieved by a pupil from experimental and control group (33 points). The lowest score of the didactic test was achieved only by a pupil from the control group (14 points). Arithmetic averages of both groups show that pupils from the experimental group were better of less than 1 point, at average, than pupils from the control group. By comparing the root-mean-squares, it is noted that the homogeneity of both groups is comparable, thus MTA does not significantly increase nor reduce the dispersion of the values of scores of individual pupils. The presumption of pupil performance differences was proved for the sample evidence by descriptive statistics. In order to generalize the argument as a basic set, it is necessary to make an inductive statistical analyze.

According to the analysis of the characteristics of both groups, we can confirm that it is reasonable to test the hypothesis H1, which says that pupils in the experimental group achieve statistically significantly better results than pupils in the control group when taking the final didactic test focused on the issue of road safety education. This means that we test the hypothesis:

H0: Median value (estimated by the arithmetical average) of experimental and control group is the same.

To verify this hypothesis, we used the T-test of two choices. This test works with a variable that is the choice of the normal distribution and assuming equal scatters. It was necessary to perform also a test for equal scatters, the so-called Leven F-test for the correctness of the calculations. We used a statistical system which calculates the two possible cases (including the equality of scatters as well as its inequality) - Therefore, the outputs of the table 4 are sufficient for us.

Because of this, we take into account the results from the bottom line (the output of the statistical system SPSS for two-sided alternative, where p (T-test) = 0.061 (for two-side d alternative) and p (T-test) = 0.0305 <0.05 (for one-sided alternative), thus we reject the hypothesis H0. We summarily show the outputs from the system SPSS of T-test in table 4.

Statistical testing using the T-test confirmed the significance of differences between the performance of experimental group and control group is made by the use of MTA designed by us.

Table 4. The T-test with Two Choices on the Equality of the Median Values for Hypothesis H1

	Leven F-test		**T- test on the Equality of the Median Values**						
	F	**P-value of F-test**	**T**	**Df**	**P – value two-sided alternative**	**Difference of Median Values**	**Standard Error of the Difference of Median Values**	**95% konf. Interval for the Scatter**	
								Down	**Upper**
equality of scatters	0.122	0.728	-1.881	212	0.061	-0.88785	0.47208	-1.81842	0.04272
inequality of scatters			-1.881	206.523	0.061	-0.88785	0.47208	-1.81856	0.04286

The T-test confirmed that the difference of averages of the total score of the final didactic test of the independent variable COG was not random, but it was statistically significant at significance level $\alpha = 0.05$, which rejects the hypothesis H0 on equality of averages over the one-sided alternative $\bar{x}_{exp} > \bar{x}_{con}$.

Interpretation of the results of the T-test is that if the same teacher taught in any other class of the basic sample using MTA as in the experimental class (sample), then pupils would reflect, with greater probability than 95%, the operation of this MTA in the same way and with the same difference of scores of the variable COG as pupils from the sample set.

The research results confirm the assumptions made in the working hypothesis H1. We argued that pupils in the experimental group achieve statistically

significantly better results than pupils in the control group when taking the final didactic test focused on the issue of road safety education. Thus, the performance in the cognitive field of pupils from the experimental group, which uses the proposed MTA during the lessons, would be better than in the control group. Hypothesis H1 was confirmed, and its validity can be generalized to a basic set of pupils.

Conclusion

The overall concept of Technical Education in modern schools of Slovakia (in school education programs) was given into a systematic work through individual educational subject (compulsory lessons for all pupils in primary school), teaching aids of a good quality, instructional texts, or through extra-curricular activities that develop theoretical and practical knowledge of pupils.

Technical Education has been a part of education at primary schools in Slovakia for many years. Its level was very good particularly in the 90s. In the past, a relatively large number of teaching materials and teaching aids of a good quality was provided. Topics promoting the issue of Technical Education become a part of textbook for primary schools. There was and there still is rich experience with projects and competitions.

The experiment showed that the pupils using MTP absorb knowledge easier and are more active during classes. The final result is not as significant as expected: it improved, but the difference is not relevant, in fact the experimental group achieved only less than 1 point more than the control group in average.

If we try to find a common denominator of the following chapters, then it is our desire to promote the issue of Technical Education at Slovak primary schools, whose quality is to be a guaranteed and functioning system. A creation and implementation of modern multimedia teaching aids give a good opportunity to it. It depends on people (teachers) who create and implement it together. In case of Technical Education, there is no doubt that the effort is worthwhile.

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