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Level practical skills of 7th grade pupils while working with technical material – metal

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Abstract

At the beginning of this article we characterize the current technological education in primary schools affected by the negative impact of school reform (2008–2012). We then further describe of the methodology of field of educational research: aims, methods, hypothesis and research sample. We analyze the main research tools: non-standardized educational practical tests and observation sheets. Based on statistical processing of the student results we verify the hypothesis of the research.

Key words: subject Technology, student, teacher, skills, wire, sheet metal, research problem, hypothesis, research analysis tools.

Introduction

Technology undoubtedly affects the quality of human life and is a fundamental condition for its present and future existence. It was always closely linked to human creative professional activity. Relationship to technology and understanding technology should be gradually developed within a framework of education at primary school, secondary vocational school, respectively at university of technical education.

The school reform implemented in Slovakia (2008–2012) most significantly affected the technical education at the second level of primary schools, which is part of general education elementary school students. The result of the reform is reduced time devoted to the subject of technology, restricted curriculum content compared to 1997, insufficient material and technical support of the subject, causing in the period of the reform, but also in the present a situation where the goals and challenges of technical education at the second level of primary schools did not fulfill. The consequence is a lack of interest by final year students of primary schools for teaching courses and technical specialization, which means that we currently have a lack of skilled specialists for various professions, not just a in technical field but as well in craftsmanship or Handicraft.

To increase the interest of students in technical education, it is important to pay much more attention to technical education in terms of its content, pupil motivation and in terms of new equipment especially at primary school. Equally important is to devote sufficient time to practical employment of students in the teaching of the subject Technology in lower secondary education.

Education on the subject of technology

The subject technology creates suitable conditions so that pupils can develop a basis of knowledge and know how to independently propose, operate, maintain and evaluate technical processes and systems. Exploring the relationship between the material, chosen work procedure, the ability of the pupil to have adequate occupational knowledge, skills and habits allows you to get premise alone to organize their work, find original solutions and new relationships [Šoltés 2012].

Since 1. 9. 2011, the entry into validity of revised public education program (introduced into education by the school reform in 2008), the subject Technology It is taught in lower secondary education with a time subsidy of one hour per week, where the specified time allocated is not tied to a specific year. It also includes covered by a framework curriculum for primary schools (primary school).

We do not have to be an expert to really be able to conclude that the practical work of students at primary schools is an essential part of technical education. In order to have students interested in practical action, to adopt good work habits, practical skills in working with technical material, and consequently making quality products with good aesthetic design, they must be sufficiently acquired with theoretical knowledge in this field. Unless students have essentially adopted the theory of machining various engineering materials, there is little expectation that the workflow production of any product will proceed correctly. Mismanagement of theoretical knowledge may lead pupils to demotivation, because in the manufacture of the product they will meet with the challenges that they will not be able to solve. Making or completing a product by the pupils will then become impossible. The issue of acquisition of practical skills of students when working with metal became the target for the implementation of our educational research.

Methodology of empirical research

The school reform (2008–2012) very significantly affected the technical education at secondary level schools, which is part of the education of primary school pupils. The low time allowance of the subject Technology does not allow teachers to devote enough attention to theoretical aspects of teaching this subject, and neither does it offer space for practical work activities of students. That

results in a lack of interest by final year students of primary schools to go study at secondary vocational schools in the technical field. Our intention is to find out to what extent were the established educational goals fulfilled in the 7th grade of primary school in the subject Technology, specified in the education and performance standards, and what is the level of the practical skills of students.

The goal of the educational research was to verify the level of the acquired and adopted practical skills of students in the subject of technology in the 7th year of primary school, which paves the way for future career choices focusing on professional courses at vocational school.

From the main goal of the research we obtained the following tasks:

- Analyze the basic pedagogical documentation (content and performance standards NEP, general curriculum, thematic educational plan in the 7th grade of primary schools in the subject Technology, a textbook for the subject Technology)

- Analyze its content to the thematic range of materials and technologies within the scope of the subject Technology in 7th grade of primary schools with a focus on working operations and practical skills and habits of the students.

- Propose practical non-standardized educational tests for basic matters covered by the thematic range of materials and technologies in the subject technology in 7th grade of primary schools. Part of the practical achievement test will be observation sheets for recording the occupational activity of students.

- Analyze the results of non-standardized educational tests quantitatively and qualitatively, specify the causes of the condition and formulate conclusions.

From the issue, based on the objective and tasks of research, we created a hypothesis which we verify using statistical methods. which will be verified by statistical methods.

Hhypothesis of research

H: The achieved performance of students in solving practical test in the thematic area Materials and technologies in the subject of Technology in the seventh year of primary schools does not meet the set performance standards. There will be a statistically significant difference between the pupils achieved performance amd the required standards.

Variables in the research

Based on the formulation of the research problem, we conducted the educational research ex-post-facto, where we watched the dependent variable – y:

- the performance of students in solving practical tests of the thematic areas Materials and Technologies – further in the analysis of results referred to as **VYP**.

Intervening variables that will not change in the course of the research:

- substantively identical non-standardized teaching practical tests for all pupils,
- the same material and technical conditions for all students to solve problems in practical tests.

The subject of our research are 7th grade pupils of primary schools a their performance in the thematic area Materials and technologies – metals in the subject of Technology.

Research methods

To explicitly confirm or refute the hypotheses set, we used the following methods and research procedures:

- literary method, content analysis method,
- non-standardized educational practice tests DPT 1 for working with wire and DPT 2 for working with sheet metal, assembled non-standardized observation sheets PH,
- monitoring the performance of students,
- for the procesing of the research results and verification of the hypothesis H we used the normality Shapiro-Wilk test: W and chi-squared test of conformity: χ^2 .

Research sample

To achieve the full research and objective results, we opted for a deliberate choice of a representative set, because the participating schools had to meet the following requirements:

- fully organized primary school situated in the territory of Banská Bystrica region (hereinafter BBR)
- teaching at primary school in Slovak language,
- the subject technology must be taught by a qualified teacher,
- schools must have special classrooms for the subject Technology,
- thematic area of materials and technology taught in the 7th grade,
- time allowance for the subject technology in the 7th grade must be 1h/week.

The total research group consists of seven schools and 212 7th grade pupils. In the table no. 1 we present accurate representation of students from various schools in research. For ethical principles of the research, we used the following indication for individual schools, which are further numbered:

- city primary school – CPS,
- rural primary school – RPS.

The educational research was conducted in the direct environment of primary school in the school year 2014/2015.

Table 1. Number of students in individual schools

School	Sex		together Σ
	Girls	Boys	
CPS 1	14	24	38
CPS 2	22	19	41
CPS 3	39	29	68
RPS 1	12	9	21
RPS 2	15	12	27
RPS 3	2	8	10
RPS 4	1	6	7
Together Σ	105	107	212

The analysis non-standardized practice tests and their assembled observation sheets

To determine the level of their skills in the thematic area Materials and technologies – metals from the subject of technology, we have created a practical non-standardized educational tests – (DPT 1, DPT 2).

These practical tests can be from a didactic classification standpoint marked as:

- non-standardized, psychomotor, outgoing, objectively scorable, verifying – CR achievement tests.

To ensure a high content validity of didactic test, the tests evenly covered the basic subject matter set by educational standards.

To illustrate, we briefly describe the various non-standardized educational tests and their practical compiled observational sheets:

DPT 1 – this practical test was aimed at finding practical skills of students when working with wire. Students passed the test individually under our supervision in laboratories - school workshops. On the desk were stacked all the necessary tools, tools and equipment that were necessary to the execution of individual work operations. The test consisted of five tasks aimed at straightening thin wire, its measurement and outlining, cutting and possible adjustment of the cut ends – by sawing, and bending to sharp and rounded shapes in DPT 1 the pupils could by achieving the right solution earn a maximum of 30 points. The test time was set at 20 minutes.

DPT 2 – This practical test was aimed at finding practical skills of students when working with metal. Students passed the test individually under our supervision in laboratories – school workshops. On the desk were stacked all the necessary tools, tools and equipment that were necessary to the execution of individual work operations. The test consisted of four tasks aimed at straightening sheet, its measurement and outlining, cutting and possible adjustment of the cut edges – sawing and bending into sharp shapes. In the DPT 2 the pupils could earn up to 38 points. The test time was set at 20 minutes.

Scoring of tasks in the practical tests was as follows: each practical task has been compiled to include different working operations with a given material. The right solution to the problem could earn the students a maximum of 12 points. We evaluated the proper implementation of work operations, partially correct, but also incorrect implementation work operations which we observed and recorded. When scoring the tasks, DTT and DPT, we used the binary scoring, but also a multi-stage scoring.

Monitoring the activity of the pupils

For the recording of the practical work of students in the implementation of teaching practice tests we construct a non-standardized observation sheet PH 1, PH 2 for DPT 1, DPT 2 to the content of the curriculum.

PH 1 – observation sheet corresponding with DPT 1. For each work operation there was option to mark the right or wrong approach of the operation carried out by pupils by using the correct or incorrect aids.

PH 2 – observation sheet corresponding with DPT 2. For each work operation there was option to mark the right or wrong approach of the operation carried out by pupils by using the correct or incorrect aids

Verification of the hypothesis H

H: The achieved performance of students in solving practical test of the thematic areas Materials and Technologies in the subject of technology in the seventh year of primary schools does not meet the set performance standards. To the detriment of the pupils' performance, there will be a statistically significant difference between the set requirements and the achieved performance of pupils.

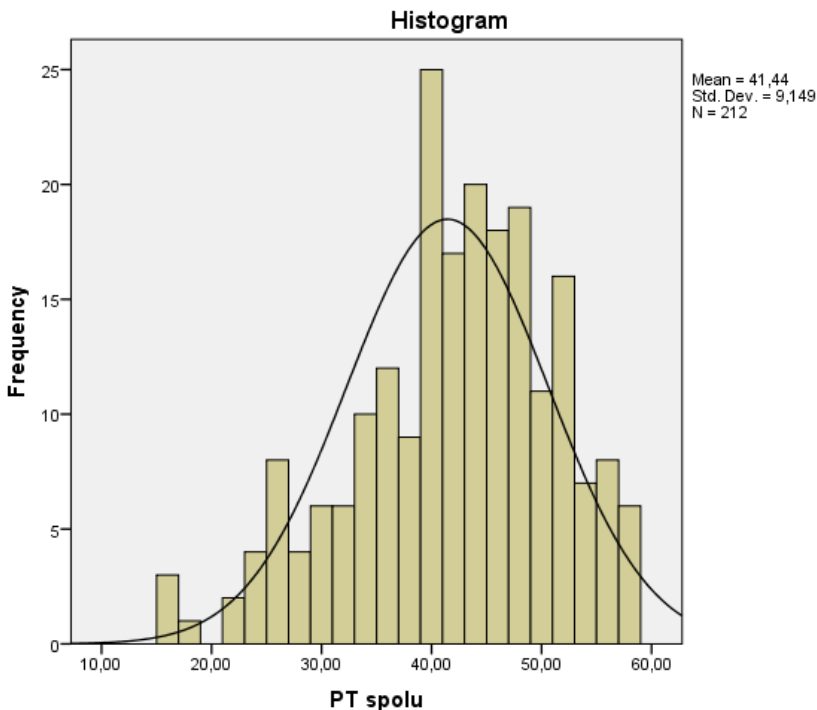
The practical skills of students of the thematic area Materials and Technologies – metals, were tested by non standardized didactic practical tests. To verify the skills in crafting wire we used DPT 1 and DPT 2 for working on sheet. For the verification of hypothesis H we added together the test results and on the basis of descriptive statistics we present these results in Table 2.

Table 2. Descriptive statistics on the results of students in solving DPT 1 and DPT 2

Variable	Average value	Error of the average value	Median	Modus	Standard deviation	Sampling variance	Spread	Minimum	Maximum	Sum of points	Count
VYP	41,44	0,63	42	47	9,15	83,71	42	16	58	8786	212

From the table above we can conclude that the average number of points in DPT 1 + DPT 2 is 41.44 from the total of 70. Modus (most frequently occurring unit of achieved results) is 47 points. The intermediate value the results achieved is 42 points (median). The minimum value achieved by pupils in the test is 16 points where the maximum is 58 points. We can also conclude that from the entire research set, none of the students had a minimal number of points (0 or 1) and also none of the students achieved the maximum number of points (69 or 70).

Because of the expansiveness of the scoring we do not provide a frequency charts (table of frequencies) in practical tests but instead we present the students achieved score in DPT 1 + DPT 2 by the help of a histogram (graph 1).



Graph 1. Histogram of frequencies achieved scores of students in DPT 1 + DPT 2

From the histogram view it may seem that the results of the score, the DPT 1 + DPT 2 have a normal distribution. So that we can reassure ourselves in the data normality, we have chosen the Shapiro-Wilk test. The null hypothesis of normal distribution of data was as follows:

H_0 : The random variable **VYP** (PT together, thus DPT 1+ DPT 2) comes from a core set of normal distribution.

Table 3. Normality test of achieved scores of students in DPT 1 + DPT 2.
Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PT spolu	,088	212	,000	,974	212	,001

a. Lilliefors Significance Correction

Table no. 3 shows that the calculated value of the test criteria W is 0,974. Normality verification of distribution of the variable VYP is indicated on the basis P-values. The calculated P-value of 0.001 is less than the chosen significance level $\alpha = 0,05$. Based on a comparison $P < \alpha$ **the null hypothesis of normal distribution of the variable VYP rejected and we say that the variable VYP does not come from a core set of normal distribution.**

For the statistical verification H we have subsequently chosen chi-square goodness test. Here we inserted the performances of students from practical tests in certain categories. Table 4 indicates the frequency of how many students received full score in the categories DTT 1 + DTT 2.

Table 4. The real frequency of pupils of categorical distribution and achieved score in DPT 1 + DPT 2

Category	Task in DPT 1	Task in DPT 2	Max. points	Real frequency <i>P</i>	Expected frequency <i>O</i>
Compensation materiálu	1	1	12	93	212
Measurement and outlining	2	2, 3	20	103	212
Material cutting	3	3	12	152	212
Sawing	3, 4	3	8	116	212
Bending	5	4	18	109	212

Since we are comparing whether the pupils acquired practical skills meet the requirements set out in the performance standards for the subject Technology, the points score of pupils in the various roles we categorized according to work operations in metalworking. The requirements set out in the performance standards are expressed by using the score. Since the standard prescribes minimum requirements for pupils, which successful fulfillment will allow the pupils to advance to the next stage of education, realistically, all pupils should achieve the highest points score.

Table 5. The value of the test criteria χ^2 for DPT 1 + DPT 2
Test Statistics

	PT test body
Chi-Square	18,387 ^a
Df	4
Asymp. Sig.	0,001

Also in this hypothesis, we selected the chi-square test as a test criteria. Table no. 5 shows the number of categories in the theory tests $k - 1 = 4$.

If we take the average expected numbers of students and hypothesis H testing of the criterion χ^2 , the null hypothesis would read as follows:

H0: The expected frequency and the real frequency of pupils who have reached their maximum point score DPT 1 + DPT 2 is the same.

Calculated value χ^2 given in table. 5 = 18,387. The critical value declared by the level of significance $\alpha = 0,05$ and a degree of freedom $k - 1 = 9,488$. After comparing the calculated value and the critical value: $18,387 > 9,488$, the null hypothesis H0 is rejected on the clarity of the significance level $\alpha = 0,05$.

**Table 6. Significance DPT 1 + DPT 2
Hypothesis Test Summary**

	Null Hypothesis	Test	Sig.	Decision
1	The categories of PT test body occur with the specified probabilities.	One-Sample Chi-Square Test	,001	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

The null hypothesis we rejected on the P-value = 0,001 (table 6), which is less than the chosen significance level $\alpha = 0,05$, which indicates a statistical significance scores of points in the pupil DPT 1 + DPT 2. Of the above-it follows the validity of the hypothesis and conclude that **H was confirmed. The achieved performance of students in solving practical test of the thematic areas *Materials and Technologies* in the subject technology in the 7th year of primary school does not meet the performance standards set. The resulting capacity of students and requirements is a statistically significant difference to the detriment of pupils' performance.**

The statistical significance of the lack of practical skills of students from the working of metals justify a deeper qualitative analysis of the results of DPT 1 and DPT 2.

Student performance in dealing with DPT 1 – working with wire:

– The correct procedure of balancing the thin wire with a \varnothing 1,2 mm were unable to implement up to 49% of pupils. Many pupils tackled by wire is clamped in a vise between drawing pads and potential offset by locksmith hammers and anvils, but only straightened wire in the hands clung to or more times in a vise. With these results, it is very difficult to state which is a consequence.

– When measuring a drawing wire progressed 62% of pupils wrong: the measurement used by pupils instead of steel gauge plastic ruler, pupils could not work with the zero mark on the steel scale, eye pupil and scale interval were

observed in a plane perpendicular to the surface of the scale. When drawing pupils instead of using pencils, markers or not parking, only attached a finger to the approximate dimensions of rest of the wire straight cuts down. Here it can be assumed that the teacher will not consolidate enough work habits with the help of proper work tools and equipment. A common error was the deposition of incorrect dimensions pupils, but 250 mm, but 205 mm, 215 mm, or 25 mm, which shows a lack of students and mathematics.

– Decoupling the remaining wire with cutting pliers mastered by almost all pupils, only 4% of pupils separated the remaining part of the wire using hand shears or scissors for paper. For operation with the pupils biggest problem with the adjustment wire at the ends of the cut down, since only 28% of the students this work operations are carried out correctly. From the above we can conclude insecure proper work habits among pupils and teachers underestimation of non-compliance and safety.

– Shaping wire in sharp shapes according to technical drawing mastered 67% of pupils. The most frequent errors were failure to comply with the dimensions from a technical drawing, inaccurate observance of the right angles, pupils not drawing a rectangle, but rhomboid, or other undefined shape. It can be stated, that in this case teachers with pupils thoroughly not teach technical documentation which is the basis for the production of student products. Teachers just a little sensitive to the aesthetic treatment of the product, important for them is to manage individual work operations.

– Shaping wire into round shapes (spring) using wooden preparation mastered almost all pupils, although it should be noted that some students place a wooden hammer handle preparation used. But also they created a spring. Only two students were not able to construct the spring.

Student performance in dealing with DPT 2 – working with metal:

– The correctly procedure balancing sheet with a thickness of 1 mm were unable to implement up to 53% of pupils. Many students tackled by plate wooden hammer on the anvil with a catering plate up, but used for sheet metalwork hammer turned the sheet down to cater or plate tackled by the anvil, but on the desk who had an uneven surface. Some students cope plate clamped in a vise or simply in his hands. These results are due not exercises and unfastened the working operations pupils on training work. Probably teachers devote little time to the working operation.

– When measuring a sheet drawing progressed 65% of students incorrectly. When measuring pupils used instead of steel gauge plastic ruler, pupils could not work with the zero mark on the steel scale. When pupils drawing, instead of scribe used pencils, drawing dimension across the width of the sheet or drawing diagonal or not drawing only to attached the finger of a approximate dimensions

and cuts down the rest of the sheet. Here it can be assumed that the teacher will not consolidate enough work habits with the help of proper work tools and equipment.

– The distribution plate into two equal halves using hand shears mastered almost all pupils. Only 9 pupils plate not divide. Students have cut sheet largely outside drawing lines, a few millimeters either side lines or have cut crooked. Only 13 students after it cuts straight drawing line. Here it is clear that the hand shears are great tools for students and therefore most students held wrong – at the beginning or in the middle handles. Also, students did issue a blank for the primary material in which it was sometimes necessary assistance to the researcher. To facilitate this step only the number of students UPLO plate in a vice and then cut it. Since it was cutting the sheet for pupils hardest work operations for working on sheet metal, some students more time to trim the sheet and thus the separation of the edges created sharp, pointed to trim. In these cases, we had a replacement ready to slit plate so that they can continue to test students, but primarily because of compliance with OSH.

– Adjustments to the separate edges after rupture implemented to 71% of pupils. Other students either filing modified sheet metal corners into arcs or not filing. From the above we can conclude insecure proper work habits among pupils and teachers underestimation of the principles of safety at work.

– Marking the center of one sheet mastered almost all pupils. We regret to see that mark the center of the sheet using the punch they knew only three students. We noted, however, that all three pupils used a punch properly. Marking the centre of other students have several options for example. middle tagged estimate, the center determine the division ratio in half drawing or drawing diagonal sheet. On the label used in most cases a pencil, then scriber needle.

– When sheeting at a right angle or a student who did not use protective pads between the jaws of the vise and sheets. Half of the plate to said measuring only 5 students. Most pupils when bending sheet metal used wooden hammer. However, we must state that not all students use a hammer properly, because some students held him in the middle of the handle. Correctness of bend (angle) check the metal bracket only 4 pupils. It concluded that a right angle bend knew sheet only 12% of pupils. Most pupils bent sheet into smaller or greater angle than the right angle. And yet there were also 10 students who work operations that take place. In this case, obviously, teachers do not use a metal bracket when performing an operation or not perform work operations where the required angle. This in turn affects the ignorance, disability and working inconsistency students.

Close

Students of 7th year at primary schools in Slovakia have insufficient practical skills in basic metalworking hand. They weakly adopted or not adopted at all elementary working operations, improper use work tools and equipment do not comply with safety at work not cleaned working tools to its original position, can not work with the technical documentation and have shortcomings when applied knowledge of mathematics, which has an impact on application correct dimensions for the material. It is therefore important that teachers of a technique for primary school students consistently taken over the thematic area of materials and technology should pay attention to good and proper adoption and strengthening working skills of pupils in the upper years to be applied of the creation of more demanding products.

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