

Material Didactic Means in the Educational Process

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Abstract

Material didactic means (technical means and teaching aids) are means of a material nature and are an essential component of education and a means of achieving the goals of the educational process and are part of Engineering Pedagogy. They serve to achieve educational goals. They are part of didactic resources. A technical means as a material means that creates the conditions for delivering the prescribed curriculum to students. He is only an intermediary who performs a secondary function concerning the content of education. Didactic means are divided into didactic technique and didactic content. The didactic technique is a set of technical means. In our research, we focused on the content of the processed innovative professional text for engineering technology in dual technical education as an effective support for teachers. The result is the evaluation of the processed professional text for the subject of mechanical technology through the Close test. The results showed that the text is readable and manageable for the specified group of students.

Keywords: Material didactic means, Technical devices, Teaching aids, Professional text

1 Introduction

Material didactic means are means of a material nature and are an essential component of education. They serve as a means to achieve educational goals. They are part of didactic resources. Before we start thinking about creating and choosing a method of inclusion in the classroom, we need to know the content of the education for which it is intended. The main criteria for the selection of didactic means are the goal pursued, the content of the teaching, the nature of the phenomena demonstrated, the age, level, level of education of the students, the purpose of the teaching and the level of the teacher and his ability to use the intended didactic means.

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According to Pavlov (2018), the term "material didactic means" narrows the class of didactic means to material carriers of information, to technical devices and equipment of schools and classes that serve educational purposes. Didactic aids accompany teaching since the beginning of cultural history, e.g. when familiarising with objects and phenomena when using tools, etc. Here, it is also possible to consider them a drawing in the sand. From a developmental point of view, several generations of aids can be distinguished:

- specific subjects and phenomena functionally used in education,
- pre-machine tools (e.g. sketch, picture, real models),
- tools associated with the invention of printing (printed materials, books),
- means that improves human senses (binoculars, microscope, film, etc.),
- a device enabling human-machine communication (computer, Internet).

Didactic means are divided into didactic technique and didactic content. The didactic technique is a set of technical means. The didactic content is a set of signals with the subject matter. Teaching depends mainly on the quality of didactic content. Even the best-prepared teacher cannot apply the didactic technique unless he has high-quality didactic content. Integrated didactic workplaces are part of the material didactic resources.

2 Material Didactic Means

The tool serves to achieve educational goals. It complements the word of the teacher, which is a very powerful argumentative tool. The term material-didactic means narrows the class of didactic means to material carriers of information, to technical devices and equipment of schools and classes that serve educational purposes (Porubčanová, 2018).

Didactic tools have an irreplaceable place in the educational process. They became necessary not only in the work of a teacher but also in the work of a student. The results of use depend not only on the teacher's technical level and ability but especially on the level of didactic content (Ugrai, 2020).

Didactic means (Fig. 1) are material or immaterial according to their nature.

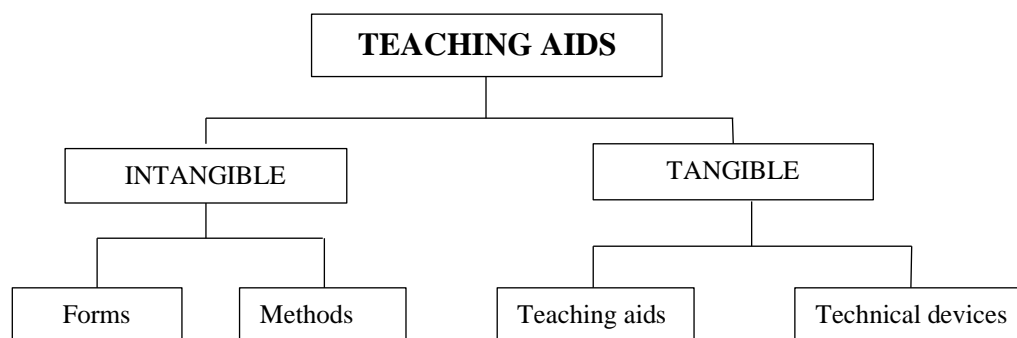


Figure 1: Didactic (teaching) aids (Hrmo-Turek, 2003)

Part of the teaching aids are non-material, among which we classify forms and methods. These ensure the professional component, while the teaching methods are focused on the thought process of the teacher and the student; on the other hand, the forms ensure the teaching-educational process, i.e. the external side. Organisational forms of teaching are most often divided according to the number of students participating in the teaching process together with the teacher (individual, collective and mixed), the place of implementation of the teaching process (school and extra-curricular) and the degree of independence of students' work in the teaching process (individual work of students, group work of students and students' frontal work).

We understand the methods of the teaching process as a deliberate arrangement of the curriculum and activities of the teacher and students, which are aimed at achieving the goals of the teaching process while respecting didactic principles (Hrmo-Turek, 2003).

Material didactic means are a means of achieving the goals of the educational process and are part of Engineering Pedagogy. According to Szókö (2015), engineering pedagogy is a frontier scientific discipline that transforms the knowledge of pedagogy and psychology into technical sciences. Its purpose is to increase the didactic effectiveness of engineering education. They include teaching aids and technical means, which inseparably include integrated didactic workplaces. Better results are achieved in the educational process, which means that knowing and acquiring knowledge has a multi-sensory and multi-code character.

Hrmo and Turek (2003) define a technical resource as a material resource that creates conditions for the delivery of the prescribed curriculum to students. He is only an intermediary who performs a secondary function in relation to the content of education.

Hrmo and Turek (2003) define a teaching aid as a material means that is a direct carrier of information and can provide content directly (e.g. a model) or through a technical means (e.g. a data projector).

Material teaching aids can be shown in a few numbers and the fact that the average person remembers approximately 10% of what he reads, 20% of what he hears, 30% of what he sees in the form of an image, 50% of what he sees and at the same time hears, 70% of what he sees, hears and actively performs at the same time, 90% of what he has arrived at on the basis of his own experience by performing the activity (Marks, Lajcin, 2017).

"Didactic means, as a category of didactics, all material objects that ensure, condition, and make the course of the teaching process more efficient. These are subjects that, in close connection with the teaching method and organisational form, help to achieve educational goals" (Marks, Lajcin, 2016).

We must know and respect certain requirements for the selection, creation, use and appropriate inclusion of teaching aids in the teaching process. Such requirements are didactic, ergonomic, aesthetic, technical, and economic. We must also consider the functions and requirements placed on material teaching aids. Bilčík (2018) lists informational, transformational, activation and regulatory functions among the basic functions of material teaching aids.

Material teaching aids are teaching aids and those technical aids that perform didactic functions (Hrmo & Turek, 2003).

2.1 Technical Devices

According to pic. 2, technical devices are described as basic equipment, auxiliary equipment, technical aids and machines and devices. Appropriate equipment of the school with technical equipment is an essential condition for ensuring the quality of the educational process. Here, there must be harmony and agreement between the school management and the school's teaching staff. In primary and secondary schools, they are teachers, and in secondary vocational schools, in addition to teachers, there are also masters of expert training.

Basic facilities include classrooms, specialist classrooms, language classrooms, laboratories, school workshops, etc. Kindergarten students' classrooms are basic classrooms for the educational process, where, as a rule, some re-educational subjects are taught or when the capacity of expert options is insufficient, and their equipment is basic school furniture, among which we include school desks, chairs, teacher's desk and a green or whiteboard, or their combination. In addition to the mentioned equipment, if the schools have the funds, the classrooms are additionally equipped with a PC, a data projector, a projection screen and possibly speakers. The technical aids include, according to pic. 2 display surfaces, projection surfaces, projection technology, sound technology, television technology and video technology, teaching machines, computers and multimedia resources. We also call this group of aids didactic technique.

Technical aids (Fig. 2) are such material didactic aids that create the conditions for passing on the prescribed curriculum to students. They are only an intermediary that performs a secondary function in relation to the content of education, e.g. a data projector with a PC that projects a didactic video. For auxiliary equipment, we recommend heating, cooling, air conditioning, darkening, electrical distribution, water supply, etc. Teaching machines also belong to the group of technical aids. They can download learning information according to the embedded program. Furthermore, they can assign tasks for practice, repetition, to consolidate the learning material, evaluate the achieved knowledge and manage the learning with the help of feedback. We recommend informants, examiners, repeaters, trainers and combined types for teaching machines. We use the tools Macromedia Director, Macromedia Flash, Microsoft FrontPage, Macromedia Dreamweaver... to create multimedia applications. Didactic machines and equipment, devices and gauges include those that we use for didactic purposes.

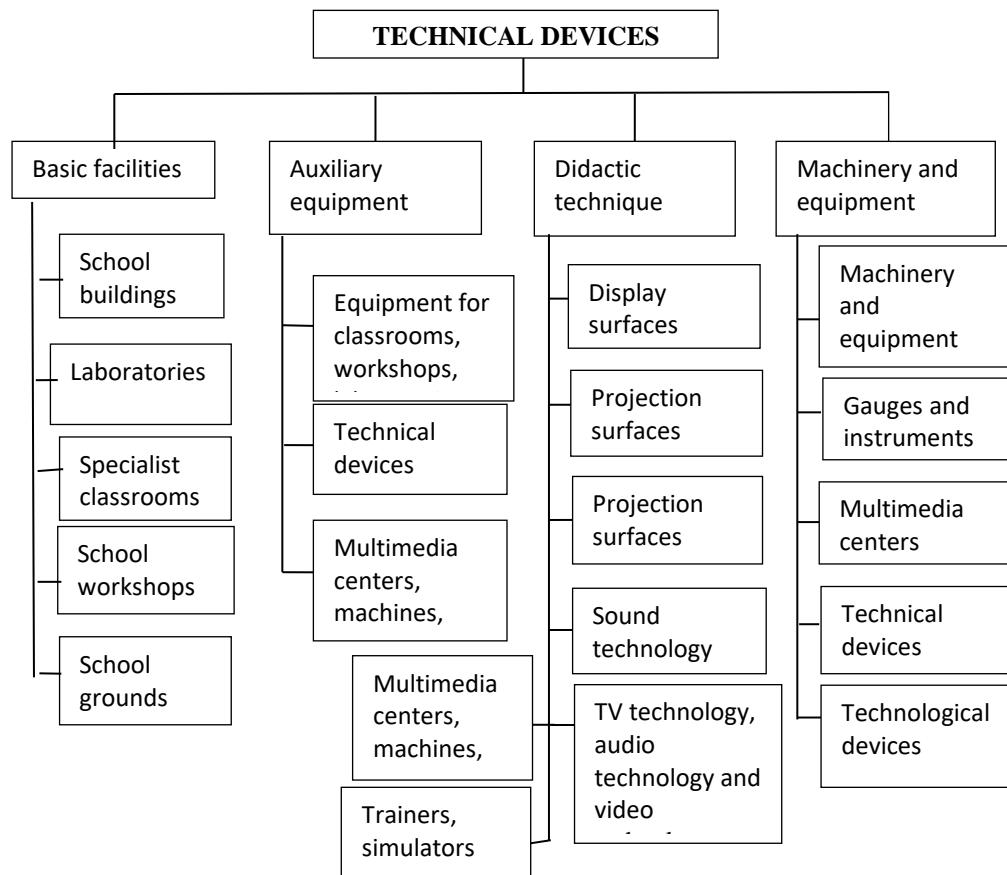


Figure 2: Technical devices (Szököl, 2016)

As a rule, special classrooms are equipped with instruments and measures. The equipment of special classrooms is usually extended by machining and forming machines, welding aggregates or their combination in-school workshops. There are secondary schools that have classrooms equipped with machines and devices.

2.3 Teaching Aids

According to Zsámbokiné (2021), teaching aids are those aids that enable the observation of real objects. According to Driensky and Hrmo (2009), we divide teaching aids into auditory, visual, audiovisual and cybernetic (Fig. 3). The way they are made depends on the function (information, transformation, activation, regulation, etc.) and the task in teaching (motivational, application, demonstration, simulation, descriptive, repetition, examination, etc.).

Švejda et al. (2018) were based on the original division according to fig. 3 and expanded the teaching aids by three more categories. Thus, in addition to auditory, visual, audiovisual, cybernetic, they describe listening machines, hypermedia and multimedia, and special MDP.

This topic is also addressed by Bendíková (2020) in the article Reflections on the Use of Interactive Whiteboards in Instruction in International Context. If we want to achieve the best

possible didactic effectiveness, we need to know in what form we will make the curriculum accessible using a teaching aid. When preparing it, it is necessary to take into account the educational goal, forms and methods, the subject, its nature and the focus of the material covered, the target group, the level of knowledge, skills and experience of the participants, the type and level of education of the target group.

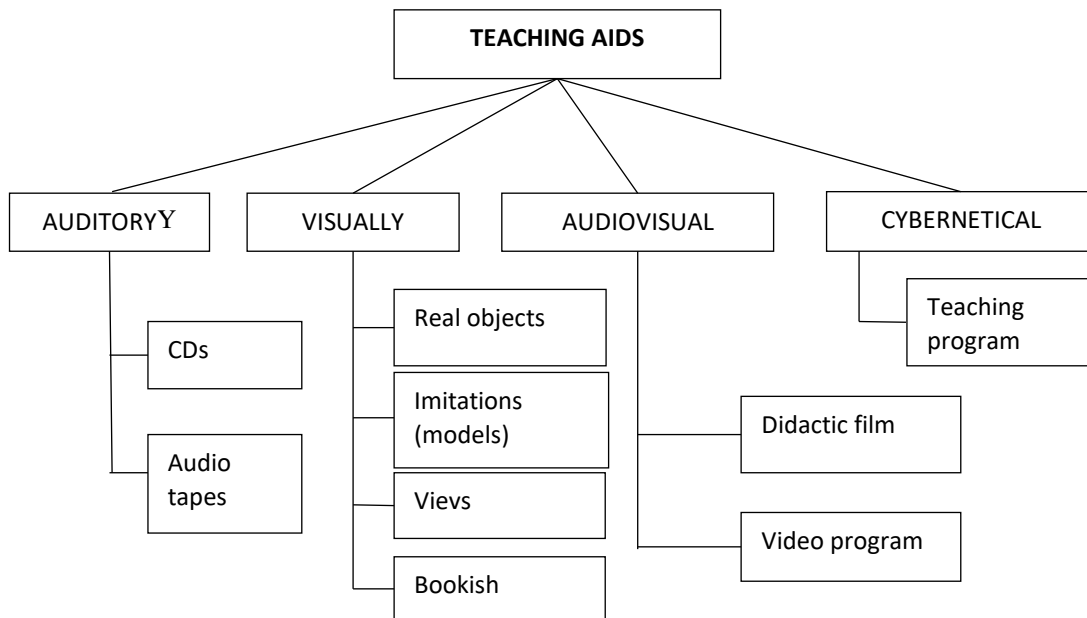


Figure 3: Teaching aids (Hrmo-Turek, 2003)

Průcha (2009) states that the most essential part of material didactic (teaching) means are teaching aids; their function is immediate participation in the teaching process. Their optimal action results from the position they have in the system of structural bonds, as shown in Figure 4.

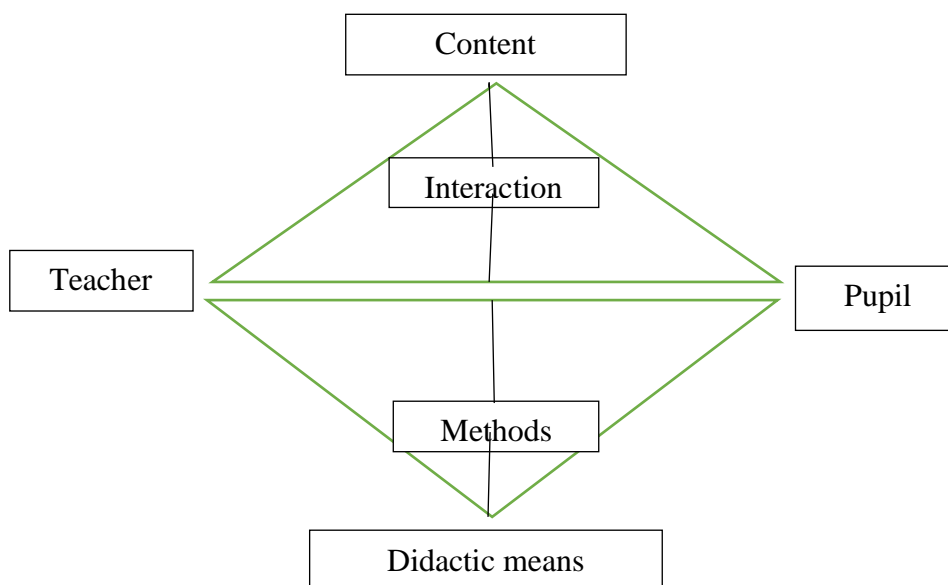


Figure 4: The structure of the teaching process (Průcha, 2009)

Figure 4 follows the traditional didactic triangle supplemented by an element of didactic means. Here, we distinguish the quality between bindings.

From a historical point of view, several generations of teaching aids can be distinguished:

- specific subjects and phenomena functionally used in education,
- pre-machine aids (sketch, picture, model),
- tools associated with the invention of printing (books, printed sheets),
- means that it makes human senses more effective (binoculars, microscope, film),
- a device enabling human-machine communication (PC, Internet).

Just as we must learn to express words accurately, it is necessary to learn to read images, i.e., understand their information. We distinguish several levels of reading images (Bilčík, 2018):

- stage of enumeration, calculation,
- descriptive stage,
- stage of thought processing.

According to this, it is important that students are led to critical thinking and that they learn to co-create images, e.g. take notes and picture notes. Teaching aids have differences among themselves. We can assess them mainly according to the fulfilment of economic and material-technical requirements for production and mainly according to the didactic function.

Teaching aids as carriers of didactic information are the bearer of the goal-content-method and are a teaching management tool in that:

- they make the curriculum available to the student through various means of communication:
- how the sources lead the student to the active acquisition of knowledge, subject matter and preparation for practice,
- they provide space for the development of the student's abilities, interests and the creation of attitudes,
- they intensify, rationalise, and make the work of both teacher and student more effective.

According to Fig. 3 teaching aids are auditory, visual, audiovisual, and cybernetic. Part of the visual o. i. They are also bookish.

3 Professional Text for the Selected Chapter on the Subject of Mechanical Technology

Engineering technology is one of the basic subjects of engineering departments and follows the subjects of mathematics, physics, chemistry, technical drawing, mechanics, and electrical engineering.

Based on the ŠkVP, which is part of the "ŠVP Strojárstvo" 23, 24 Engineering and other metalworking production, we prepared professional teaching texts for the subject of Mechanical Technologist. This subject is taught in all years in the school educational program 2381 M - mechanical engineering at the secondary industrial school. The processed didactic

text is part of the seventh thematic unit: Turning in the 1st year of study. The subject aims for the student to acquire the target knowledge and skills after taking over the individual thematic units.

The graduate should know the basic technical terminology for engineering and other metalworking production, the basic types of materials and semi-finished products used in engineering, their production process, the methods of heat treatment and surface treatment of materials, and know the basic technological procedures of manual and machine processing, machining, forming, casting, welding, assembly and functional tests of engineering semi-finished products and products.

After studying the teaching text, the student should know:

- characterise turning,
- list the essential turning knives,
- name the basic types of lathes,
- describe the universal point lathe,
- determine typical turning jobs,
- prescribe the accuracy and surface quality achievable by turning,
- determine the cutting conditions of turning.

We have prepared the teaching text into four chapters. After studying the thematic unit, the student should know:

- characterise turning,
- list the basic turning knives,
- name the basic types of lathes,
- describe the universal point lathe,
- determine typical turning jobs,
- prescribe the accuracy and surface quality achievable by turning,
- determine the cutting conditions of turning.

4 Pedagogical experiment

Vargová (2014 in Porubčanová, 2018) states that the quality of technical education in schools can be supported by using modern, innovative concepts of the teaching process. Innovation is generally understood as "a new phenomenon, a new idea, a new product". Innovation concerning education is "the introduction of something new, new methods, new forms in teaching, the introduction of new teaching aids and means". The quality of education also depends on the school's equipment with teaching aids. Ugrai (2020) stated that appropriate material and technical equipment is the result of cooperation of their management with teachers and masters of professional training. When there is a lack of cooperation from teachers and masters of professional training towards management, it may not result in deficiencies in equipment; the opposite case leads to the emergence of negative phenomena at school.

Hypotheses and methodology of the experiment: The main goal of the pedagogical experiment is to process and evaluate a professional text on selected thematic units in the subject of mechanical technology, which will be manageable in the 1st year of the school educational program 2381 M - mechanical engineering at a secondary industrial school.

Sub-goals: In order to fulfil the main objective of the research, it is necessary to implement a sub-objective:

- Determine the readability of the text

Main (initial) hypothesis: The elaborated didactic text on selected thematic units in the subject of mechanical engineering will be manageable in the 1st grade in the school educational program 2381 M - mechanical engineering at a secondary industrial school and the school educational program is part of the state educational program Mechanical Engineering 23, 24 Mechanical Engineering and other metalworking production.

To verify it, we will evaluate the following working hypothesis:

H1: The selected group of students for whom the didactic text is intended from the selected text will complete 13 or more words from the 22 missing. Statistical research methods will be used to process the pedagogical experiment.

With this method, we can examine various parameters related to the subject matter obtained by measuring certain features in the textbook.

Such parameters include:

- readability of the text

4.1 Preparation and Processing of the Appropriate Content of the Didactic text

The main goals of our experiment were to select suitable literature and process a suitable didactic text for selected thematic units in the subject of mechanical technology of the 1st year in the school educational program 2381 M - mechanical engineering at the secondary industrial school. A specific school educational program is prepared for the given subject, which is part of the state educational program Engineering 23, 24 Engineering and other metalworking production. The subject of Mechanical Technology is intended to give students basic and expanding professional key competences for their possible future application in practice.

Content of the didactic text

Based on basic pedagogical documents, the subject is Mechanical Technology for the 1st year in the school educational program 2381 M - Mechanical Engineering at the secondary industrial school for tomato units. Turning is taught in the 7th thematic unit. We have divided the selected topics of the 7th thematic unit into four chapters and at the end, there are control questions:

1. Characteristics of turning
2. Lathe and its main parts

3. Lathes

4. Turning knives

Control questions

The structure of the didactic text

We processed the didactic text in the following structure:

- Objective of the selected chapter - contains basic phrases from the given module, which the student should master after studying the chapter
- Introduction to the chapter – subsection 1: Characteristics of turning
- Subchapters 1, 2, 3, 4 – are a teaching text for the given issue and describe the given issue and give an explanation of the topic covered
- Review questions - here are questions from the curriculum on turning. Answering the questions correctly is a prerequisite for successfully mastering the given topic.

Preparation and evaluation of the Cloze test for pupils

After finishing the work on the professional text, we prepared a Cloze test for the students for whom this text is intended. Select school pupils (Tab. 1) had to complete min. 13 and max. 22 missing words. If the students do not meet the lower limit and do not complete at least 13 correct words, then the learning text is complex. The cloze test is based on randomly selecting a text of approximately 250 words. We consider that the first 35 words remain in their original state for the text, but the 36th word is omitted. Subsequently, every tenth word is omitted, i.e. 46, 56, 66, 76, 86, 216, 236, 246.

Table 1: Number and schools for the Cloze test (own)

Name of the school	Number of pupils	Focus of the school
SPŠse Levice	45	mechanical and electrical engineering
SOŠE Trnava	30	electrotechnical
SOŠD Bratislava	27	traffic
SOŠSE Velešín	55	mechanical and electrical engineering
SPŠSaS Tábor	62	engineering
Σ	219	

219 respondents completed the Cloze test. The respondents (students) were from the Slovak Republic SPŠse Levice, SOŠE Trnava and SOŠD Bratislava and from the Czech Republic SOŠSE Velešín, SPŠSaS Tábor (tab. 2).

Table 2: Percentage share of the school on the Close test (own)

Name of the school	Number of pupils	% share
SPŠse Levice	45	0,207
SOŠE Trnava	30	0,132
SOŠD Bratislava	27	0,122
SOŠSE Velešín	55	0,253
SPŠSaS Tábor	62	0,286
Σ	219	100 %

5 Conclusion

Teaching aids are a very necessary means for ensuring clarity in teaching. In many cases, they connect several subjects and thus bonds in intersubject relationships are created. At the same time, there are important relations between theory and practice. Realistically, e.g. machines, devices, tools and gauges become didactic means and teaching aids in teaching and professional training. In dual education, students have real professional training in a company or factory from the second year, where they are gradually involved in production or companies have their professional training in separate workshops. Here, from the point of view of didactics, there is a connection between theory and practice, but here there is a second big dimension and that is solving the question of where to go after finishing school, if the graduate is looking for his first job.

The experimental part was solved using the statistical method, where we examined the readability of the professional text for pupils. After performing the analysis, we found that the hypothesis was confirmed. All secondary school students completed min. 13 words in Close text from the omitted 22.

Our labour market needs a lot of high-quality experts in technical fields, and the biggest problem is with craftsmen, who are massively disappearing from the market. SOŠ and OU began to adapt again to the labour market and the needs of society. Our common goal is to raise good experts and technicians, and for this we also need good teachers not only of theory but also of practice, and above all to get good experts and experienced technicians into education for the department so that students receive knowledge, experience and skills in practice (Pavlov, 2018).

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