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Didactics of technical subjects at secondary schools in Czech Republic - development, state and perspectives

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Abstract

The paper gives an overview on the origin and historical development of didactics of technical subjects at high schools in Czech Republic. On the selected research findings we analyze the current situation and we suggest the way of further development of didactics of the technical subjects with emphasis on the importance of research activities and development of teaching methods in this area.

Didaktik der technischen Fächer an weiterführenden Schulen in der Tschechischen Republik - Entwicklung, Stand und Perspektiven

Zusammenfassung

Die Absicht der vorliegenden Studie ist es, den Ursprung und die historische Entwicklung der Didaktik technischer Fächer an weiterführenden Schulen zu skizzieren, darüber hinaus die aktuelle Situation zu analysieren und ihre Entwicklungsmöglichkeiten zu erörtern. Angesichts des Umfangs der Problematik wird der Fokus auf die Schlüsselthemen gelegt, welche die wichtigsten Trends der Didaktik mit Schwerpunkt auf die Bedeutung der Forschung und die bisherigen Entwicklungen in diesem Bereich charakterisieren. Präsentiert werden ausgewählte Forschungsergebnisse bezogen auf Unterrichtsmethoden und technische Kreativität der Schüler in technischen Fächern an diesen Schulen.

Keywords:	*Schlüsselwörter (German keywords, optional):*
Subject didactics	Fachdidaktik
Didactics of technical subjects	Didaktik der technischen Fächer
engineering education	Ingenieurausbildung
scientific research in the didactics of technical subjects	die wissenschaftliche Forschung in der Didaktik der technischen Fächer

1 Introduction

Didactics of technical subjects in the Czech Republic is relatively young pedagogical discipline, which is currently gaining in importance along with the other subject didactics and becomes a respected area of cognition of reality. Evidence of the increase of subject didactics is the existence of the permanent working group for subject didactics as a part of Accreditation Commission. As other subject didactics its evolution reflected various concepts and structure of the discipline. Its importance and necessity arises from the

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developing of the technical reality around us. Nevertheless, the current state of didactics of technical subjects is not satisfactory.

In the context with seriousness of this fact, we set a goal to map out key moments in the development of didactics of technical subjects in the Czech Republic, including perspectives of its further development. We focused on key moments of its development with regard to specificity and interdisciplinary this area of knowledge, with an emphasis on research activities. This overview study may be an inspiration for didactics focusing on technical vocational subjects in secondary schools not only in the Czech Republic.

2 Basic resources, definition of solved topic

Didactics of technical subjects is not simply a free compilation of pedagogical-psychological disciplines and the respective technical branch but a discipline which seeks concepts and clarifies answers to the questions why, what, how, who, by whom, when and where to teach vocational subjects (Stuchlíková, 2015).

To specify the scope of didactics of technical subjects, it is necessary to present related terms and to put its application in a broader context. The mission of vocational high schools is to prepare students to pursue a given job. The basic components of educational activities are the area of both general and vocational education. Under vocational education we understand teaching theoretical vocational subjects and practical training, (vocational training, all exercises, professional experience). We can divide vocational theoretical subjects at two major groups - technical subjects and vocational subjects focusing on trade and services. The third group contents vocational subjects that cannot fit neatly into any of the previous group (e.g. agriculture, health, objects of police preparation ...). We see that the role of didactics of vocational subjects is not easy. It represents a group of didactics with very wide-ranging. Didactics of technical subjects is the discipline that applies generally didactic knowledge on transformation of the results of the technical sciences to a group of technical vocational subjects in vocational schools (Bajtoš, Pavelka (1999), Čadílek, Loveček (2005). Closest to the current concept of didactics of technical subject is the definition, which states that "didactics of technical subjects deals with issues of requirements of practice and labor market on training of qualified technicians, by establishing educational objectives, teaching content, applications of didactic principles, precepts, rules, teaching methods, organizational forms and material resources for teaching technical subjects in vocational high schools. Its scope includes issues related to demands placed on teachers, on students and issues related to educational influence during teaching (teaching technical creativity, development and formation of student‘s personality, moral upbringing, etc.). Equally important is addressing to policy of technical education, issues related to the fields of education and then also issues related to vocational education, professional qualifications, lifelong learning and retraining "(Pecina, Sládek, 2013). For the didactics of technical subjects (as for general didactics) are important two moments: Binding transition and application of the general to the specific and of specific to a concrete (meaning in training and education). It includes the examination of the objective laws of teaching/learning process of given technical subject. However, we must not forget their subjective nature, based on the experience of teachers. The starting point of didactics of technical subjects relevant to school degree school are therefore not selected concrete technical subjects, but a set of technical disciplines with their content and specific needs. Systems of didactics of technical subjects are largely national affairs.

3 Historical development of didactics of technical subjects in Czech Republic

Development of didactics of technical subjects was partly influenced by general trends in the development of educational disciplines and subject didactics and partly by development of technical sciences and by the development of political and educational systems. Until the mid-twentieth century we cannot think about any system of didactics of technical subjects and about any system of training of teachers of technical subjects. Technical education was realized by teachers, engineers or craftsmen who educate future workers in the relevant profession. Origin and systematic development occurs in the fifties of the twentieth century, when it was introduced a pedagogical training of engineers-teachers of technical subjects. During the development of didactics of technical subjects for secondary education it was born an optimized discipline - engineering pedagogy. Its origin dates back to the sixties of the 20th century (German Democratic Republic). In 1972 it was

founded International Society for Engineering Pedagogy (IGIP - Austria). Further development in the 80th years of the 20th century resulted in the unification of additional teacher training for non-teaching study programs.

In the Czech Republic, there were formed learning and information centers for the economic training on vocational schools, aimed to support education on economic and other professional schools in the 50s of the 20th century. In the following period, the Research Institute of Vocational Education was founded, under whose authority were the issues of vocational technical education. Another milestone was in the mid-60s, when the Ministry of Education issued a directive on supplementary pedagogical studies and at same time it has been established departments and cabinets of education on non-teaching universities. In the 70s they were published some valuable studies that can be included within the scope of vocational technical education (Vlášek, 1976, Vlášek, Průcha, 1978). These studies were based on empirical research of teaching system of technical subjects and on the process of acquiring psycho-motoric skills in practical training in technical branches.

After 1989 the political and social changes significantly influenced the development of subject didactics. It started a move away from the communist system of education and one-sided focus on Soviet and Eastern pedagogy. It was thus opened the gate to the Western countries and the ability to draw information and experience from Western countries. Nevertheless in 90s there has been certain stagnation, which is due to disregard of subject didactics as a discipline. Didactics of technical subjects is pushed by works of I. Turek, A. Melezinek, J. Kropáč, J. Bajtoš, M. Čadílek and J. Drahovzal trying to reflect the current state of the topic.

The period after 2000 is under the sign of the curriculum reform and the introduction of general educational programs into vocational high schools.

In summary, it can be seen some important moments in the concept of didactics of technical subjects. After its formation it was developed as a practical discipline, without a deeper relationship to pedagogy as a science. Its content was created primarily by experienced teachers from their teaching practice. This resulted in practicismus preferring specific procedures and guidance to teachers in order to facilitate teaching activities. Theoretically based systematic methodological work is unfortunately absent (Kilian, 2008). This application concept didactics is now obsolete (Nezvalová, 2011). Currently we approach to design scientific based didactics of technical subjects giving to teachers a number of teaching strategies (methods, forms and means) that were justified by adequate educational research.

4 Current state

In the academic year 2014/2015 it was registered a total of 544 vocational high schools that prepare graduates in technical branches in the Czech Republic (http://www.seznamskol.eu/typ/stredni-skola/). We estimate 15 to 30 teachers of theoretical vocational technical subjects and a similar number of teachers of practical instruction on each vocational high school. These teachers have opportunity to gain pedagogical skills at the in the following institutions:

- Lifelong Learning Institute at Technical Universities (Brno, Prague, Liberec …).
- Faculties of Education (Brno, Olomouc, Ústí nad Labem ...).
- Other institutions (schools, training centers, etc.).

Unfortunately there are not many studies published in this area. In particular, there is a lack of systematic studies, books, research reports, textbooks. There is any institution acting as a national authority. Research activities are fragmented, complex research teams are the exception. This state is partly caused by low interest of young people in technical branches appearing after 1989, when the youngsters were attracted in the humanities that were not supported under previous regime. At the same time it was opened new possibilities for traveling and free life style. Moreover, society has no demand (and no source of funding) for technical education. Politicians together with representatives of the industry have begun to realize this unfavorable development in the second half of the first decade of the 21st century. This was a beginning of the foundation of few educational departments. Positive step was the start of peer-reviewed scientific journal JTIE (Journal of Technology and Information Education) in 2009, which focuses on publishing the results of theoretical studies, research activities and scientific works http://jtie.upol.cz), followed by the Lifelong Learning journal. However, some papers oscillate in the general educational level and the application potential is insufficient.

In the period 2000-2015 the effort in the didactics of technical subjects is obvious. Few EU supported project were focused on reforming curricula in vocational education at universities (e.g. at Masaryk University Brno, Faculty of Education we prepared "Innovation of bachelor study program Teacher of Practical Training" including innovation of 30 courses and creation new elective courses accompanying with textbooks and study

supports (http://upv.ped.muni.cz/, Sládek - head of the project). Some research activities are also seeing in dissertation and diploma thesis.

5 Scientific research activities in the didactics of technical subjects

Didactics of technical subjects uses fully a scientific research methodology of educational sciences. The scientific research in the field of didactics of technical subjects is based on teaching tradition, the work of successful teachers of technical subjects and on scientific investigation (Drahovzal, Kilian, Withers, 1997). Because these findings are mostly individual and subjective the scientific research must convert them to objective and generally valid conclusions.

In the Czech Republic the didactic research in the field of vocational technical education has no such a rich tradition as in some other countries (Germany, USA, and UK). Only few research activities are systematically and permanently directed towards the vocational technical education. Selected research surveys have been implemented within the theses in study program “Teacher of vocational subjects” at the Faculty of Education at Masaryk University Brno (CZ). These surveys were focused on the use of teaching methods by teachers of vocational subjects and on the aspects of development of creativity of students in technical subjects. The research on the technical creativity through project-based learning was published by J. Novotny and J. Zukerstein J. (2007). The subject of our research interests are teaching methods in the work of teachers of technical subjects at vocational high schools (Pecina, Svoboda, 2015).

The research survey (J. Wasserburger, 2010) among teachers at vocational high schools in Vyskov and selected schools in Brno shows, that teachers use activating teaching methods. However, the frequency of the use of educational games, brainstorming, and methods of problem solving tasks is relatively small. Teachers also emphasize the problems with the integration of these methods into teaching - time pressures, weaker pupils, insubordination. Another important finding is that teachers confuse the term "educational problem" with disciplinary problems, problems with understanding the curriculum, learning disabilities, etc.

In our research, we investigated which creative teaching methods are used by teachers of technical vocational subjects (except practical training) in vocational high schools and what knowledge about the methods they have. The research (questionnaires and interviews) was carried out at 13 secondary schools in South Moravia. The obtained data show that the traditional educational methods (explanation, description and writing to worksheet) are the most used methods. Positive finding is that high numbers of teachers also use discussion methods (conversation, dialogue, debate). Computer supported teaching is used in a variety of degree. Research has found that twiddling and experimentation, observation of objects and phenomena, and practical demonstrations are applied a little in teaching/learning process, which is not favorable in teaching technical subjects (Pecina, Svoboda, 2015).

6 Perspectives

In the Czech Republic, we are seeing the lack of graduates from technical schools. Therefore, there are discussions between representatives of companies and industry with the Ministry of Education to further promotion and development of technical education. Nowadays there is a tendency (proclamation) to support the vocational technical education at all school levels. Didactics of technical subjects obviously become more important and therefore it will open the scope for its development. The National Institute of Education implements projects that are focused on linking and streamlining of theoretical and practical training in technical subjects. The strategic objective is to support master's degree courses focusing on vocational education (vocational subjects), including bachelor's level (Teaching of practical training), and to support additional pedagogical studies for graduates of technical colleges. To strengthen technical subjects in high schools we need not to neglect general subjects at grammar school. This situation requires preparing teachers of all school types in advance. Therefore, it is necessary to strengthen both personally and professionally teams dealing with technical education. Staff in didactics of technical subjects must be people with both the quality in pedagogical education and in technical sciences. An experience of teaching in vocational high school is an advantage for them.

Another desirable step is mutual cooperation of teams from universities and corporate training centers with ambition and willingness to solve scientific research and development projects.

7 Conclusion

The present overview study analyzes the historical development, current status and possible development of didactics of technical subjects in the Czech Republic with an emphasis on scientific research as the basis of its scientific nature. Particular attention was paid to the key moments in the development and current state. Presented are selected research findings on the issue of teaching methods and technical creativity of students in vocational technical subjects in vocational high schools. Further work in the didactics of vocational subjects should be directed to cooperation, to funded research activities and to the creation of sophisticated textbooks and instructional supports. The existing system of didactics of technical subjects is facing many demands of today. It should reflect the rapid development of science and technology, new cognitive structures, the emergence of new fields of contemporary aspects of the use of educational multimedia and much more. The efforts of experts in this area should focus on putting the institutional ground by creating a national authority.

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