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Digital technology in the context of social science teaching at secondary schools

Introduction

Social scientific subjects can at the first sight look to be considerably far away from the digital education. If we think of the contemporary students of secondary schools, who use digital technologies in the after-school life quite commonly and if we think of the life for which they should be prepared at school, the digital technologies could not stay aloof from the social scientific education.

Social sciences and humanities belong to the scientific disciplines the importance of which at present is rather growing. In the advanced states these disciplines are frequently used in the sphere of economy and society management. It is obvious that in spite of the deep-rooted wrong belief that these scientific disciplines are the point of the basic research, it also have a considerable social and economic importance.

The products of technological sciences are intended for a man and therefore it should correspond to his needs and values. Its development and production is realized in the social environment. This fact therefore entails that competencies resulting from the findings of psychology, pedagogy, sociology, economy are important also for the workers in this sphere and naturally substantial is also the reflection of ethical contexts of the solved problems.

Interdisciplinary approach to the humanities, social and technological sciences

Problems and risks caused by the contemporary social, economic and also technological development have a many-sided and complex nature. Professionals who occupy themselves with it are on the contrary usually specialized, i.e. one-sided professionally oriented. For ten of years are therefore intensively heard voices that speak about the need of interdisciplinary education and mutual dialogue among the humanistic, technological, and social disciplines.

The scientific international conference on the topic „Humanities, technological and social sciences: is it possible to hold a dialogue in the pedagogical process?“ was devoted to the mutual multidisciplinary relations of the mentioned science disciplines, both from the general theoretic point of view and from the viewpoint of the concrete realization of the university pedagogical process. The conference was held by the Department of the engineering pedagogy at the Masarykův ústav vyšších studií to ČVUT¹. The theoretical, research and methodical partial contributions referred in its content to the long-term international cooperation – primarily with Slovakia, Poland, Portugal, Austria, Estonia, Russia, Switzerland, Germany and Brazil².

The contents of the conference was primarily focused on the following thematic groups: philosophical basis and possible interconnection of the humanities, technological and social sciences; engineering pedagogy on the verge of the 21st century and its perspectives; innovation approaches and development of curricula in the sphere of humanistic and social disciplines at technical schools; psychological contexts in education of technicians; didactical aspects and its importance to the teaching of social and humanistic subjects at technically orientated schools; information technology and its didactical contexts; teaching of social and humanistic subjects at technical schools – research and practice. A basic condition in the process of teaching psychology, pedagogy, sociology, philosophy and other branches at technically orientated

¹ P. Andres, A. Vališová, *Abychom si lépe porozuměli (In order to understand ourselves better)*. MÚVS ČVUT: Mezinárodní vědecká konference o komunikaci jako cestě spolupráce mezi technickými, humanitními a společenskými vědami. In: Pražská technika. Nakladatelství ČVUT, 2/2013, 15. roč, p. 23.

² B. Śliwinski, *(Kontr-)rewolucja oświatowa*, Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2020.

universities is the continual reflection of teaching, as more than anywhere else the basic variables – subject, goal, methodology, knowledge - have a form of interdependence. Sometime the students – technicians approach the humanistic subjects with prejudices and the teachers – non-technicians also very frequently have recourse to stereotypes. The goal of the International conference primarily was to contribute to the discussion on such an unpopular theme.

The contemporary transition from the “information society” to the “knowledge society” brings in a number of countries the increased need for unspecified and broadly-based education that creates preconditions for variable forms of activities with information of various types³. The society is undergoing changes in the framework of gradual transformational changes and at the same time the present conception of the knowledge society emphasizes the practical aspects of work with knowledge. The knowledge as such has still its value but it is necessary to emphasize also its practical applicability and ability to transform the knowledge into practical values. This trend puts unequivocally an increased appeal to the interconnection of humanities, technological and social sciences.

The necessity of the tertiary education is at present preferred not only in our country but also abroad. The current stage of industrialization of the society, the rapid development of the technology and information technologies but also intensification of the automated production brings causes radical decrease in the number of workers in industry and agriculture. The attention is therefore inevitably shifted to the so called tertiary sphere that will probably “set the tone” in creation of the lifestyle and in the care for a man in the future. Otherwise said – at a certain level of industrialization it is necessary to switch from the quantitative indicators to the care for the quality of human life as just on it will depend the whole further social development⁴.

The intensive development of the social, natural and technological sciences causes an extraordinary pressure on all educations systems in the today’s world. There is a growing inconsistency between the quantity of findings and information that a man must manage and the limited time

³ M. Kovaříková, *Security issues as a part of University Teacher Training*, „Internal Security“ 2018, january -june, p. 9-14 ID 555221.

⁴ A. Vališová, J. Kořa, *Didaktika pedagogiky - opomíjená vědní disciplína (Didactics of pedagogy – neglected science discipline)?*, Pedagogika, Praha 1995, p. 327; B. Śliwerski, *(Kontr-)rewolucja....*, op. cit.

available to its processing and adoption. Thanks to the gradual deepening of this trend can arise problems for the school graduates connected with future finding employment. In this spirit we should primarily underline such a conception orientation that will take into account both the adaptation and anticipation institutional goals. With regard to these facts it is necessary to answer the basic question, what education contents (together with means of education and use of education methodology) will help us in preparation of the future graduates, with the aim to prepare themselves for the conditions of varying requirements of the labour market, ability to adapt themselves to the new challenges, technological innovations and conditions of the society of the 21st century. From this follows the necessity to upgrade both the contents and the conception of education in the broad sense of the word. It does not concern only mechanical processing of the new education contents, and actualization of the existing curriculum, but we are looking for an answer to a question, to what extent is our contemporary conception of the postgraduate preparation in synergy with the requirements of all social partners (and so also of the labour market), who enter into the educational process and its own reflection. We search quite pragmatically such new contents, forms, means and methodologies that will facilitate us the process of transfer of the contemporary problems, knowledge and procedures in the form of a specific transfer to the new conditions and states of the world, to which our graduates will be prepared and able to solve it creatively.

Development of teachers' technical thinking relating to social scientific subjects – an important precondition for using of ICT in teaching

Teachers of social sciences and humanities necessarily need to be educated also in the field of using the up-to-date technological means in teaching. As far as the teachers will be well-prepared in this sphere, they will be able to use many technological achievements in teaching itself effectively without “digital anxiety” but “with joyfulness”. To the precondition for permanent education of teachers of the stated subjects in the sphere of ICT belongs also the development of their technical thinking.

Creativity and technical thinking is an important building block also for teachers of social and humanistic subjects⁵. The concepts of technical creativity and technical thinking are sometimes understood as synonyms, the concept of technical thinking is in our country often replaced by the concept of creativity or technical creativity.

Before we move on to the specifics of the technical thinking concept, we will briefly define at the general level the concept thinking. In this case it concerns a mediated and generalizing, abstract process of cognition that leads to cognition of substantial, general characteristics, phenomena and contexts. It is realized by specific thinking operations (analysis, synthesis, induction, deduction, generalization, concretization, analogy). To the main forms of thinking belongs the concept (speech expression of the general and substantial characteristics, a certain degree of generalization and abstraction), appraise (expression of the relation between the two concepts) and judgement (expression of the relation between the two appraises), to the basic processes of thinking belongs in particular creation of concepts, system of concepts and solution of problems. The basic individual characteristics of thinking are its depth, width, accuracy, flexibility, criticality and creativity. The development of thinking is an important object of the education process at each level and type of school. Attention, not only in the framework of teaching of social and humanistic sciences, should be paid to the development of abstract, divergent, concretely illustrative, convergent, logical, conceptual, and creative thinking⁶.

As it is evident from the above mentioned general definition of the concept of thinking, the technical thinking is in substance its specific form⁷. This concept is very broad and relates to the broadscale nature of the concept of technology. However, it has historical and professional connections, its level and content changes in the context of development (for example technically oriented amateur or professional in the sphere of technology, different requirements for the profession of the auto-mechanic

⁵ O. Neumajer, *Jak se bude zavádět informatické myšlení a zvyšovat digitální gramotnost ve školách* (How will be introduced informative thinking and increased digital literacy at schools), Řízení školy, ASPI Publishing, Praha 2016, 13 (11), p. 20-22.

⁶ Z. Kolář a kol., *Výkladový slovník z pedagogiky* (Monolingual dictionary of pedagogy), Grada Publishing, Praha 2012, p. 79.

⁷ E. Franus, *The Dual Nature of Technical Thinking*, in: *Technology as a challenge for school curricula*, Institut of Education Press, Stockholm 2003, p. 141-144.

today and forty years ago, different demands placed on the constructors of automobile motors or by electrical engineers). Demands on the development of technical thinking, technical literacy, understanding of information and communication technologies are in essence included in the basic school documents (in the context of RVP and ŠVP).

A number of foreign authors (for example W. Kazimierski, E. Franus, C. Gilbert) dealt with the problems of technical thinking and its development. To the well-known Czech and Slovak authors in this sphere primarily belong J. Kropáč, K. Kubíček, J. Malach, O. Neumajer. The mentioned individual authors characterize the content definition of technical thinking, concretize its relation to the creativity, specify not only the content but also the process focus of the technical thinking, and last but not least they mention also the criteria of the content classification of the mentioned concept.

A number of our authors refer in their professional publications to the categorization of the technical thinking at E. Franus⁸. He distinguishes in essence four types that are specified in detail together with concrete examples.

1) Practical thinking – to this belongs:

a) Simple routine activities controlled by thinking (manipulation with tools, simple production),

b) Manipulative thinking (assembly and disassembly of technical equipment),

c) Detection (diagnostic, investigation of new products).

2) Visual thinking – this comprises:

a) Reproductive thinking (reading of technical drawings),

b) Creative thinking (planning, construction works from a simple sketch to the drawings and models)

3) Intuitive thinking – it emphasizes the enhancement of existing or creation of new constructions.

4) Conceptual thinking – this type is in particular oriented to:

a) Use of thinking operations containing words and descriptions,

b) Systems of concepts or technical categories appearing in explanations, proofs and in planning, based in particular on the analytic – synthetic thinking.

⁸ Ibidem, p. 141-144.

This classification is of course only general and in such a broad scale, that is defined by the concept of technical thinking, comprises an infinite number of further sub-groups and spheres⁹.

A natural and important mean of technical thinking development is the solution of technical problems which is a mean and also object of teaching, be it solution of problems of the cognitive character (when the analytical method prevails) or application (when the synthetic method is dominant). The recommended structure for solution of a technical problem is in particular: identification and finding of the problem; its investigation and searching the necessary data for its solution; variants and concrete proposals for the solution; process of the solution itself and evaluation of the procedures and results. The process of technical problems solution and the relating methodology of individual steps solution from the initial state to the target state are therefore in itself a subject of teaching.

To teachers of all subjects, not only of the social and humanistic character, applies the necessity to develop in particular the ability to reflect their own experiences and skills in the context of technical thinking, deduce conclusions and confront it with the practical experiments, but important is also the attention devoted to the trust in one's own thinking, that at the same time adds trust in one's own conclusions, openness to other views, acquiring findings from the research, from various information resources and traditions. Further it is necessary to devote attention also to the social aspects as are the communication skills, cooperation, work in a group, willingness to the mutual use of resources for solution of a problem, last but not least developing of the ability to reflect one's own way of learning, identification of one's own style of learning and abilities to make critical evaluations.

Searching for a dialogue between the social and technological sciences

Finding differences and common features between the humanities and social sciences, natural and technological sciences can thus be considered as a requirement resulting from the current needs of the society. In the sphere of education it should be derived from its basic objects. To

⁹ In more detail for example: J. Kropáč, *K problému uceleného pojetí výuky obecně technických předmětů (To the problem of the complete conception of technical subjects teaching in general)*, E-Pedagogium (on-line), 2004, roč. 4., č. 1; W. Kazimierski, *Dydaktyczne problemy rozwijania myślenia technicznego*, Politechnika Radomska, Radom 1998, p. 231.

the most highlighted belongs the inevitability of the lifelong education, unity of education and the needs of practice, enhancement of throughput of the education systems, flexibility of graduates and therefore also broadening of teaching of the general character. These requirements contain in itself the need of “symbiosis” of the humanities, natural, social or technological sciences, considering of its optimal interconnection in the sphere of content and also forms of education.

Presentation of specific characteristics in comparing the pedagogical and technological sciences consists in specification of understanding of both scientific spheres character. In the process of comparing it is necessary to deal with the pedagogy and technological sciences with regard to its characteristics as a whole, its substance, structure, approaches and the ways of expression of the cognition results. We will try to mention here at least some aspects of this relation.

Technological sciences and pedagogy have a significantly different subject of investigation. The pedagogy is in the professional sense science and research dealing with education in various spheres of life of the society. It is therefore not fixed only on education at school institutions and on the population of children and youth. The pedagogy, as a whole complex of education sciences, is divided in the following way – history of pedagogy; general and branch didactics; methodology of pedagogy; social, special, and comparative pedagogy; philosophy and theory of education; pedagogical evaluation, diagnostic, education politics and so on.

Is it possible to define briefly at least some common characteristics of the pedagogy and technological sciences? On the basis of the professional literature it is possible to mention in particular the following authors¹⁰:

- Integrative flexibility - technology and technological sciences combine and take into consideration not only natural technical elements but also elements of mathematic, nature and natural sciences, ecological, economical, social and other elements. The technology does not serve only to technical purposes. Education and also pedagogy similarly contain aspects of philosophy,

¹⁰ J. Kropáč, Z. Kubiček, *Zaměření konference „Trendy technického vzdělávání“ - oborová didaktika technických předmětů (Topic of the conference „Trends of the technical education“ – branch didactics of the technical subjects)*, in: *Trendy technického vzdělávání 2001*, Univerzita Palackého, Olomouc 2001, p. 3-6.

psychology, sociology, nature and natural sciences, economical, technological, social and other aspects.

- **Concreteness** – technology and technological sciences have relatively concrete goals resulting from the needs of the society. Fulfilment of these goals means to create new or enhance the existing technological systems. To this purpose are focused technological sciences more concrete on the one hand and also more general on the other hand, in the technology are further used (and by technological sciences to this purpose often transformed and synthesized) results of other relating sciences. Education and pedagogy fulfil also goals resulting from the needs of the society, which entails creation of new or enhancement of the existing educational or pedagogical systems. In the pedagogy are reflected disciplines, in particular concrete but also general, pedagogical and other disciplines, the findings of which can influence the development of pedagogy.
- **Operating flexibility** – it is unquestionable that pedagogy and also technological sciences show how to proceed optimally. To this purpose it offers in particular a 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 technological sciences, purposive analysis of the process of elaboration and solution of tasks and problems of the stated sciences.
- **Creativeness** – the sense of pedagogy and also of the technological sciences is creating of something new, up to now non-existing, better, more advanced (technical creativity, and pedagogical creativity of the teacher). To this purpose it offers ever more thorough findings, rules, laws, theories, evaluations and proceedings which concern on the one hand the practical realization but on the other hand the realization is no directly anticipated.

The need of a multidisciplinary approach to the humanities, technological and social sciences is reflected for example in the fact that engineers – technicians try to fulfil in particular technical requirements needed for the design, projection, construction, production and operation of the technical equipment. No less important are also economical and environmental requirements which could not always be solved

unequivocally and are sometimes even contradictory. In addition to that accede also questions of the social impact of implementation of the technological equipment, which cover besides other things also ergonomic, ethical, aesthetical and legal viewpoints.

Up-to-date didactical and computer technology cannot be introduced into teaching of the social scientific and humanistic subjects at any cost, however always with deliberation and with regard to the fact what kind of function will these means fulfil and in what way it can contribute to the fulfilment of specific goals of teaching¹¹. If we proceed from the premise that these means are for the contemporary generation popular, it is absolutely necessary to think over also the education possibilities of individual contents which we try to mediate to the end “user” in association with the electronic equipment (computers, tablets, smartphones, interactive tables and other things). Our primary goal does not constitute an up-to-date mean but the methodology which enables the secondary school students to develop their knowledge, skills, talent and creative potential. Very important in these cases, and also in the case of the classical education, is the didactical transformation of the curriculum which takes into account the basic pedagogical, psychological and didactical aspects of preparation of these up-to-date e-materials, not only at the level of the technical processing which is just one of the stages.

What to say in conclusion?

In spite of the fact that up-to-date technical means quite considerably pervade the process of teaching, the humanization tendencies in teaching are currently getting stronger in all subjects. Humanizing influence of the school, and education cannot get along without interpersonal communication, natural contact of the teacher and students. Hardly any technique can replace interpersonal relations which come into existence in the process of teaching among the individual participants of the pedagogical interaction. It is often spoken about the so called social profit which is an important aspect in forming of the student’s personality in the education process. It leads naturally to sharing of one’s own feelings, emotions, values, knowledge and experiences, to the social interaction and also to the gradual crystallization of one’s own thoughts, ability of presentation of one’s own stances, opinions and arguments, since these forms

¹¹ M. Kovaříková, *Security issues ...*, op. cit..

cannot be realized only “virtually” through the systems in support of the electronic education. These systems can exist as a supplement to the present-day traditional education systems when the distance preparation is realized beside the attendance (contact) part of education.

At the contemporary paradigm of the Czech education system it is also necessary to take into account the preparedness and conditions of individual schools and teachers and their relation to these up-to-date didactic means. There is often necessary to overcome some information barriers and stereotypes which can prevent understanding of the substance and importance of introduction of these technologies into the environment of schools. The stated problems indicate that application of ICT in education is in no way a simple matter (as is often wrongly presumed by those who technically secure it). This significantly applies also to teachers of social scientific branches.

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Technologia cyfrowa w kontekście nauczania nauk społecznych w szkołach średnich

Celem artykułu jest wniesienie wkładu w problem niedostatecznie rozwiniętych kompetencji cyfrowych nauczycieli przedmiotów społecznych w ramach szkolnictwa średniego. Rozwiązanie tego problemu opiera się na założeniu, zgodnie z którym jeśli nauczyciele nie będą kompetentni cyfrowo, nie będą oni w stanie rozwijać kompetencji cyfrowych uczniów. Fakt ten może negatywnie wpłynąć na ich zdolność do znalezienia pracy na rynku pracy XXI wieku, gotowość do dalszej edukacji zawodowej oraz możliwość uczestniczenia w procesie uczenia się przez całe życie. Tekst rozwiązuje problem integracji technologii cyfrowych oraz nauczani anauk społecznych, kładzie nacisk na multidyscyplinarne podejście do nauk humanistycznych, społecznych i technicznych, przedstawia potrzebę rozwoju technicznego myślenia nauczycieli w zakresie nauk społecznych oraz wskazuje cechy wspólne i różnice pomiędzy naukami pedagogicznymi a naukami technicznymi. Przedstawione opracowanie stanowi rezultat projektu TAČR (PID: TL 01000192, w okresie 02/2018 - 02/2021). Bazuje ono na podrozdziale „Integracja technologii cyfrowej w nauczaniu nauk społecznych”, który zostanie ujęty w przygotowywanej monografii zatytułowanej „Rozwój kompetencji cyfrowych nauczycieli w zakresie nauk społecznych w szkołach zawodowych”.

Słowa kluczowe: technologia cyfrowa, modernizacja nauczania, społeczne przedmioty ścisłe, pedagogika, myślenie techniczne, humanizacja, edukacja frekwencyjna, urządzenia elektroniczne, kompetencje ICT, nauki techniczne, kreatywność, podejście multidyscyplinarne, społeczeństwo informacyjne.

Digital technology in the context of social science teaching at secondary schools

The goal of the study is to contribute to the problem in hand regarding the insufficiently developed digital competencies of teachers of social scientific subjects within the secondary education. The solution to it is based on a precondition that if the teachers will not be digitally competent they will not be able to develop the digital competence of students. This fact can negatively affect their ability to find employment at the labour market of the 21st century, preparedness to further professional education and ability to participate at the lifelong learning. The text at issue solves the problem of digital technology integration into teaching of social sciences, emphasizes multidisciplinary approach to the humanities, social and technological sciences, presents the need of development of teachers' technical thinking relating to social scientific subjects and specifies common features and differences of the pedagogical and technological sciences. The study is the actual output of the project TAČR (PID: TL 01000192, in the period 02/2018 – 02/2021). It is based on the sub-chapter "Integration of the digital technology into teaching of social sciences" that will be embodied in the currently prepared monograph "Development of teachers' digital competencies relating to social scientific subjects at vocational schools".

Keywords: digital technology, upgrade of teaching, social scientific subjects, education sciences, technical thinking, humanization, attendance education, electronic devices, ICT competency, technological sciences, creativity, multidisciplinary approach, information society.