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The information – communication technology in technical education

Key words: hypertext, research, pedagogical experiment
Słowa kluczowe: hipertekst, praca naukowa, eksperyment pedagogiczny

Introduction

The teacher as the activator of the process of education, can control and teach the pupils to use technical data, though he must be able to have own reflexion and evaluation of himself. He supports individual, but cooperative work of pupils as well, keeps pedagogical, psychological and social aspects of the education. He uses appropriate educational equipment and the didactical technics. The new media and various innovative exercises are motivating elements from the subject of the technics and the new technologies. Our aim is to propose a system of controlled study for pupils using didactical environment created by hypertext portal. Important parts of this project are to find out the method to create mentioned environment and also its following application by the teachers at the education of technical subjects. The effectiveness of this new method will be examined by a pedagogical experiment.

Present state of subject

The problematic of modernization the general education from the point of incorporation the educational stuff of the technological character into its content, is one of the basic programmes, which is solved by UNESCO ether[1]. Starting with the technical subjects, it enables to know certain forms of work, and moreover it develops the technical meaning and technical creativity of the pupils during the school presence. The technical subjects (Technics and Technical education) in the

[1] P. Askerud, *A guide to sustainable book provision*, Paris 1998.

system of educational subjects at the 2. level of primary school have ensured basic defined conditions of individual educational subject – they have certain subject, educational methods, terminological and didactical system. The technics and technical education can be considered as a key element which can prepare pupils to live in the technosphere. UNESCO Pilot Project targeted the aim to make the technical knowledge to be a part of general education. Introducing the pupils to the technical knowledge and learning basic abilities and habits various countries solved in two ways:

– finding the special subject of technical character (technology),
– several technical topics are incorporated into the educational stuff of other subjects in the field of life sciences.

The project emphasized and still emphasizes the necessity of keeping the speed with the changes in the production and it makes important the preparation of young generation as a flexible and adaptable for fast changing conditions in the field of technics at present and in the future.

Also in Slovakia the primary school is important level of study to reach a certain degree of technical education, and which has the subject "technics" as one of the educational subjects (according to the new State educational programme) as well as the subject "Technical education". Those subjects have their strong place at the lower secondary education. They are rooted in the principles of the connection between the school and life. Technical education must be organic compartment of the general education on all degrees of education. A man with a creative way of thinking has bigger chance to apply himself in the present technical modern society.

Under the creative way of thinking we can understand the solution of the problems actively and finding even more options of the solutions. Creative technical way of thinking is a divergent process, which starts from learning the knowledge through their changed organization can lead to the production of a new information. Modern society is a society, where people work with informationand communication technologies actively, and where the hypertext educational material can occur. The knowledge from this field of science can be taught at the primary school degree at the subjects "technics" and "Technical education". So the man can easily understand the principles how various technical devices work. It must be a basis of present modern education. To be technically skilled we can understand the technical educated minimum that should be taught as a part of general educational by each pupil.

Present school must give a young man a chance to get the basics of the technical skills. It is necessary to keep in mind that in the era which we live in, technology has a strong place for practical application, but also in the present school. It is necessary to understand that every man is not a producer of technical objects,

but he should be an active user. However, at present school the technical subjects are taught traditionally still more and more. Also the research which went on in 2004 resulted in the facts that the teachers present the content of lessons to their students traditionally. There is a demand for the methodical material between the teachers, educational stuff and information-communicational technologies. This long-lasting tendency can be improved by a proposal, creation and application of the hypertext educational material for the education of the technical subjects at the primary schools. We understand that the hypertext educational material will not be a real electronic shape of the classical exercise book, but will support the pupils in a more active way of work with the information, individual educational environment, the options for actualization and comments shaped as hypertext educational material.

Particular contribution expected

The content of lessons is enriched by the information in connection between a man and his work, with the necessity to have basic work skills in various work fields. Education in this field is directed at the creation and development of the key competencies of the pupils, so that they are directed to know the surrounding world objectively, they need to enhance self - thrust, have new attitudes and values in life in connection with work, the technics and life environment. The aims of the technical education involve cognitive, sensitive and psychomotoric fields at the primary school and must be developing proportionally. These aims follow these key competencies:

– to give proof to get the knowledge and abilities in various work and extra-work life situations,
– to propose new tasks, new solutions, look for the solutions of the tasks in the new projects, to be able to plan and to control work.

The teacher controls and teaches the technical data for the pupils in the process of education. He uses appropriate educational tools – traditional or modern ones, to reach the aim. We consider as the most modern educational tools the multimedia tools, which are able to unit various forms of information. We think the hypertext is one of the most characteristic marks of the multimedia. Information in form of the text we could imagine only shaped classical way such as in the magazines, in the newspapers, or in the books recently. The structure of the classical text is simple and linear. The new options of computer utilization enable to create the new form of the text, where the linear text is only starting unit of wide rooted structure named as hypertext. From informational point of view we define the hypertext as many of the text information. The elements of this group are information items.

Information items are connected with each other into the linear, tree, network, net, or another structure hyperlines. From these information items the total information can be prepared following certain rules. The bonds between the parts of information enable to enter t information effectively. Technical and programme tools, which enable to save these information in form of hypertext (to create hypertext) and makes possible comfortable access to the information (to make hypertext), we call a hypertext system. The main characteristics is to unite the text. While working with the hypertext we can use some more of its characteristics. The comeback to the previous pages is possible if we have already worked with it, or there is some offer for previously visited pages. These characteristics and the structure of the hypertext some educational software are using, as well as the multimedia encyclopedias and also the service World Wide Web.

Healthy competitiveness between the pupils is natural, but there must be some friendly spirit, responsibility and team work. Using hypertext educational material we can enhance the pupil's interest to be educated. There is also the space to use dramatic performances to increase the activity of pupils so that they could directly influence the process of education. Widening the pedagogical activities of the teachers through hypertext educational material we can see the effective transfer of knowledge in frame of fastl developing technical disciplines as the basis of the "technical revolution".

The Goals and Contents of the Thematic Units in the Course "Technical Education" for the 7th Grade

The contents of the course Technical Education for the 7th grade of elementary school consist of the following thematic units:

– Procedures and tools for processing technical materials;
– Means of mechanization;
– Components of residential installation;
– Wiring works. Electronic components of automation and regulation;
– Individual work of the pupils.

The curriculum contents mean the curriculum which the pupil is supposed to learnat school. It is a sum of knowledge, skills and habits mastering of which provides development of mental and physical capabilities of the pupils necessary for their future life.

Furthermore, we will attempt to analyse individual thematic units and point out the shortcomings of a new textbook which contains the respective curriculum.

One of the first topics in the 7th grade of elementary school is the thematic unit "More Complex Procedures and Tools for Processing Technical Materials". In the thematic unit "Procedures and Tools for Processing Technical Materials",

the teacher develops technical thought and imagination of the pupils. The content of the thematic unit is focused in such a way that the pupils will be introduced in detail to technical materials and they will learn to tool and process them manually through basic technical procedures and with the use of available and proper equipment, tools and requisites. Pupils should understand, know and be introduced to the characteristics and proper selection of technical materials. The requirements for knowledge and skills in this thematic unit should contain: planning, chiseling, drilling, coupling of technical materials (both dismountable and non-dismountable) through mortising, gluing; with nails and screws; riveting, soldering, welding; the principle of casting; external and internal threads – manual cutting. Name the characteristics and use of board products made out of wood, profiled metal semi-products and plastics. Know how to cut, rasp and abrade these materials. Be able to choose proper material on the basis of knowing its mechanical and physical characteristics. Be capable of wood coupling with nails and screws and by gluing and cladding in practice. Know and be able to describe wood coupling with dowel pins and mortising. Know the basics of manual and mechanical processing of wood, metals and plastics. Be introduced to wood planning; know the basic components of a plane and types of planes.

Be able to solder and to identify screw and nut joints; be introduced to riveting. Know the principle of metal (plastic) casting and cast manufacturing. Be able to distinguish and describe dismountable and non-dismountable coupling of wood, metals and plastics (with nails, screws, screws and nuts, gluing, soldering, welding, constructional coupling, and riveting). Be introduced to the essence and difference among metal coupling, soldering and welding. Master wood chiseling and drilling with a crank brace and a hand drill in practice. Know how to measure with a slide gauge. Know the procedure for cutting external and internal threads both in theory and practice. Manufacture a joint via soldering in practice. Be able to describe and manufacture a wood joint via mortising. Be introduced to a procedure for manufacturing an elementary form for casting objects made out of wax. It is appropriate to explain the curriculum simultaneously with production of elementary objects; for example, a product will be manufactured combining wood, plastic and metal. As the situation of a respective school is taken into account, it is possible to produce only objects made out of materials which are accessible to a teacher at that school (e.g. only wood, plastic or only metal; alternatively other accessible natural materials such as leather). With regard to science and technology development, the teacher continuously supplements the respective curriculum with new information. She/he leads the pupils to master the curriculum so that they would use and master the correct technical terminology. She/he introduced the pupils to the work safety and hygiene. In this thematic unit, the emphasis is put on the correct fixture of material, hold and conduct of a tool, and the correct posture at work,

coordination of hands and feet, pace of movements with a tool as well as a direction of its conduct. At the practical activity of the pupils, the teacher monitors these rules, regulates the pupils and gives notice of mistakes they are making.

The contents of the thematic unit "Work Principle and Mechanical Components of the Household Means of Mechanization" is focused on means of mechanization and means of minor manual mechanization which represent the main contents of this thematic unit. The content is focused on their main division, use as well as their importance for the human and safety during their operation. The pupils will learn to use the household means of mechanization economically and sensibly. They will know the safety rules for their operation and regular maintenance. Manual and electric mechanisms in household and a school workshop classroom, their function, work, operation, use and maintenance. The safety rules for operation and work with manual and electric means of mechanization. The requirements for knowledge and skills of the pupils in this thematic unit are as follows: Be introduced to the principle and know functions of the most common manual and electric household mechanisms (kitchen and garden; manual and motor). Be able to operate easy basic household mechanisms and do their basic maintenance. Be able to explain the function of minor manual mechanization which the pupils have a chance of encountering in the technical education (drill; electric grinder; band-, oscillatory- and circulatory saw; spray gun).

Know the safety rules for operation of manual and electric means of mechanization in household and the technical education. Be capable of doing regular maintenance of some kinds of household mechanisms (vacuum cleaner, refrigerator, juicer, etc.) in practice. Be introduced to operation and work with the means of minor manual mechanization and to the safety rules for their operation (hand drill, metal grinder, circulatory and oscillatory saw, etc.). The teacher may accomplish a significant didactic effect using a practical demonstration in class (also a dysfunctional appliance is suitable for a practical demonstration). The study *Spotrebiče v domácnosti*[2], published at the Faculty of Natural Sciences of the Matej Bel University in Banská Bystrica in the first half of 2003, may be of effective assistance to the teacher. In their study, the authors provide a selection of the most common household appliances which are, on the basis of their function, divided to electric and mechanical ones. The identical structure is preserved with all appliances. The point of departure is represented by the construction of an appliance while the emphasis is put on the principle of its operation, basic maintenance and its eventual repair. The text is supplemented with schemes and figures so that the user gets as broad information as possible in a simple form. Questions

[2] M. Ďuriš, J. Pavlovkin, *Spotrebiče v domácnosti*, Banská Bystrica 2003.

and tasks intended for confirmation and repetition of the curriculum are stylistically included in the text. A part of the publication is also a CD ROM where the user finds all figures which are included in the text in a separate form[3].

The contents of the thematic unit "Basic Components of Residential Installation" introduce the pupils to basic information from the field of residential installation. In this recently introduced thematic unit, the content of the curriculum is focused on basic information on the field of residential installation – heating, distribution of cold and hot water; in sum, on the household and energy saving, ecological aspects and minor maintenance in the household. The pupils will be introduced to the system, and basics of construction and maintenance of individual components of residential installation. They will learn to evaluate individual systems economically and ecologically.

The pupils will get to know the system of central heating in residences and its function. Know to describe the distribution system for cold and hot water in a flat. They will get to know the structure and function of a water faucet and a simple water battery. Be introduced to replacement of a seal or cartridge in the water faucet (battery) and to reparation of a WC in practice. They will know ways of heat and hot water saving as well as means of prevention against heat escape – means of door and window insulation. Know to describe the principle of combustion in heating units – the central heating. They are introduced to the scheme of central heating and basic structure of a boiler. They know how to calculate energy consumption for heating. Master the repair of a seal in the water faucet (battery) via its replacement, milling of valve seats or replacement valve seals in practice. The teacher draws the knowledge from a textbook for the technical education. The above mentioned study *Spotrebiče v domácnosti*[4] is also suitable. On the basis of science and technology development, the teacher continuously supplements the curriculum with new information.

The contents of the thematic unit "Wiring works. Electronic components of automation and regulation" virtually broadens and deepens knowledge and skills of the pupils at wiring works. A significant part consists of practical exercise of soldering when plugging in electric circuits. The pupils will be introduced to components of automation and they will solidify their habits of safety operation with the electric current.

They will get to know the basic components of automation and their application in household electric appliances (electric doorbell, electromagnetic relay, bimetal temperature regulator, regulation valve, various types of sensors, etc.). They will be able to draw an electric scheme and to plug the circuit of an electric

[3] Ibidem.
[4] Ibidem.

doorbell correctly. They will be able to describe the system of household electric installation and the most important components of an installation circuit. They are introduced to voltage indication in an electric circuit. They are able to explain the significance of production automation for human and production. They know the principle of electromagnetic relay and basic circuits using its function. They know the work principle of an automatic switch – a circuit breaker. They are able to explain some automatic systems – in an iron, automatic door opening, lighting, PC printer, principle of elevator functioning, etc. They know the principle of disc (HDD, FDD) function in a computer. They are introduced to PC hardware and software.

The last thematic unit which is prescribed by the curriculum for the Technical Education in the 7th grade is "Individual work of the pupils". In this thematic unit, the pupils are supposed to apply their theoretical knowledge and practical skills as good as possible. The task in this unit is that the pupils independently and correctly draw a construction of a chosen topic, select correct material, follow a correct technological procedure and, if applicable, choose an adequate surfacing. After having been familiarized with the working procedure in detail and having obtained material, the pupils are working individually or in groups. The teacher manages their activity by the way of an individual or frontal discussion. The goal of this thematic unit is development of self-reliance and creativity of the pupils by the way of proposing or, possibly, selecting and manufacturing chosen products, applying a solution of appropriate technical problems. *Manufacturing chosen work topics with tasks such as:*

– Choice of construction (elaboration), finalization of an ideological topic,
– Possibly a change of construction,
– Selection of a material,
– Selection of a technological procedure,
– Selection of a surfacing, etc.

Products may be made of metal, wood, plastic or combined or, alternatively, in combination with electric installation. Co-operation at reparations and maintenance of installation material in school

Methodology and research management

We used a pedagogic experiment as a research method. The research strategy was conditioned by the character of a problem which we have been dealing with at work, being a proposal, formation and verification of a hypertext didactic text in educational process. In order to research performances of pupils in the cognitive sphere, we used a non-standard cognitive final didactic test. The didactic test was

differentiating, that is the performances of the pupils were compared to the performances of the pupils in the experimental group. We processed the acquired data using basic statistical methods. We calculated basic statistical characteristics (arithmetic mean, decisive deviation and error, median, modus, etc.). Subsequently, we tested given hypotheses at the significance level of $\alpha = 0.05$.

Pedagogic experiment

We have dealt with a problem concerning to what extent the existing hypertext didactic text will help pupils in the 7th grade or, possibly, will affect a degree of acquired mastered knowledge. In the control group (K), the education process has been carried in a traditional way (the pupils have not worked with the hypertext didactic text); in the experimental group (E), the pupils have worked with the hypertext didactic text. After the education process in both control and experimental groups had been finished, we used the didactic test for both groups at the end of the natural pedagogic experiment. The didactic test (DT) was intended for the pupils in the 7th grade of elementary school.

Determination of hypotheses

H_0: The results obtained via the non-standard didactic test will be identical in both control and experimental group.

H_1: We assume that the hypertext didactic text will increase efficiency of teaching of the technical education in the 7th grade of elementary school.

H_2: The respondents in the experimental group at the education process with the hypertext didactic text will achieve a higher performance in the cognitive sphere in comparison with the control group in which the education process will be realized in the way of traditional methods without the use of the hypertext didactic text.

$H_{2.1}$: We assume that the pupils in the experimental group at the education process with the hypertext didactic text will achieve a higher performance at the education level "memorization" in comparison with the pupils from the control group in which the education process will be realized without the use of the hypertext didactic text.

$H_{2.2}$: We assume that the pupils in the experimental group at the education process with workbooks will achieve a higher performance at the education level "understanding" in comparison with the pupils from the control group in which the education process will be realized without the use of the hypertext didactic text.

$H_{2.3}$: We assume that the pupils in the experimental group at the education process with the hypertext didactic text will achieve a higher performance at the

education level "specific transfer" in comparison with the pupils from the control group in which the education process will be realized without the use of the hypertext didactic text.

$H_{2.4}$: We assume that the pupils in the experimental group at the education process with the hypertext didactic text will achieve a higher performance at the education level "non-specific transfer" in comparison with the pupils from the control group in which the education process will be realized without the use of the hypertext didactic text.

Selection sample in the research

The research sample consisted of pupils from the 7th grade at elementary schools. In the research, there were included 12 control groups with total of 300 pupils and 12 experimental groups with total of 300 pupils. The control and experimental groups represented a sample with total of 600 pupils. On the basic list, there were 15 schools from the whole Slovak Republic. By the way of an accidental selection (drawing of lots), we chose 12 schools. At each school, we chose 50 pupils by the way of an accidental selection; further on they were divided (drawing of lots) into two groups – the experimental and the control. The control and experimental groups were equal concerning the indicators of a number and sex of the pupils. The pedagogic experiment was realized in the 7th grade of elementary school and no pupil repeated the grade. The reviewers' age was almost identical.

Statistically verification of hypotheses research

We were interested to find out what performances will the pupils achieve on the didactic test. Answering the questions on the test for the 7th grade correctly, the pupil could have gained maximum of 15 points of a gross score (gs) in the 7th grade. It is obvious already from the descriptive statistics (Charts 1, 2 and 3) that the 7th graders from the experimental group mastered the curriculum with a greater success than the pupils from the control group. The calculated arithmetic mean and decisive deviation were calculated on the reliability interval: the lower interval: -95%, the upper interval: +95%.

It is also possible to see from the Figure 1 that the acquired results in the experimental group were better than in the control group. The calculated arithmetic mean for the experimental group lies between 11.26 and 12.02 on the reliability interval; for the control group it lies between 9.17 and 9.96 on the reliability interval.

The variation span is determined by a minimal value of 3.5 and a maximal value of 15. We discovered that the acquired results among the pupils are divergent. It is possible to see from the Figure 2 that a medium value of the unit is equal

to 11 with the control group and to 12.5 with the experimental group. The quartile span represents an area of medium 50% of the values of variables; i.e. from 6 to 12.5 with the control group and from 10.5 to 14 with the experimental group.

By the way of a value analysis, we found out if these results are statistically significant. To be able to choose the right value analysis, we first of all needed to examine the presupposition on a normal division of probability of accidental errors. We examined the presupposition on a normal division of probability of accidental errors with the help of a histogram and also through comparison of variances of basic files. Both figures (Figure 3 and 4) are not unequivocally symmetrical and also the calculated variances are not identical (Chart 5). The variances of both files are not equal because 0.05 > 0.001737 (α > p value). On the basis of the established facts we decided to use a non-parametrical test, the Kruskal – Wallis test (Chart 4). We reject the zero hypothesis if $H \geq \chi^2_{1-\alpha(k-1)}$. For the significance level of $\alpha = 0.05$, a sphere of rejection is determined by the quantile of $\chi^2_{1-\alpha(k-1)} = \chi^2_{0.95(1)} = 3.841$[5]. It means that value of the test statistics lies in the sphere of rejection of the zero hypothesis. A conclusion follows from this observation that the performances achieved by the pupils in the control and experimental groups are statistically different. Also, the calculated p value is too small, thus we reject the zero hypothesis. Last of all, we may conclude that both H_1 and H_2 hypotheses were confirmed.

We have determined a phenomenal analysis of the tasks of the didactic test. On the basis of the phenomenal analysis of the tasks of the didactic test we have found out solution successfulness of individual components of the curriculum included in the didactic test. The tasks in the didactic test were weighted; we have calculated a total weighted score which is a weighted average of solution successfulness of the tasks in the didactic test. In the case of our final didactic test, the pupils have inadequately mastered the curriculum included in the tasks 6 and 9 (Chart 6) which the pupils solved with the average successfulness lesser than 60%. These are the tasks which solution demands a correct application of theoretical information and knowledge in typical school and problem tasks. When comparing successfulness of solution of the tasks among the 7th grade pupils in the control and experimental groups, it follows that the pupils from the experimental groups were more successful in task solving in comparison with the pupils from the control groups at all four education levels according to the Niemierko taxonomy (Chart 7 and 8). We have used the Kruskal – Wallis test to find out if the differences at the individual education levels were also statistically significant among the pupils of the control and experimental groups in the 7th grade. We give

[5] J. Chajdiak, E. Rublíková, M. Gudába, *Štatistické metódy v praxi*, Bratislava 1994.

the results in the Charts 9 to 12. We have found out that the calculated p value is too small, i.e. the hypotheses $\mathbf{H_{2.1}} - \mathbf{H_{2.4}}$ were confirmed for the significance level of $\alpha = 0.05$.

Chart 1. Descriptive statistics

			score	score	score	score	score
	Level of Factor	N	Mean	Std.Dev.	Std.Err.	-95%	95%
Total		600	10,60167	3,558431	0,145272	10,31636	10,88697
group	control	300	9,56333	3,500022	0,202074	9,16567	9,96100
group	experimental	300	11,64000	3,309619	0,191081	11,26397	12,01603

Chart 2. Descriptive statistics

Variables	A	Control group
Valid data	300	
Missing data	0	
Sum	2869	
Mean	9,563333	
Variance	12,25016	
Standard deviation	3,500022	
Variance coefficient	0,365984	
Standard error of mean	0,202074	
Upper 95% CL of mean	9,961001	
Lower 95% CL of mean	9,165666	
Geometric mean	8,805213	
Skewness	-0,2624	
Kurtosis	1,743843	
Maximum	15	
Upper quartile	12,5	
Median	11	
Lower quartile	6	
Minimum	3,5	
Range	11,5	
Centile 95	14,5	
Centile 5	3,5	

Chart 3. Descriptive statistics

Variables	A	Experimental group
Valid data	300	
Missing data	0	
Sum	3492	
Mean	11,64	
Variance	10,95358	
Standard deviation	3,309619	
Variance coefficient	0,284332	
Standard error of mean	0,191081	
Upper 95% CL of mean	12,01603	
Lower 95% CL of mean	11,26397	
Geometric mean	11,01388	
Skewness	-0,92298	
Kurtosis	2,721242	
Maximum	15	
Upper quartile	14	
Median	12,5	
Lower quartile	10,5	
Minimum	4,5	
Range	10,5	
Centile 95	15	
Centile 5	4,5	

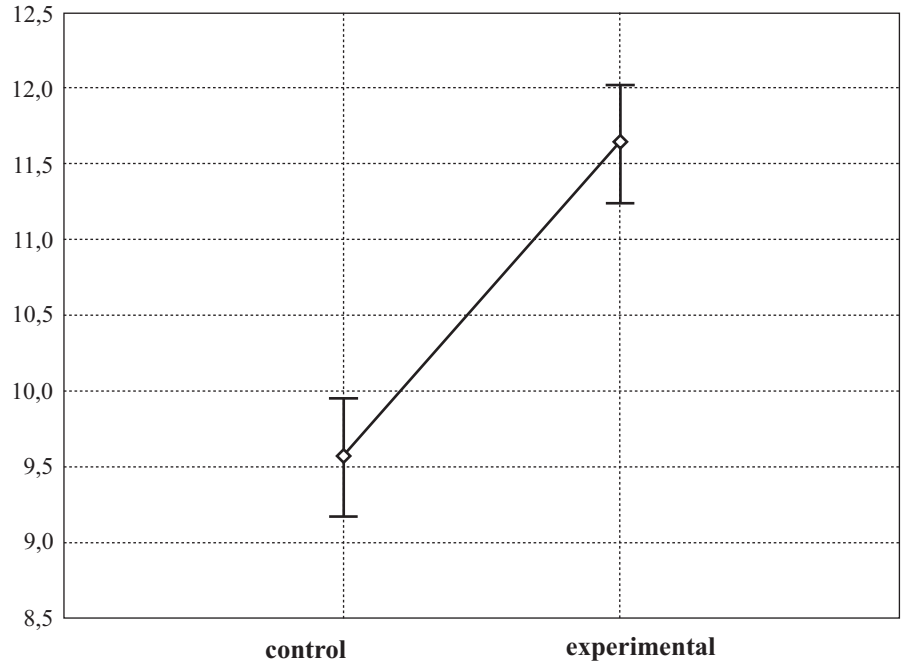

Figure 1. Comparison of results in the control and experimental groups

Chart 4. Kruskal – Wallis test

	control	experimental	Total	
<= Median: observed	191,0000	122,0000	313,0000	
expected	156,5000	156,5000		
obs.-exp.	34,5000	-34,5000		
> Median: observed	109,0000	178,0000	287,0000	
expected	143,5000	143,5000		
obs.-exp.	-34,5000	34,5000		
Total: observed	300,0000	300,0000	600,0000	
	Overall Median	df	Chi-Square	p
Median test	11,5	1	31,79971	0,0000
	Valid	Sum of Ranks		
control	300	73980,0		
experimental	300	106320,0		
	N	df	H	p
Kruskal-Wallis test	600	1	58,34968	0,0000

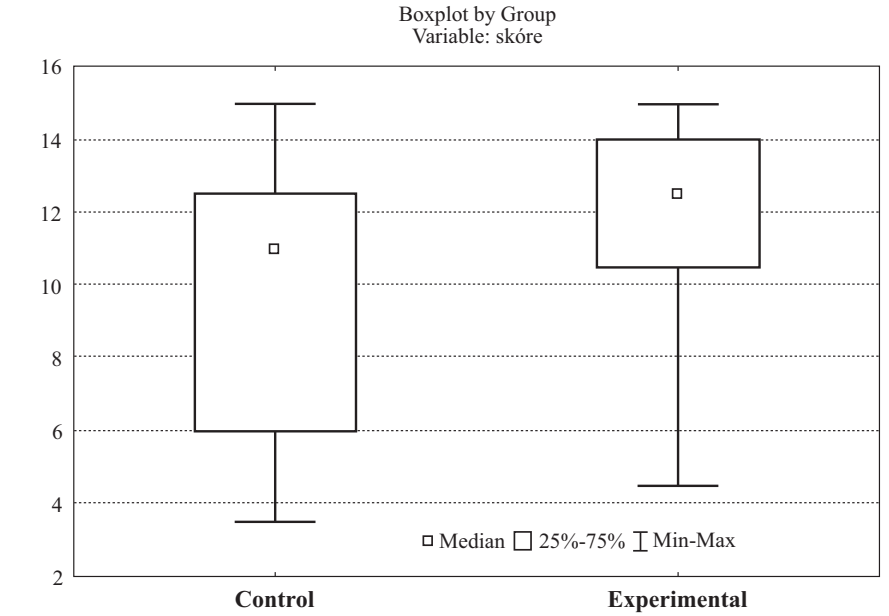

Figure 2. Boxplot by Group, Variable score

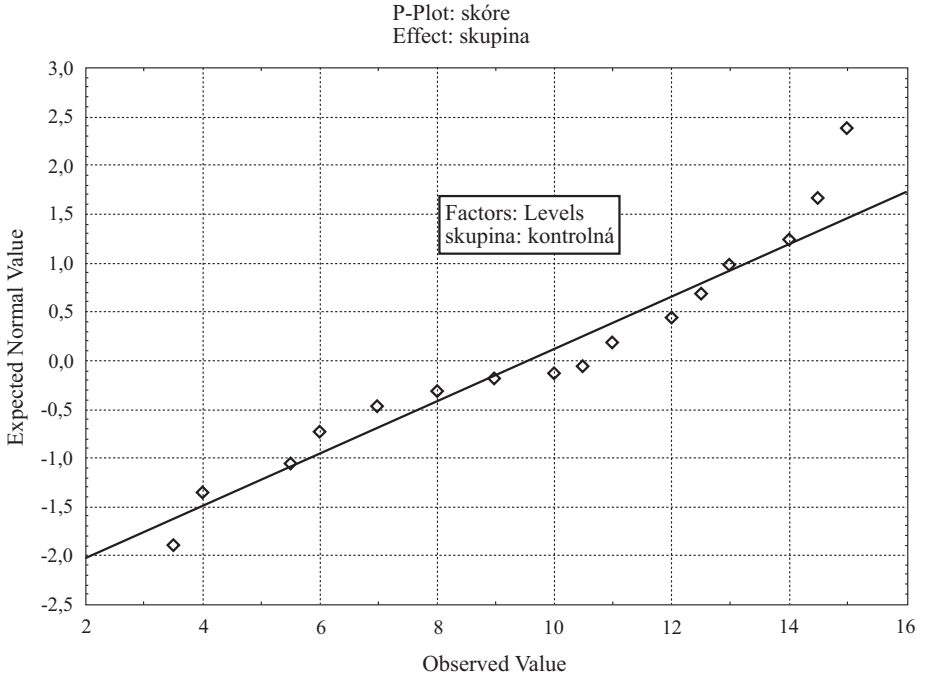

Figure 3. Normal division of probability of accidental errors in the control group

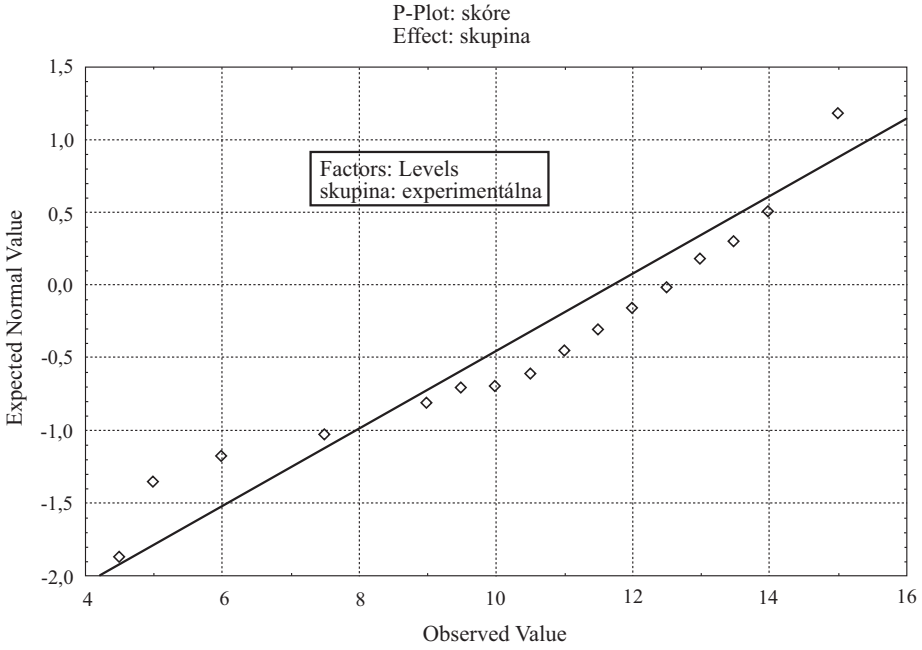

Figure 4. Normal division of probability of accidental errors in the experimental group

Chart 5. Levenov F-test

Levene's test	MS Effect	MS Error	F	p
Score	30,62752	3,094280	9,898111	0,001737

Chart 6. Phenomenal analysis of tasks in the didactic test

number of task	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***DT summary***	***Score P***
Max. score	1	1	2	1	1	2	1	2	3	1	**15**	
Σ	551	402	822	526	501	612	542	812	1021	572	6 361	
p i,j	91,8	67,0	68,5	87,6	83,5	51,0	90,3	67,6	56,7	95,3		**75,9%**

$\mathbf{P_{i,j}}$ – Percentage fruitfulness of solution tasks

Chart 7. Phenomenal analysis of tasks in the didactic test **(control group)**

number of task	*memo-rization* ***1,4,7,10***	*under-standing* ***2,3,5,8***	*specific transfer* ***6***	*non – spe-cific transfer* ***9***	***DT summary***	***Score P***
Max. score	4	6	2	3	**15**	
Σ	882	1112	298	577	2869	
p i,j	73,5	61,7	49,6	64,1		**62,2%**

$\mathbf{P_{i,j}}$ – Percentage fruitfulness of solution tasks

Chart 8. Phenomenal analysis of tasks in the didactic test **(experimental group)**

number of task	*memo-rization* ***1,4,7,10***	*under-standing* ***2,3,5,8***	*specific transfer* ***6***	*non – spe-cific transfer* ***9***	***DT summary***	***Score P***
Max. score	4	6	2	3	**15**	
Σ	994	1328	481	689	3492	
p i,j	82,8	73,7	80,1	76,5		**78,2%**

$\mathbf{P_{i,j}}$ – Percentage fruitfulness of solution tasks

Chart 9.

Kruskal-Wallis test
Variables: A, B. Groups A – control group, Groups B – experimental group (*memorization*)
Groups = 2
df = 1
Total observations = 600
H = 27,208996
P < 0,0001

Kruskal-Wallis: all pairwise comparisons (Dwass-Steel-Chritchlow-Fligner)
Critical q (range) = 2,771808

A vs. B	significant
(|7,864131| > 2,771808)	P < 0,0001

Kruskal-Wallis: all pairwise comparisons (Conover-Inman)
Critical t (598 df) = 1,963939

A and B	significant
(73,83 > 27,181452)	P < 0,0001

Chart 10.

Kruskal-Wallis test
Variables: A, B. Groups A – control group, Groups B – experimental group (understanding)
Groups = 2
df = 1
Total observations = 600
H = 31,137306
P < 0,0001

Kruskal-Wallis: all pairwise comparisons (Dwass-Steel-Chritchlow-Fligner)
Critical q (range) = 2,771808

A vs. B	significant
(|8,032412| > 2,771808)	P < 0,0001

Kruskal-Wallis: all pairwise comparisons (Conover-Inman)
Critical t (598 df) = 1,963939

A and B	significant
(78,98 > 27,08792)	P < 0,0001

Chart 11.

Kruskal-Wallis test
Variables: A, B. Groups A – control group, Groups B – experimental group (specific transfer)
Groups = 2
df = 1
Total observations = 600
H = 108,384384
P < 0,0001

Kruskal-Wallis: all pairwise comparisons (Dwass-Steel-Chritchlow-Fligner)
Critical q (range) = 2,771808

A vs. B	significant
(|15,469943| > 2,771808)	P < 0,0001

Kruskal-Wallis: all pairwise comparisons (Conover-Inman)
Critical t (598 df) = 1,963939

A and B	significant
(147,353333 > 25,1782)	P < 0,0001

Chart 12.

Kruskal-Wallis test
Variables: A, B. Groups A – control group, Groups B – experimental group (non - specific transfer)
Groups = 2
df = 1
Total observations = 600
H = 29,062556
P < 0,0001

Kruskal-Wallis: all pairwise comparisons (Dwass-Steel-Chritchlow-Fligner)
Critical q (range) = 2,771808

A vs. B	significant
(|8,070786| > 2,771808)	P < 0,0001

Kruskal-Wallis: all pairwise comparisons (Conover-Inman)
Critical t (598 df) = 1,963939

A and B	significant
(76,303333 > 27,137359)	P < 0,0001

Conclusion

We believe that we have succeeded in showing that the application of the hypertext didactic text to the education process is legitimate and brings a better efficiency of the results of teaching.

The analysis of the issue related to the teaching of the technical education at the 2nd level of elementary school cannot be considered complete and resolved because only the 7th grade has been reviewed. The issue and its proposed solution should be also extended to other grades after a careful analysis. If we want to educate a young generation for more demanding conditions well, we need to inculcate them with the technical culture from their childhood on; it needs to be done in adequate conditions. Our proposed, created and verified hypertext didactic text should precisely help to achieve that goal.

Summary

Question that will be solved in this paper, will be the utilization of hypertext educational material as a source, using which the effectiveness of education the technical subjects at the 2. level of primary school can be increased. As a comparison between reached results in the control and experimental groups of pupils we will use the final didactical examination, which will be evaluated using statistical methods. Via pedagogical experiment we will verify our hypotheses.

Technologia informacyjno-komunikacyjna w kształceniu technicznym

Streszczenie

Głównym tematem niniejszej pracy jest wykorzystanie hipertekstualnych materiałów edukacyjnych, które przyczyniają się do zwiększenia skuteczności nauczania przedmiotów technicznych w szkołach podstawowych drugiego stopnia. Do porównania wyników osiągniętych przez grupę kontrolną i wyników grupy eksperymentalnej wykorzystana została metoda eksperymentu pedagogicznego, który zostanie przeprowadzony za pomocą narzędzi statystycznych. Eksperyment pedagogiczny podda naszą hipotezę weryfikacji.