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MULTIMEDIA AS A PHENOMENON IN THE SUBJECT TECHNOLOGIES

Abstract

Introduction and aim: We deal with the summary of essential characteristics of technology, which are the fundamental elements of the state educational programs. The aim is to analyses an example of usage of a multimedia teaching aid in technology and to draw attention to its function as a tool to develop knowledge, skills and creativity of students. In the empiric part is adverted to a pedagogical experiment which proves that a computer (MTA) significantly influences not only the efficiency of students during teaching but also their motivational effect during the lessons.
Material and methods: In this article we present a pedagogical experiment. Here is a detailed process during the pedagogical experiment and subsequent evaluation of research results.
Results: 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.
Conclusion: 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.

Keywords: Technology, teacher, pupils, digital competence, teaching process, multimedia.
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MULTIMEDIA JAKO ZJAWISKO W PODSTAWOWYCH TECHNOLOGIACH

Streszczenie

Wstęp i cele: *Mamy do czynienia ze streszczeniem podstawowych cech technologii, które są podstawowymi elementami państwowych programów edukacyjnych. Celem jest analiza przykładu wykorzystania multimedialnych pomoc nauczyciela w zakresie technologii i zwrócenie uwagi na jego funkcję jako narzędzia do rozwijania wiedzy, umiejętności i kreatywności uczniów. W części empirycznej jest prezentowany eksperyment pedagogiczny, który dowodzi, że komputer (MTA) znacząco wpływa nie tylko na efektywność uczniów podczas nauczania, ale także na ich wpływ motywacyjny podczas lekcji.*
Materiał and metody: *Prezentowany jest eksperyment pedagogiczny. Opisano szczegółowy proces eksperymentu pedagogicznego i późniejszą ocenę wyników badań.*
Wyniki: *Wyniki badań potwierdzają założenia przyjęte w hipotezie roboczej H1. Stwierdzono, że uczniowie w grupie eksperymentalnej osiągają istotnie statystycznie lepsze wyniki niż uczniowie z grupy kontrolnej podczas wykonywania końcowego testu dydaktycznego koncentrującego się na kwestii edukacji w zakresie bezpieczeństwa drogowego.*
Wniosek: *Kreacja i realizacja nowoczesnych multimedialnych pomocy dydaktycznych daje dobrą okazję do doskonalenia procesu nauczania. Proces ten zależy od ludzi (nauczycieli), którzy tworzą i wdrażają go razem. W przypadku edukacji technicznej, nie ma wątpliwości, że wysiłek się opłaca.*

Słowa kluczowe: *Technologia, nauczyciel, uczniowie, kompetencje informatyczne, proces nauczania, multimedia.*
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1. Introduction

If we live in the digital age is nonsense to education this direction. We can even argue that time is forcing schools to introduce digital practices and generally accepted approach digital educational process. Because the pupil is increasingly comes into contact with various forms of IT school student must learn to work your co-exist in the digital world. Here are opening doors to schools for various devices and technological advances.

In the spirit of current trends concerning development of technology and knowledge about effective education, teachers of natural science subjects aim to use computers during lessons and develop their digital competences that way. They are trying to create MTA which would fulfill the conception of creative humanistic teaching approach in subjects where computers serves as a means of the teaching process. Teaching with the use of multimedia helps to develop in individuals such abilities, skills and competences, which help them cope with fast changes in personal and social life. They will help him in a range of unpredictable problems.

2. Transformation aims of education in Slovakia

In Slovakia they have been speaking about the need to change education and transform current school into a school based on humanistic principles of tolerance and mutual support. Purposeful and systematic development of key competences, knowledge and skills, which can be used to take over a wide range of positions and functions at a certain moment, have become the subject-matter of education. Acquiring these life important competences causes that a man is not only able to specifically and flexibly apply what he has learnt but in the future he will also be able to:

- change what he has learnt according to one's needs,
- integrate into his knowledge system new dealing alternatives,
- choose from more alternatives so that he would behave appropriately,
- combine newly gained skills with the older ones,
- widen his behavior repertoire by means of one's own synergy.

On the basis of researches conducted by a number of authors the importance of some competences, which are essential for professional and economic future of an individual, is currently evident. These competences are called key competences:

- ability to speak and cooperate,
- ability to solve problems and create,
- responsibility,
- independence and efficiency,
- ability to think and learn,
- ability to justify and evaluate,
- information and computer literacy.

A new step in Slovak educational environment is represented in the interest of professional but also lay public in issues concerning education focused mostly on its quality and functionality. Economic categories such as efficiency and quality, which are hard to measure, have become a challenge even in the environment of our school education, mostly under the pressure of practice and in confrontation with foreign experiences of many pupils, students and their parents (Krišťák, 2008).

The common element, which characterizes closing in of educational systems of the EU and OECD member states, is represented by key competences as a part of curriculum with the aim to develop not only knowledge but also the personality of a student. Key competences have become a real need of modern education during the recent years, which led to applying a strategy that knowledge is the most valuable source of economic growth and the most important capital of Europe are educated people (Eurydice, 2002). Integrating this effort resulted in the Lisbon process and its main strategic target for the European community: to develop key competences in a society based on knowledge, which the Council of Europe in Lisbon specified from the year 2000 until 2012 as follows:

- make key competences acquisition accessible to everybody, even to less gifted pupils, pupils with special educational needs, pupils who leave the educational system untimely, and to the adults;
- support validity and evaluation of key competences in the public and make further education and employment of citizens easier that way.

These steps have been recommended by the European Parliament when concerning key competences for lifelong learning (the European framework) with the aim to provide such content and quality of basic and specialized education, that they would offer young people a means to develop key competences in such extent, which would equip them for adult life and for further self-education according to the needs of practice, and which would represent a basis for their further education and professional growth. (Official Journal of the European Union, 2006).

3. Digital competence and teaching process

There are only a few competences that students acquire based on their own effort and whose development they even prefer. Among these belongs digital competence, i.e. awareness to use digital technologies and working with information. Acquiring this competence along with communication competences represents an important element of formal and informal education. Developing technologies such as computers, the Internet and its services (chat, social networks, e-mail, video conferences), mobile telephones, digital cameras etc., participate on developing digital competence.

Under digital competence we understand the ability of pupils to:

- search for and evaluate information - pupils should not only be able to look for information but also to asses their reliability, validity, possibilities of distorting data and information sources, choose information relevant for solving a certain task when considering their origin and quality. Pupils should be able to obtain and collect information, process the acquired data, draw conclusions and answer hypotheses;
- process information - pupils should be able to use digital technologies to analyse, process and present information, they should know that they can use models and modelling for demonstration of a situation and a process on the screen, to analyze equations and relations based on a change of variables and use this possibility;
- share and exchange information - it is connected with communication, pupils should know different ways and conventions which are used during communication and use this knowledge for a suitable presentation of information taking into consideration the audience. (National strategies, 2009).

Digital competence includes self-confident and critical use of technologies of the information society for work purposes, in free time and for communication. It is based on basic skills in ICT. Using a computer to obtain, asses, save, create, present and exchange information and to communicate and participate in cooperating networks using the Internet.

Digital competence requires full understanding and knowledge about the character, task and opportunities of technologies of the information society in everyday context, in personal and social life and at work. These include main computer applications like word and spreadsheet processor, databases, saving and managing information and understanding opportunities and possible risks, which are concerned with the Internet and communication via electronic media (electronic post, network tools) at work, in free time, to share information, to cooperate on the network, for education and research. Individuals should also understand how technologies of a communication company support creativity and innovations and should also be aware of the issue connected with validity and reliability of accessible information and of legal and ethical principles of interactive use of technologies of the information society. The necessary skills include ability to look for, collect and process information and to use it in a critical and systematic way, to asses its relevance and to distinguish between reality and virtual world and at the same time identify connections. Individuals should be able to use the tools for creating, presentation and understanding difficult information and to make accessible, to look for and use services created on the Internet. Individuals should also be able to use technologies of information society to support critical thinking, creativity and innovation.

4. Multimedia in teaching technology

For each subject of a curriculum in our schools abilities have been defined, which should primarily be developed in a certain subject concerning the content and character of the subject. By an intersection of all subjects we can naturally develop all aspects of digital competence of a student. In natural science subjects it is important to assign students with such tasks which will make them search, asses, choose, analyze, process and present information.

Technology as a natural science and experimental subject, literally offers itself to a complex use of digital technologies. Their significant advantage when compared to traditional teaching means is their visualization, simulation, active intervention, interactivity, instant feedback, decision making strategies, motivation. How can a teacher of Technology catch the attention of a present day student? Digital technologies offer a solution, which significantly support object and interactive teaching while still allow the teacher to apply innovative teaching strategies more effectively. These strategies primarily are:

- group work and cooperative teaching - develops social skills, ability to cooperate, to share work, and take the responsibility for it;
- integrated teaching - builds an integrated view at natural phenomenon,
- project teaching - develops a variety of skills of a student during a complex processing of an assigned task,
- problem teaching - develop the ability to think critically and creatively.

Applying digital technologies and developing key competences of students on the Technology lessons require direct interference into the organization of teaching and into the teacher's work. The most serious step is adjustment of curriculum in such a way that it would offer enough space not only to use digital technologies but also to create space to discover knowledge, to solve problem tasks and situations, for project work and other outputs (3D tools, simple animations, quiz, etc.) which would be created by students. Sophisticated work with a textbook and a scientific text (reading comprehension, learning from a text, orientation in a text, classification, using essential information), individual search, examination, discovering represent a didactically effective way.

From the point of view of developing digital competence and basic competence in the filed of science an technology it is necessary to conduct observation and experiments with the support of digital technologies on the classes of practical exercises. The method of observation and experiment is mostly used only to consolidate and confirm already obtained knowledge of students. While solving problem tasks and situations it is necessary for students to search for, critically asses and choose information while taking into consideration its relevance and credibility of the information sources.

Growing accessibility of computers in education allows students to analyze a problem and validate its result using real school experiments. Another value added to conducting e.g. school experiments in computer supported laboratories is the possibility to apply in students' work the basic principles of scientific research and that way simulate working conditions of scientists.

Fig. 1. Demonstration of Current Textbooks and CD for Technical Education

Source: Elaboration of the Authors

Digital microscope shows the field of vision on a computer screen. Visualization of abstract technical terms for students offers space for discussion, interaction and active participation of students in the construction of their own knowledge. It allows mutual problem solving and cooperation of students.

Modern digital technologies support mobility and possibility to organize teaching or its parts directly in the field. Students have an opportunity to collect information in the field and process them subsequently in the class or in a workroom. Mobile Internet accessibility enables on-line communication between the field and the class.

5. Search of innovative approaches and forms of teaching technology in a tower 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.

6. Multimedia teaching aid for 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.

If the education is supposed to be effective, the needs of the pupil must be met in the cognitive as well as in the affective area.

MTA is designed for MS Windows. The program is able to operate in the operating systems MS-DOS and MS Windows. If we want to use all the options, it is necessary to have a computer supporting the playback of various computer applications and respecting the system requirements mentioned above (CD-ROM or DVD-ROM drive, Adobe Reader, Windows, etc.). A mouse is a necessary element of control. To control the MTA program is very simple. Everything is controlled by the simple mouse clicking on various objects in the program. Running of the program from CD-ROM requires a free memory on the disk (c: disk requirements are reduced with more available memory). It is still possible to open the objects, if the mouse pointer has an arrow shape. Installing the program is not needed. MTA application runs right after you insert the media into the CD drive as Autorun.

Initial instructions are as follows:

- run the Windows operating system,
- insert the MTA CD into the CD drive and wait for the automatic run of Autorun,
- the main menu of MTA appears.

Autorun (material on CD-ROM) is divided into the following main headings which include:

- a multimedia teaching aid - The Program,
- the construction, basic repair and maintenance activities - PowerPoint presentation I,
- PowerPoint Presentation II,
- publication in PDF.

The main menu is the base of the program. It is possible to choose the desired item by using the arrow pointer. The first item of the MTA offer is the Program. It has the nature of interactive games with elements of Technology. It consists of the main MENU, which includes five main parts:

1) PROGRAM - brief information on orientation in the program is described here, pupils very quickly learn how to use the program;
2) MEMORY GAME- a classical type of memory games. Randomly distributed cards are placed in the game field. The task is to look for a pair of identical pictures of electric signs and its name. After choosing two cards, they are compared, and if they are the same, they remain visible. After the game, the cards are automatically mixed;
3) TEST - contains 28 questions on issues of electric signs and situations, where the response is supposed to be selected from the menu a, b, c. The number of the questions and correct answers is shown;

4) END - this section serves to complete the application. A single mouse click brings us back to Autorun.

Other files of MTA: The construction, basic repair and maintenance activities. Presentations in MS PowerPoint include solving traffic situations. In the first of them, there is a graphically presented bike (bicycle types, construction, main parts, construction junctions, repair works of various bicycle components, bicycle lighting system, adjusting of brakes, handlebars, seat, bicycle accessories, etc.). The next presentation indicates solutions to various traffic situations, especially crossroads with an interpretative text. The presentations are closely connected to the content of the publication and they appropriately complete it.

7. Use of multimedia teaching aid in the teaching process

We started using MTA at selected primary schools. Gradually, we refined it and added new information. Currently, MTA is used by number of teachers who attended a training seminar at the Department of Techniques and Technology at the Faculty of Natural Sciences of Matej Bel University for the output of the grant project ME SR and SAS named *A System of Lifelong* Learning in the Field of *Technical Vocational Subjects* in *Information Society*. These teachers (multipliers) became familiar with the aid at the seminar and learnt how to use it.

When using MTA, it is suggested to organize teaching as 45 minutes long lesson (one teaching unit), which is internally divided into three parts: a part of motivation and exposure, a part of implementation and activation, and a part of creativity and improving.

8. Part of motivation and exposure

In the introduction, the teacher motivates pupils, briefly repeats the already known knowledge and skills from the previous lesson. If the teacher finds out that pupils have not acquired the previous lesson matter (issue) enough, he or she will explain it by using an example and will describe the problematic things that are not clear to pupils.

In this part, pupils are not required to remember all the details of the new discussed matter. Understanding of the context, relations and causes is particularly required. The discussion of the new matter starts with the explanation of what its theme is. Pupils must have an idea about what they are going to learn and why.

If the teacher is sure that pupils have understood what the problem is going to be discussed, he or she proceeds to a new interpretation of the new subject and he or she describes, solves and comments the problem and its steps and important observations. Pupils watch the interpretation on the computer screens or projection screens and listen to the explanation of the teacher. The teacher should choose illustrative examples that motivate pupils to work alone. The teacher's examples ought to respect the pupils' interests and they should include the problems of the real life. Such examples meet the needs of pupils to actively repeat and strengthen skills and acquired knowledge.

When explaining, the teacher might use also wrong procedures, where pupils learn how to identify the wrong approach and try to correct it. They acquire skills and learn how to find solutions to problems. They develop their critical and evaluating thinking, and they adopt also the model procedures at the same time.

9. Part of implementation and activation

The objective of the second part is to correct the practice of each pupil. Pupils repeat the acquired matter which was demonstrated by the teacher. During the second part, they use MTA.

During the lesson, pupils add the teacher's audio-visual presentation with their supplementary notes and they ask the teacher or classmates some questions. The teacher supports the discussion on the topics and integrates the whole group.

The corrections of students´ own work is important. Pupils check themselves and verify, if they proceed in the right way or not. They choose the following steps on their own. They need the teacher's aid in emergency situations, especially in technical matters when something does not work. According to a number of educational resources, the self-assessment of pupils is possible only if several conditions are met:

- During the educational activities, pupils have to know the basic steps of the activities leading to solving the problem. This condition is met when the teacher summarize the entire procedure into a few main points at the end of explaining.
- Pupils have to be familiar with model solutions in order to compare their work and the work of the teacher. This condition is met, since pupils solve the same problems as the teacher.
- Pupils have to know the output solution of problematic tasks. This condition is met, since pupils know the result, to which they have to come.
- The teacher should assign more open (divergent) problem tasks during the lesson, where students have the opportunity to obtain a sense of achievement and self-esteem. This condition is met, since within the various parts the teacher implements the solutions of problem tasks that are designed to develop creative thinking and gives a space for the invention of the pupils.
- The teacher should enable pupils to freely choose the number of tasks, their sequence, intensity, or the procedures and means to solve them during the lesson. This condition is met in the third part.

10. Part of creativity and improving

In the third part, pupils deal with problem tasks or they write a test, which is offered in MTA. The didactic test is in terms of intensity and the applicable procedures comparable with the previous teacher explaining. Handling of these tasks should demonstrate the pupils' application of their skills and knowledge. The test also serves as a feedback to the teacher. In addition, pupils individually or in groups suggest simple problem situations; they propose and describe, etc.

During the creative, individual and team work of pupils, the teacher monitors and directs their work. After finishing the duties and tasks, pupils individually evaluate their performance. The teacher tries to positively evaluate the pupils by verbal praise.

11. Research of the impact of MTA on development of technical education 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.

❖ 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 technical education 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.

❖ 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 1.

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 and 2).

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)

Source: Elaboration of the Authors

The Figure 2 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).

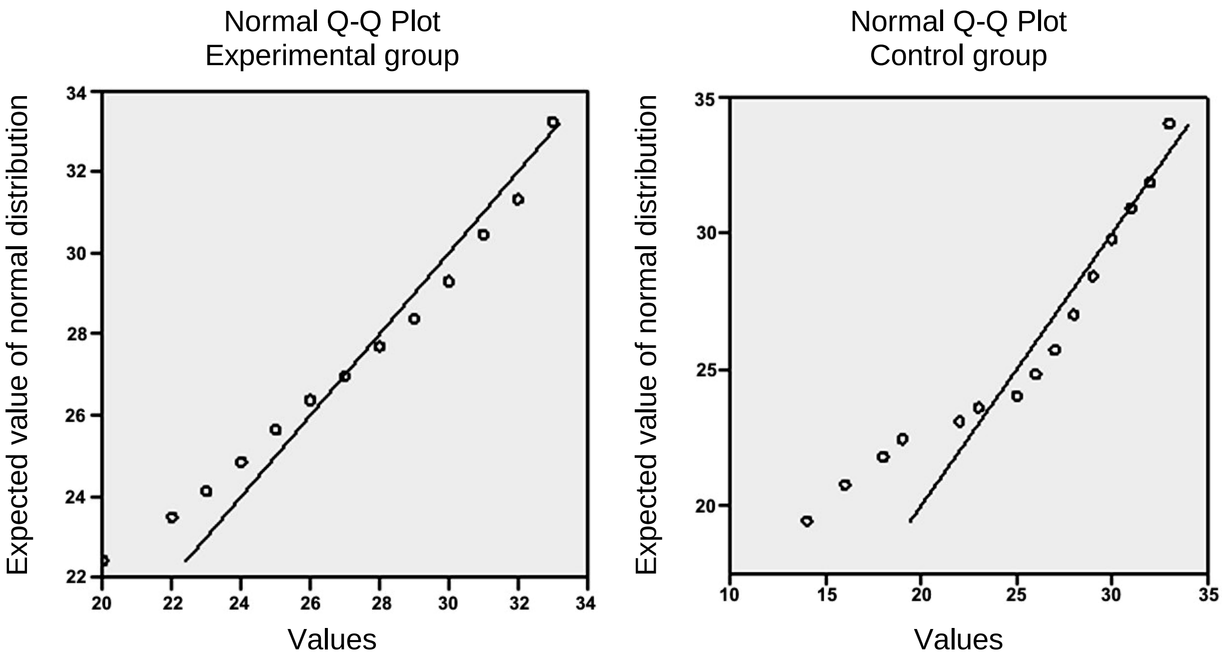

Fig. 2. The approximation of the distribution of the variable COG frequency to a normal distribution

Source: Elaboration of the Authors

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-sided 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 the Table 2.

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.

Tab. 2. 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 alterna-tive	Differ-ence 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

Source: Elaboration of the Authors

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 $\overline{x}\,\mathrm{exp} > \overline{x}\,\mathrm{con}$.

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.

12. 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.
- 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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