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TECHNICAL EDUCATION OF THE YOUTH – THE PRIORITY OF THE CZECH SCHOOL SYSTEM IN THE 21ST CENTURY

Abstract. Vališová Alena, *Technical Education of the Youth – the Priority of the Czech School System in the 21st Century* [Edukacja techniczna młodzieży – priorytet czeskiego systemu oświaty w XXI wieku]. Studia Edukacyjne nr 46, 2017, Poznań 2017, pp. 193-206. Adam Mickiewicz University Press. ISSN 1233-6688. DOI: 10.14746/se.2017.46.12

The presented text conceptually proceeds from the strategic and conception documents of the Czech Ministry of Education (MŠMT) and includes among the priority objectives primarily the openness to the new methods and manners of teaching by means of digital technologies, improvement of pupils' competences of working with information and digital technologies and, last but not least, the development of pupils' IT thinking. The motivation for secondary school students' choice of technical branches is regarded as a priority orientation of the contemporary school system in the Czech Republic.

Key words: technical education, Czech school system, motivation, competence, information and communication technologies, technological changes and innovations, polytechnic education, technical science, education sciences

Introduction

Information and communication technologies in the last few years underwent a rapid development with consequences for the sphere of upbringing and education as well. Reflection of the up-to-date didactical trends takes place at the interface of the pedagogical, psychological and sociological disciplines. The development is considerable accelerating as a consequence of technological changes and innovations. What kind of real impact does it have on the key and professional competencies of the primary and secondary school-leavers? Do the education programmes reflect the demand for competencies required by the industry and the practice generally? What determi-

nes the present education reality in the sense of a broader conception of the education technologies? How is the problem of young peoples´ motivation to study of professional technical subjects interpreted from the viewpoint of the theory (analysis of our and external professional publications and studies)? The support of professional technical branches is therefore a priority of the contemporary school system in the Czech Republic.

Technological education in the context of the general education – historical excursus and the present

At the beginning of the twentieth century the traditionalistic ideas prevailed in the sphere of general and professional education. The value of the general education was viewed in its humanistic and philological contents, in its abstractly theoretic character, far off the life practice. Relation of the general and technological education from the historical point of view is in more detail presented in the publication General didactics.[1]

Ideas of this *bipolar conception of education were apart from other things over-done by the representatives of the reform pedagogy*. They were aware of the new social assignments and the pupils´ new living conditions as well – they therefore emphasized the idea of connecting the school with life and its practice, the role of practical activities and work in the process of the young man´s education. The school was viewed as a "*life community*" (i.e. forms and procedures of upbringing and education were formed together both with the pupils and the teachers and parents). The objective of the school education was the pupils´ involvement into the world of work and ordinary life i.e. *teaching "from life for life"*. The ideas of the reform pedagogues assumed concrete forms in the context of individual authors´ pedagogical conceptions (O. Decrola, A. Ferriere, P. Petersen G. Kerschensteiner, P.P. Blonskij, J. Dewey and others). These ideas were realized by way of introduction of the pupils´ direct practical activity in the course of teaching, by making experiments, active participation at the life of the community, manual training and the pupils´ productive activity.

Different contexts were perceived *in the second half of the twentieth century* in relation of the general education to the technology, to the world of work and to the life. The period of a dynamic industrial society is characterized by the intensive development of the industry and production. The troublesome relation of the scientific and technical progress, modern technology and traditional conception of the general education escalated. In connection with the

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[1] J. Skalková, *Obecná didaktika*, Praha 2013, p. 49-53, p. 49-52.

advancing democratization of education and the requirement of scientific cognition for everybody, the education conception of a Gymnasium type (with its noticeable features of one-sided verbalism, abstractness, orientation to the memory acquirement of knowledge) was widely gaining ground towards the whole population even at the lower education levels and towards all the time more diversified population at the medium level. *General education and its modernization by incorporation of curricula of the technological character* became in the second half of the twentieth century a lasting subject *of UNESCO´s attention*. In 1985 UNESCO elaborated a basic line for development of the young generation´s general education. *It contained the idea that study of the natural sciences together with findings of the technological character form the necessary precondition for development of the national economy.*

Concept of the polytechnic education, the objective of which was to acquaint the youth with the basic findings about the main branches and the production scientific principles, was intensively developed in the pedagogical theory solving concrete issues of the school practice in the then socialist countries. It included also provision of practical generally technical skills necessary for activities in the production. *Polytechnic education* was also directed at the development of skills to understand the schemes and graphs, to the skills of technical thinking, creative approach to the problems and their solution, to the rational organization of one´s own individual work and to the skills of cooperation with other people as well. The objective of the polytechnic education was also the support of such personal qualities as are positive relation to work, responsibility for one´s own work, respect to the work results of the other people. It was realized in different ways – by means of special subjects (handicraft, work on the land and in the workshop), further in the framework of individual school subjects (in particular in the maths, physics, chemistry, biology) but also in the framework of optional subjects (as are basics of the technology, technical drawing, car driving) and last but not least in the framework of various technically oriented interest groups and excursions in the production processes. All these *means and possibilities to develop the technical thinking in the framework of polytechnic education should motivate the pupils and adolescents to a professional orientation and choice of a technically oriented career.*

The period of a highly industrialized society at the end of the twentieth century that represents a new stage in solution of the technological education, used to be denoted as a post-industrial and information society. The technology of education can be conceived: a) *in the broader sense* as projection of such technological procedures that enable optimally to manage the pupil´s learning in situations of a pedagogical type; these are compact and to the special programmes integrated management procedures (i.e. integrated in the special curricula, in the computer programmes, trainers, simulators and others); they draw from fin-

dings of the cognitive psychology, motivation psychology, management psychology, regulation theory, artificial intelligence and others; to that end was developed a special theory of the education technology and at b*) in the strict sense* the technology of education represents in particular the use of technical means (computers, audiovisual technology etc.) in education.

New information and communication technologies influence the economic development and bring *substantial changes into the world of work*. Considerably *grows also the sector of services*, and emerge *new demands on the work of a man.* They anticipate skills of an abstract, systematic theoretic thinking, comprehension of complicated relations, skills of planning the work, ability to react flexibly to the new conditions, creativity and other things. *The necessity to master the up-to-date information and communication technologies is reflected in the General education programme for the primary schools and also in the General education programme for the Gymnasiums* (the sphere of information and communication technologies and The man and the world of work).

The first decade of the twenty first century is characterized by the growth of electronic devices used in the upbringing and education process. A substantial attention is nowadays also paid to the modernization of the material and technical basis at all types and levels of schools. The up-to-dateness of this issue results from the permanent development of the existing scientific disciplines (traditionally already cooperating with the pedagogy), but also from the development of the newly emerging branches or branches newly cooperating with pedagogical branches (cybernetics, ergonomics, cybernetic pedagogy, theory of information etc,) An important objective of the contemporary school is to prepare all the pupils and students for the broadest possible use of electronic devices and computer technology both at the future employment and in the personal life as well.

One of the key objectives of the education policy in the twenty first century is thus to raise interest of the primary and secondary school pupils in technical branches and enhancement of motivation to the study of these branches at the universities. The mentioned objective is a logical reaction to the new trends on the labour market and to the necessity of increasing the number of professionals with technical education.

Development of the technical thinking and support of the young people´s technical education

Modern technologies become an important aide in the education. However, it can by stated that *schools so far offer relatively few possibilities of a meaningful use of the up-to-date technologies as regards motivation to the study of technical*

branches. It is important to point out the fact how these means can be effectively used and how the teachers can be given ample scope for a creative approach to these issues at the individual types and levels of schools. *How to motivate the pupils of the primary schools and adolescents as well to the study of technical branches and work in an ethical way work with information* is a theme very desirable under the current conditions of the Czech school system. The requirements of the labour market and the requirements of the school practice correspond with development of the technology, and information and communication technologies in the Czech Republic and also worldwide.

Development of the technical thinking and creativity is the cornerstone in teaching of technical subjects and didactics of the technically oriented subjects. The *concepts of technical creativity (creativity) and technical thinking are at present sometimes perceived as a synonym*, what can lead to a certain constriction of the role of teaching technical subjects. The concept of technical thinking is in our country often replaced by the concept of creativity or technical creativity. In the Czech Republic are these concepts commonly used, nevertheless it is necessary to look for the literary sources in the professional literature abroad. Theory concentrated on the problem of technical thinking can be more often found in the external literature than in the Czech didactics of technical subjects.

Before we switch to the concept specifics of the technical thinking it is necessary to define briefly the *term thinking* at a general level. In this case it concerns the intermediated and generalized, abstract process of cognition that leads to cognition of substantial, general attributes, phenomena and contexts. It is effectuated by specific *thinking operations* (analysis, synthesis, induction, deduction, generalization, concretization, analogy). Among the main *forms of thinking* pertains the concept (the speech expression of general and substantial characters, a certain degree of generalization and abstraction), opinion (expression of a relation between two concepts) and judgement (expression of a relation between two opinions).Among the *basic processes of thinking* pertains in particular the creation of concepts, systems of concepts and solution of problems. The basic *individual attributes of thinking* are its depth, wideness, precision, elasticity, criticalness and creativity. The development of thinking is an important objective of the upbringing and education process at every level and type of schools. Attention should be focused on the development of abstract, divergent, iconic, concretely illustrative, convergent, logical, conceptual, and creative thinking, not only in the framework of technical subjects teaching.[2]

As it is evident from the general definition of the concept of thinking mentioned above, the *technical thinking is in substance its specific form as well.* The wide-ranging character of this concept is connected with the broad-spectrum

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[2] Z. Kolář a kol., *Výkladový slovník z pedagogiky*, Praha 2012, p. 79.

of the concept of technology itself. However, it has historical and also professional contexts, its level and contents changes in the context of development (for example technically oriented amateur or professional in the sphere of technology, different demands on the profession of an auto-mechanic today and forty years ago, different demands made on the present constructer of the car motors or on the electrical engineer) The requirements for development of the technical thinking, technical literacy, understanding the information and communication technologies are in substance contained also in the basic school documents (in the context of RVP and ŠVP).

With the issues of technical thinking and its development dealt a number of *authors abroad* (for example W. Kazimierski, E. Franus, C. Gilbert). *To the Czech and Slovak well-known authors* in this sphere rank in particular I. Škára, J. Kropáč, Z. Kubíček, M. Chráska, M. Havelka, and I. Krušpán. The individual authors *characterize the contents definition of the technical thinking, concretize its relation to the creativity, specify the contents and processional orientation of the technical thinking, and last but no least they state also the contents classification criteria of the mentioned concept.*

A number of our authors refer in their professional publications to the *categorization of technical thinking at E. Franus*. He distinguishes in substance four types of categories which are specified in detail together with the concrete examples: 1) *Practical thinking* – to this belongs a) simple routine activities controlled by thinking (manipulation with instruments, simple production), b) manipulative thinking (assembly and disassembly of technical equipments), c) discovering (diagnostics, investigation of new products). 2) *Visual thinking* – this includes a) reproductive thinking (reading of technical drawings), b) creative thinking (planning, constructive work from a simple sketch to the designs, and models. 3) *Intuitive thinking* – stresses improvement of the existing or creation of the new constructions. 4) *Conceptual thinking* – this type is oriented in particular to the a) use of thinking operations containing words and descriptions, to the b) system of concepts or technical categories that can be found in explanations, evidences and in planning, based in particular on the analytical and synthetic thinking. This classification is of course only general as in such a broad scale that the concept of technical thinking defines is a plentiful quantity of further sub-groups and spheres.[3]

As a self-evident and important *means of technical thinking development is considered the solution of technical issues* which is also a means and objective of teaching, be it the solution of issues of a cognitive character (where prevails the analytical procedure) or of an application character (where dominates

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[3] In detail for example: J. Kropáč, *K problému uceleného pojetí výuky obecně technických předmětů*, E-Pedagogium (on-line), 2004, 4, 1, www: http://epedagog.upol.cz/eped1.2004. Tištěná forma (Printed form).

the synthetic procedure). The recommended *structure for solution of a technical problem is primarily* the identification or finding of a problem; its investigation and seeking the data necessary for its solution; variants and concrete solution proposals; solution process itself and evaluation of the procedures and the results as well. The process of technical issues solution and the related methods of individual steps solution from the initial to the target state are therefore as such a subject of teaching. In teaching, and in the context of technical thinking, it is necessary to develop the ability of pupils and students to reflect in particular their own experiences and skills, deduce conclusions and confront them with the practical experiences. Important is also the attention paid to the confidence in one´s own thinking, which at the same time lends confidence in one´s own conclusions, openness to the views of others, acquirement of findings from the research, from various information sources and traditions. Further it is necessary to pay attention to such social aspects as are the communication skills, cooperation, working in a group, willingness to mutual use of sources for solution of a problem, and last but not least to the development of abilities to reflect one´s own way of learning, discerning one´s own style of learning and the abilities of critical evaluation of solution results of the respective technical issue or target.

The necessity of an intentional and systematic enhancement of interest in the study of technical branches, maths, physics and chemistry is increasingly emphasized. Impact of the lack of interest and insufficient technically oriented education at the pupils of primary and secondary schools has also a significant impact on the university students´ choice of the study field. In case the students opt for a technically oriented secondary school or university, they often have at their disposal only low-quality and insufficient knowledge of the given study subjects. A considerable percentage of the accepted students thereafter leave the secondary school or the university already at the initial stage of study. Representatives of the industry and the Chamber of Commerce at present urgently point out the *critical situation, which arises in the production firms* due to the gradual retirement of the technically educated workers. There is sometimes nobody who could replace them, as in the recent years the technical professional school system was not too much supported.

A long-term trend of absence of technicians on the Czech labour market tries to reverse a number of professional technically oriented secondary schools, whether by appropriate orientation of the study programmes with accent on the needs of practice in the region, involvement of the projects into the European Union, the object of which is the support of technical education of the youth, and further also by building of specialized laboratories for the professional teaching and also by activities of the secondary schools in the framework of SOČ, and at the universities in the framework of SVOČ.

Teaching of technical subjectsin the context of
a multidisciplinary approach

Problems and risks which brings the nowadays social, economic and also technical development have a many-sided and complex nature. Professionals who are dealing with them are on contrary usually specialized, i.e. they are one-sided professionally oriented.

For that reason can be several decades intensively heard voices that speak about the necessity of an *interdisciplinary education and mutual dialogue between the technical, humanity and social disciplines.* The society transforms in the framework of gradual transformational changes together with the contemporary conception of the functional society that emphasizes the practical aspects of the work with knowledge. The knowledge as such has still its value, it is however necessary to emphasize also its practical applicability and ability to transform the knowledge into practical values. This trend unambiguously puts higher appeal on the interconnection of technical, humanity and social sciences (Andres, Vališová 2013).

Today are on the increase also the demands on one´s own responsibility in the choice of a professional career. Transition towards the information society in the today globalised world, brings to a number of countries the increased *need of an unspecified and broadly based education that creates preconditions for the variable forms of work with information of various kinds.* In connection with this fact a number of new professions and working possibilities are arising to which the young people are groomed in the framework of the *tertiary education* i.e. in the context of the International classification of education (ISCED) – partly by way of the non university tertiary education (higher secondary schools) and partly by the higher or university tertiary education – 3 to 6 years study, bachelor´s and master´s degree.[4]

The intensive *development of the natural and technical sciences caused at present an unprecedented pressure on all the education systems.* A growing contradiction can be noted between the quantity of findings and information that a man must manage and the limited time frame to its processing and appropriation. The gradual deepening of this trend can cause problems connected with the future fulfilment of the school-leavers. In this spirit we should primarily underline such conceptual orientation that will *take into account both the adaptation and anticipation institutional objectives.* In view of this facts it is necessary to answer the basic question what kind of education contents (together with the upbringing and education means and use of education methods) will help us in preparation of the future school-leavers with the objective to prepare

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[4] Z. Kolář a kol., *Výkladový slovník z pedagogiky*, p. 75.

them for the changing conditions of the labour market requirements, ability to adapt themselves to the new challenges, technological innovations and conditions of the society in the twenty first century.

From this follows the necessity to *modernize both the contents and conception of the education in the broadest sense.* It does not concern only a mechanic incorporation of the new education contents, and actualization of the existing curricula – we also seek an answer to the question, *to what extent is our contemporary conception of the pre-gradual preparation in synergy with the requirements of all the social partners* (and therefore also of the labour market), who enter into the upbringing and education process and its own reflection. We seek quite pragmatically such contents, forms, means and methods which will facilitate us the transition process of the contemporary problems, knowledge and procedures in the form of a specific transition to the new conditions and situations of the world, to which our school-leavers of the secondary schools and universities will be prepared and able to solve them creatively. And how does the school system react to this problem, connected with the rapid development of a number of branches, digitalization of a number of activities and development of ICT? It can be stated that for the most part it reacts conservatively, slowly and with caution. Innovative approaches actually put higher *demands on the pedagogues´ further education and self-culture,* the mentioned contemporary trends so concern also the *institutionalization of teachers-technicians and engineers´ education.*

Technical sciences and education sciences – the pedagogy – have a considerable different subject of investigation. *Pedagogy* in the professional sense means science and research dealing with education, upbringing and research in the various spheres of life of the society. Pedagogy as a whole complex of education sciences consists principally of the following – history of pedagogy; methodology of pedagogy; social, special, and comparative pedagogy; philosophy and theory of upbringing, pedagogical evaluation, diagnostics, education policy and others. An important position in the system of pedagogical sciences has also the didactics that is defined as a theory of education and teaching. It deals with the issues of education contents that as results of the humankind´s social and historical experience turn into the individual skills of students in the process of teaching. It deals at the same time with the process that characterizes the activity of teachers and students who acquire this content, which means by way of teaching and learning.[5] The subject of the didactics are in particular the objectives, contents, principles and rules, methods, organizational forms and planning of education and teaching, up-to-date is the use of modern material didactical means and information technologies.

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[5] Ibidem, p. 30-31.

In case that the *subject of the didactics* is solved from the viewpoint of individual levels or types of schools, it can be spoken for example about primary didactics of the primary or secondary school. The subject of the didactics from the viewpoint of individual school subjects or groups of similar school subjects is solved by the *branch didactics* as a relatively independent discipline that significantly interconnects the general didactics and the concrete contents of the school subject or the group of school subjects (branch didactics of the technical subjects, didactics of the technical branch, didactics of the mechanical engineering subjects, didactics of the social and science subjects, didactics of the economic subjects and other). The branch didactics (didactics of a branch, a group of branches) processes generally didactical principles, conceptions, methods and forms of education and teaching in relation to the concrete contents of the respective branch, school subject, or group of school subjects. It forms a part of study of the future teachers – technicians and is interconnected with the pedagogical practice.

Technical sciences are defined as sciences, the direct investigation subject of which is the technology (understood as a set of technical objects) its projection, production, use, maintenance and liquidation. A number of sciences or their branches rests on the imaginary frontier that separates the technical sciences, as the term technology denotes a vast and complicated sphere of civilization. It is difficult to formulate the definition of the technology concept as the final formulation for example used to be different from the science in the framework of which it originated (it need not concern only one of the technical sciences but for example the philosophy as well). The development of the technical sciences and technologies is closely connected with the development of the society, and forms one of the main pillars that create preconditions for a qualitative change of the social system.

The definitions or at least characteristics of the concepts of pedagogy, didactics and technical sciences mentioned above are based on the formulation of their investigation subject. These are in the case of pedagogy and the technical sciences not only different but also distant. Whilst the pedagogy pertains to the sphere of social, possibly humanity sciences, the technical sciences investigate an "artificial world created by a man and with this world connected activities". There are of course also points of important contexts between them. *Is it possible to define at least some of the common characteristics of the pedagogy and technical sciences?* On the basis of the professional literature it is possible to mention at least the following characteristics:[6]

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[6] In detail for example: Gawrysiak, 1998, J. Kropáč, Z. Kubíček, *Zaměření konference „Trendy technického vzdělávání" – oborová didaktika technických předmětů*, [in:] *Trendy technického vzdělávání 2001*, Olomouc 2001, p. 3-6.

a) *Integrateness* – technology and technical sciences integrate in itself and take into account the elements directly technical, but also elements of the maths, nature and natural sciences, ecological, economical, social elements and other. Technology does not serve only for the technical purposes. Upbringing, education and also pedagogy analogously comprise aspects of the philosophy, psychology, sociology, nature and natural sciences, economical, technical, social aspects and other.

b) *Concreteness* – the technology and technical sciences have relatively concrete objectives resulting from the needs of the society. Fulfilment of these objectives means to create new or improve the existing technical systems. To that end is the orientation of technical sciences more concrete and also more general. In the technology are further used (and by technical sciences to that end oftentimes transformed and synthesized) results of other connected sciences. Upbringing, education and pedagogy fulfil also the objectives, resulting from the needs of the society, which means creation of the new or improvement of the existing upbringing or pedagogical systems. In the pedagogy find its reflection the disciplines mainly concrete but also general disciplines, pedagogical and also other ones, the findings of which can influence the development of the pedagogy.

c) *Operativeness* – it is indisputable that pedagogy and the technical sciences show how to proceed optimally. To that end they offer in particular: systematic presentation of the existing solutions; theoretical generalization of the research results; selected findings of other sciences presented from the viewpoint of needs of the pedagogy and technical sciences; purposeful process analysis of the processing and solution of the tasks and issues of the enumerated sciences.

d) *Creativity* – the purpose of the pedagogy and also of the technical sciences is creation of something new, so far not existing, better, advanced (technical creativity, and pedagogical creativity of the teacher). To that end they offer invariably perfect findings, rules, laws, theories, evaluations and procedures that concern the practical realization but they do not anticipate it.

The need for a multidisciplinary approach to the technical, humanity and also social sciences is reflected for example in the fact, that engineers– technicians, when they come up with the design, projection, construction, production and operation of the technical equipments, are trying *to fulfil in particular the technical requirements. No less important, however, are also economical and environmental requirements* that cannot be always solved unambiguously and are sometimes also contradictory. To these requirements can be further added *questions of the social impact of the technical equipments introduction that comprises apart from other things also ethical, esthetical and legal viewpoints.* The complex solution of technical issues should therefore take into account also the im-

pact of the technology on the life of the society, which means the necessity to solve the technical tasks in broader contexts and on an interdisciplinary level. Thereto is of course also necessary to draft and realize alternative models for a broader general education of engineers– technicians. Solution of issues of the contemporary training of teachers and their skills to motivate the students to the study of technical branches, and also issues that concern the role of information and communication technologies as well, exceeds at present their traditional seeing and get them into the new contexts, relations and meanings.

What to say in conclusion…

The conception of the functional society is necessary to dynamize. The role of knowledge in the contemporary society cannot be understood statically but processionally. As a matter of fact, we should rather speak about a *society of intensive knowledge processes* instead of a functional society. Indeed, all that we can now observe is a huge and unprecedented dynamics of processes connected with the knowledge. Permanent innovations become a condition of the company´s survival on the market, the lifelong learning is an inevitable precondition of the employment, a continual recombination of a huge quantity of findings produces new and new knowledge, implicit knowledge is codified in such manner that it could be distributed by information technologies, produced knowledge is subject to a continual reflection and recombination with other knowledge, whereby it comes about to a further production of knowledge and so on. Innovation depends on the transmission of various types of knowledge that often is not codified but forms a component of the social networks, in consequence of which also grows the importance of relations between the participants producing knowledge.

An important element of the students´ motivation enhancement is the opportunity to show them the possibilities of the practical use of theoretical information acquired in the course of the study, and to lead them to an independent application of knowledge into the practice. Methods and forms of teaching used in the project enable the students to acquaint themselves with the new approaches to the acquirement of knowledge in such professional subjects as are lectures led by academicians using the up-to-date information technologies, emphasis on the independent study and also teamwork in solution of the common projects and critical analysis of the information sought-
-after on the internet.

The teaching efficiency of the technical subjects rests in particular on the elaboration of new methodical materials and the proposal of new innovative aids necessary for a new conception of teaching that will be supported by the

technical and material equipment enabling introduction of interactive forms of teaching and also professional training of the pedagogues. For fulfilment of the mentioned objectives are important not only activities directly incorporated into the teaching process but also professionally conducted excursions and lectures for the pedagogues and students themselves, oriented on the target competences and also on interesting themes from the sphere of technical branches and information technologies. A close cooperation of the secondary schools and universities enables both the introduction and use of the described methods and enables the students to acquaint themselves with the course of the university studies and so further support the fulfilment of the main project objective, which means the enhancement of the students´ motivation.

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