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The level of students technical knowledge – survey results

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Abstract

The necessity of the universal technical education of the youth, understood as providing them with the basis for technical culture, is a consequence of a widespread and still growing importance of technology in all domains of contemporary life.

In the face of modern technical culture requirements, present day education cannot be limited to acquiring manual skills. It should at the same time ensure gaining basic technical knowledge and developing technical thinking and interests [Depešová 2011: 51–57; Piecuch 2008].

Children and teenagers should be prepared to receive and apply technical knowledge in everyday life. The grounds for that are laid by school, but it should be accompanied by other cultural and educational institutions, and by family [Depešová, Knych, Noga 2014: 59–64; Furmanek 2006: 33–48; Hrmo, Kundratowa, Tinakova 2005].

Forming children's and teenagers' technical interests is a matter of the utmost importance. Hence the necessity to coordinate the efforts of all educators in order to encourage students to acquire knowledge independently and to take an active part in an educational process organised by school. Such a process requires from students the practical usage of mental work methods. The knowledge about technology should systematically be updated because of a dynamic scientific and technical development or due to new technologies. This study shows selected survey results of students' technical knowledge on three different educational stages in Poland [Hašková, Pisoňová, Bitterová 2011; Kozík, Depešová 2007; Nazar 1973].

Key words: technical education, evaluation, the level of knowledge.

The methodology of the author's own research

The following study examines the level of students' knowledge on three educational stages in Poland. The surveys were conducted among second grade students of middle, secondary and secondary technical schools. The research analysed students' opinions, schools documentation and the survey results of

students' knowledge, and it was carried out among 106 students chosen at random in May 2015. Before undertaking the survey the respondents were informed about its purpose and took part in it voluntarily. They received additional information about filling in the survey questions and were reassured about the anonymity of the gathered data.

The survey took place in:

1. General Education School Complex in Tarnów (Middle School and Secondary School).
2. Power Engineering School Complex and Secondary School in Kraków.

Among 106 students there were 40 second graders of the Middle School, 32 second graders of the Secondary School, 34 second graders of the Secondary Technical School.

The examined teenagers aged between 15 and 18 years old in a huge majority came from cities where, as it is commonly known, the conditions for developing any interests, including the technical ones, are better. The house facilities and the conditions for developing knowledge and interests by the youth are good.

The survey includes 20 categories from various technical domains adapted to the technical subjects curricula. Each of the categories consists of 5 more detailed issues. Evaluation of the respondents answers was based on a three-level scale: complete or incomplete knowledge, and the total lack of it.

Before choosing the right terms, technical curricula in the above mentioned schools were analysed. To adapt the definitions to students' individual possibilities, the scope of knowledge in electronics, physics, mechanics, electrical engineering, materials science and theory of machines, were taken into consideration. The survey results are presented in Chart 1.

Chart 1. The level of technical knowledge among students of the school types under examination

Question number	**School type**									Total
	Number of students									
	Responses									
	Middle			Secondary			Secondary technical			
	Complete	Incomplete	Lack	Complete	Incomplete	Lack	Complete	Incomplete	Lack	
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1	1	17	22	7	17	8	15	18	1	106
2	6	21	13	11	16	5	23	11	0	106
3	2	25	13	8	21	3	17	17	0	106
4	2	15	23	9	17	6	23	11	0	106
5	1	27	12	6	25	1	18	16	0	106
6	1	22	17	4	17	11	12	20	2	106

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
7	0	15	25	11	19	2	13	21	0	106
8	0	12	28	9	19	4	20	14	0	106
9	3	19	18	7	22	3	22	12	0	106
10	2	16	22	7	22	3	10	22	2	106
11	0	25	15	7	21	4	9	21	4	106
12	0	16	24	14	15	3	14	20	0	106
13	0	21	19	2	14	16	8	25	1	106
14	2	20	18	8	16	8	26	8	0	106
15	2	15	23	8	15	9	28	6	0	106
16	4	9	27	7	20	5	17	17	0	106
17	4	14	22	8	20	4	23	11	0	106
18	0	20	20	7	14	11	13	21	0	106
19	0	15	25	1	9	22	6	22	6	106
20	0	9	31	2	9	21	14	19	1	106
Total	30	353	417	143	348	149	331	332	17	2120

Having done the research one can observe that the answers of most middle and secondary school students surveyed are unsatisfactory and the level of their knowledge is mediocre. The middle school students were unable to give thorough definitions for most of the terms, although the majority of boys gave complete responses. Such a lack of knowledge seems strange since the vast majority of terms is encountered by students on everyday basis. What is more, many definitions are misunderstood, which leads to numerous mistakes. Out of 40 respondents, only 2 could define "threading", only 4 named correctly "slide caliper" and "vise", and just 6 of them knew what a "solar cell" is. Altogether just 15 terms, including a "loudspeaker", "alternator", and "battery" were explained completely, and the students had no problems with them. The survey results are presented in Chart 2.

Chart 2. The level of technical knowledge among middle school students

Question number	**School type**									Total
	Middle									
	Number of students									
	Responses									
	Girls			Boys			Total			
	Complete	Incomplete	Lack	Complete	Incomplete	Lack	Complete	Incomplete	Lack	
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1	0	9	15	1	8	7	1	17	22	40
2	4	12	8	2	9	5	6	21	13	40

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
3	1	12	11	1	13	2	2	25	13	40
4	1	9	14	1	6	9	2	15	23	40
5	0	16	8	1	11	4	1	27	12	40
6	0	11	13	1	11	4	1	22	17	40
7	0	9	15	0	6	10	0	15	25	40
8	0	6	18	0	6	10	0	12	28	40
9	1	9	14	2	10	4	3	19	18	40
10	1	5	18	1	11	4	2	16	22	40
11	0	16	8	0	9	7	0	25	15	40
12	0	9	15	0	7	9	0	16	24	40
13	0	16	8	0	5	11	0	21	19	40
14	0	8	16	2	12	2	2	20	18	40
15	0	4	20	2	11	3	2	15	23	40
16	0	5	19	4	4	8	4	9	27	40
17	0	9	15	4	5	7	4	14	22	40
18	0	8	16	0	12	4	0	20	20	40
19	0	8	16	0	7	9	0	15	25	40
20	0	5	19	0	4	12	0	9	31	40
Total	8	186	286	22	167	131	30	353	417	800

As presented in Chart 3 below, the level of technical knowledge is higher among secondary school students. There are more answers which are complete. 11 students already knew what a “solar cell” or an “electric circuit” mean. Almost one third of the students are familiar with the term “voltage.”

Chart 3. The level of technical knowledge among secondary school students

Question number	**School type**									Total
	Secondary									
	Number of students									
	Responses									
	Girls			Boys			Total			
	Complete	Incomplete	Lack	Complete	Incomplete	Lack	Complete	Incomplete	Lack	
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1	1	10	6	6	7	2	7	17	8	32
2	5	8	4	6	8	1	11	16	5	32
3	5	12	0	3	9	3	8	21	3	32
4	1	11	5	8	6	1	9	17	6	32
5	2	14	1	4	11	0	6	25	1	32
6	0	7	10	4	10	1	4	17	11	32
7	5	11	1	6	8	1	11	19	2	32

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
8	4	12	1	5	7	3	9	19	4	32
9	3	12	2	4	10	1	7	22	3	32
10	2	12	3	5	10	0	7	22	3	32
11	1	12	4	6	9	0	7	21	4	32
12	7	9	1	7	6	2	14	15	3	32
13	0	6	11	2	8	5	2	14	16	32
14	1	9	7	7	7	1	8	16	8	32
15	2	6	9	6	9	0	8	15	9	32
16	3	10	4	4	10	1	7	20	5	32
17	1	12	4	7	8	0	8	20	4	32
18	0	8	9	7	6	2	7	14	11	32
19	0	3	14	1	6	8	1	9	22	32
20	0	2	15	2	7	6	2	9	21	32
Total	43	186	111	100	162	38	143	348	149	640

The number of incomplete answers, as compared to the total lack of knowledge, was also higher. The respondents still find it difficult to explain a “pneumatic drill”, “milling-machine”, or “hardening”. However, their biggest problem is to define what a “transformer” means. There was only 1 students who knew the answer. It is worth emphasising, though, that boys have considerably smaller difficulties with giving the words definitions, than girls. It is probably due to the fact that at this stage of education boys are far more interested in technology than girls, which was proved by the survey (Chart 3).

Chart 4. The level of technical knowledge among secondary technical school students

Question number	**School type**									Total
	Secondary									
	Number of students									
	Responses									
	Girls			Boys			Total			
	Complete	Incomplete	Lack	Complete	Incomplete	Lack	Complete	Incomplete	Lack	
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1	0	3	1	15	15	0	15	18	1	34
2	2	2	0	21	9	0	23	11	0	34
3	1	3	0	16	14	0	17	17	0	34
4	0	4	0	23	7	0	23	11	0	34
5	1	3	0	17	13	0	18	16	0	34
6	0	2	2	12	18	0	12	20	2	34
7	1	3	0	12	18	0	13	21	0	34

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
8	2	2	0	18	12	0	20	14	0	34
9	3	1	0	19	11	0	22	12	0	34
10	0	2	2	10	20	0	10	22	2	34
11	0	3	1	9	18	3	9	21	4	34
12	2	2	0	12	18	0	14	20	0	34
13	0	3	1	8	22	0	8	25	1	34
14	0	4	0	26	4	0	26	8	0	34
15	1	3	0	27	3	0	28	6	0	34
16	2	2	0	15	15	0	17	17	0	34
17	2	2	0	21	9	0	23	11	0	34
18	0	4	0	13	17	0	13	21	0	34
19	0	1	3	6	21	3	6	22	6	34
20	0	3	1	14	16	0	14	19	1	34
Total	17	52	11	314	280	6	331	332	17	680

Chart 4 shows that the secondary technical school students have much broader technical knowledge than middle and secondary school students. It is most probably due to the bigger number of technical subjects in schools curricula. The respondents have no problems explaining the terms which are of everyday use to them, like “welding, “soldering” or “vise.” One can observe a considerable increase in complete (17 among girls and 314 among boys) and incomplete (52 among girls and 280 among boys) answers. There still occurs an occasional lack of responses, but boys no longer predominate over girls. One may thus conclude that what helps in explaining technical terminology are students’ previous experiences, interests and practice which is obligatory for secondary technical school students. What is also useful are various magazines, books, and other sources of technical knowledge, including the Internet.

The above research analysis leads me to the conclusion that the level of students’ technical knowledge increases together with their age, and it mostly depends on a type of school the students attend. The knowledge of certain technical issues at the middle school stage is very superficial. Then, at the secondary school stage it is slightly bigger, and in secondary technical school it reaches a satisfactory level. It needs to be emphasised that, if in middle and secondary school the predominance of boys over girls in the respect of technical skills is significant, in secondary technical school it is almost unnoticeable.

Conclusions

In the light of survey analysis conducted it is possible to answer the questions raised in its methodological part:

1. The research revealed various levels of students’ technical interests. Most interested in technology are secondary technical school students due to the

fact that they previously chose such kind of interests, which they develop in their schools. Almost all respondents, boys and girls alike, even though the latter are definitely in minority in technical classes, said they are very interested in technology. However, in middle and secondary schools, technology is of average interest to the students, and the predominance of boys over girls in this respect is clearly visible.

2. It is out of the question that teenagers' technical thinking needs to be developed as it constitutes a crucial element of a modern technical culture. Undeniably, a leading role in this process is attributed to broadening technical interests. Their appropriate development, based on valuable teaching materials, suitable teaching and learning methods which trigger students' mental activity and provide them with possibilities to practise their cognitive skills, lets them acquire the ability of technical thinking. It will manifest itself, among others, in a capability of analysing problematic situations, applying rational methods to solve technical problems, in a considerable correctness and variety of solutions, as well as the ability to justify them.
3. Students acquire their technical knowledge from various sources. In all of the school types chosen for the above study the most popular are the Internet and television. Books have lost their importance because of their difficult, inaccessible language, similarly to magazines. There is a slight interest in the latter ones, biggest in secondary technical schools, smallest in middle schools. Additional sources of knowledge mentioned by students were notebooks, teachers, fathers and friends.
4. Students are aware that knowledge passed during technical lessons will have practical implications in their lives. The number of respondents who apply their theoretical skills in practice grows with their age. It is obviously highest in secondary technical schools, where, to pass a given subject, students need to undertake an obligatory practice in different work places. It provides them with necessary experience and expands their knowledge on how to deal with particular situations of everyday life. Girls put their skills into practice to a noticeably smaller extent than boys.

Teaching technical subjects should ensure teenagers' acquiring basic technical knowledge understood as complete work means and ways of applying them to change the reality. It should also allow to understand general directions of science and technology development in the country and all over the world [Kozík, Depešová 2007; Nazar 1973].

The above presented outline of the survey results as well as the main conclusions lead to a number of demands addressing the content of technical education in schools:

1. The content and functions of the educational process should be unified, which means choosing such educational content that would develop students' appropriate skills, especially their independent thinking and acting, so that

such a development would have a profitable influence on assimilating the technical knowledge.

2. The content of technical lessons should ensure students' knowledge of the main methods and techniques used in typical production branches, as well as their understanding of commonly encountered technical processes.
3. When choosing the content for teaching, what should be taken into consideration are current and prospective needs of a given society, technical status quo and its prospective progress, technical activities development, among which the foremost place is taken by the most important issue of developing technical thinking.
4. The content should be chosen and presented in a way allowing students to acquire both the scientific regulations and technical rules.

In the light of the requirements discussed above, enriching the content of technical subjects, as compared to the present curricula, and preparing a more modern curricula in the future, should head towards a visible intellectualism of technical classes, especially in combining teenagers' practical activities with suitable theoretical knowledge [Vargová 2014]. It is necessary e.g. because in the era of increasing scientific and technological revolution the practical preparation, not supported by any thorough theoretical knowledge, has a very limited value, not to mention its being one-sided, which considerably weakens the youth's cognitive and developmental abilities. It should thus go without saying that students must assimilate basic technical knowledge mainly during technical classes which should be based on the teaching content that takes into consideration the above mentioned rules of its selection and distribution [Słomkiewicz 1966].

From the very beginning of their stay in schools children and teenagers should be prepared to receive and consequently apply technical knowledge in everyday life. It gains more and more importance, especially in the times of a modern, dynamic scientific and technological development. Expanding in students the ability of technical thinking, we cater for everyone's good, because above all we try to improve the quality of our lives.

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