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The global perspective of technics in education

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Abstract: *A characteristic of production-oriented economies of the developed countries is that they demand technology literate students from their educational system. The paper presents key characteristics of technics in education with reference to the international standards and subject development perspectives. Modern education involves multidisciplinary knowledge and the production in digital environment, so the student skills and competencies make a complex kaleidoscope.*

Keywords: *technics; education; perspective*

1. INTRODUCTION

Technics and technology are important factors in any modern society, whether we use them in private or professional life. The introduction of technology in economics, culture, healthcare, and society, ensures the sustainable development, encourage innovations, change our habits, lifestyle and professional performance. Technical education enables the acquisition of fundamental technology knowledge base and the ability to adapt the use of technology to private, social and professional needs. Technologies gave us mobility and communication as the fundamental social changes and defined the way how we see ourselves in modern society. Having in mind the perspective and the importance of technics and technology, it should be expected that technics education is a key element of the curriculum. Developed countries, such as Germany, United Kingdom, Netherlands, Australia, USA, etc. are explicatory in having technics/technology education in compulsory education framework [4] [7] [8].

Many researchers have studied the legitimacy and the emancipation of technics education [10], and they stated four basic characteristics:

- Educational theory – based on two key elements: (1) students must be prepared for society and life; (2) technology makes the integral part of the culture. The educational potential of technics is reflected through understanding, construction, evaluation and technology design. Having in mind the technology-oriented environment, the educational theory perspective implies that everyday use of technology is active participation in society. Social participation is the key educational goal of technology literacy in creating ITEA standards [6];
- Epistemological stance – technology science is considered to be a separate interdisciplinary science. Its interdisciplinarity is reflected in close cooperation with

the science and engineering, philosophy, sociology, and economy;
- Sociological impact – new technologies (e.g. Internet) can become the important factor in social changes [4];
- Practical professional importance – it is assumed that technical skills in combination with intelligence will induce the success in education [2].

The examples of international standards and the basic characteristics of technical/technology education are further presented.

2. INTERNATIONAL STANDARDS FOR TECHNICAL/TECHNOLOGY EDUCATION

The introduction of educational standards is aimed at providing the results of education and improving the teaching quality. Specific subject goals are formulated through skills that Weinert [15] defined as the cognitive abilities and skills that individuals possess or can learn aimed at solving specific problems in various situation. Skills should be modelled in accordance to the subject specifics. Unlike traditional science subjects, such as physics, chemistry or biology, educational standards for technical education does not exist in cross-countries unique framework. This consequence is due to the fact that standards for technical/technology education were usually created by interested groups (e.g. ITEA – International Technology Education Association, AAAS – American Association for the Advancement of Science, VDI – Verein Deutscher Ingenieure) based on the curriculum of different countries. It should be noted that there are cases that technical education does not exist as a subject in formal education.

A selection of relevant international educational standards and curricula for technical education is further presented:

- Delphi-study [11] presented the results of technical education key goals analysis. The study was prepared and participated by the 32 internationally recognized experts in the fields of education, philosophy, history and communication. Resulting five concepts that technical education must meet were: designing (optimization, specification), systems (structures, functions), modelling, resources (materials, energy, information) and values (sustainability, innovation, social interaction).
- ITEA International standards for technological literacy [6] included the proposed educational programmes from pre-school to secondary level of education. They are based on the concept of literacy and are not in the form of binding curriculum, but serve as a basis for creating educational standards by state institutions. The pragmatic literacy concept is based on PISA assessments and is oriented on practical knowledge. Technological literacy is defined as the ability to use, manage, assess and understand technology. The standard is divided into five clusters: properties of technical products and processes, technology and society correlation, design and construction of technical products, necessary skills for living in a world of technology, and technology world.
- AAAS standards [1] are formulated for 12 areas of subjects from kindergarten to secondary education. The areas are connected by mathematical, scientific, and technological perspective. The “Nature of technology” subject is defined by three clusters: technology and science, design and systems, and problems in technology.
- Educational standards of the German engineering association for the Technology subject [12] are created for five skill areas: understanding technology (goal, function,

concepts, structure), design and production (planning, optimization, technical solution testing), using (selecting technical solution, application), technology evaluation, and communication (relevant information exchange). According to the concept, teaching should be based on the development of components that are needed for solving technology-oriented real-life situations and the preparation for using technology in private and professional life.

Based on the analysis of various approaches for technical education, we specified some general subject characteristics:

- Subject area and/or clusters of technical education are based on modern contexts and activities;
- Technical contents are only implicitly described;
- The concept of technology literacy is clearly focused. The subject goals are generalized and oriented towards practical knowledge;
- The subject areas are closely related to engineering domains;
- Skill areas (cognitive, action, communicative, and evaluative) are largely identical to the structure of skills in natural sciences (biology, chemistry, physics);
- Conceptualization is focused on problem solving approach and action-oriented implementation.

3. PERSPECTIVES OF TECHNICAL/TECHNOLOGY EDUCATION

Papers related to the issue of technical/technology education are mainly conceptual and descriptive in nature [3] [5] [9]. A rare empirical studies [13] [14] may offer a starting point for defining perspectives for future research that should be directed to the development of technical/technological literacy. The key development perspectives are further emphasized.

3.1. Methodics improvement

So far we have mainly relied on the use of results of researching secondary education needs to define the subject content and create the basis for further development. However, this approach has its limitations because it has shown that it is not practical to focus neither on gymnasium or vocational education. In the first case, often there is no vertical relationship with the gymnasium subjects, which is an obvious lack of secondary level of education. In the second case, studied areas and the level of knowledge and skills gained in primary education are not suited to the needs of vocational schools, so they are often forced to repeat the contents that should already be adopted.

Given the wide range of areas of technical education, it would make sense to empirically study the way in which educational practice theoretical approaches could contribute to the desired skills development and the promotion of technics and technology.

3.2. Skills development

The question is whether the structure of adopted skills can be applied to the integrative concepts of teaching technology. There is a risk that the technological perspectives, characteristics and methods are inadequately considered, and that teaching technology is limited to its application. The analysis of student interests should examine the relation between adopted technical/technological skills and the selected educational direction or future profession.

3.3. Skills evaluation

Educational standards for technical education can be effective in quality assurance if the appropriate skill assessment instruments can be developed. It is necessary to clarify whether normative educational standards can be empirically tested by skills demonstration.

3.4. Digitalization

Technological development and innovations has digitalized virtually all technics and technology modalities in modern industry. Technical/technology education must be more flexible in adjusting to constant rapid changes to retain expediency. The demands placed upon future workers are increasingly stringent, as processes become more interrelated and complex, especially in the industry. Lifelong learning, development of IT competencies and interdisciplinary thinking skills will become the basic requirements of specialized workers.

3.5. Teacher education

Professional knowledge, values and motivation are the proven factors for shaping teacher skills. Given the wide range of disciplines associated with technical education (biology, chemistry, physics, civil engineering, electrical engineering, mechanical engineering, IT, sociology, etc.) raises the question of teacher scientific skills and professional methodic profile. The extent of knowledge expected from future teachers is extremely large and complex, while the timeframe of their training is limited. This fact indicates a potential structural problem of developing only basic technical knowledge and skills in accordance only to the needs that are defined by the subject programme. It is necessary to establish and acquire the key skills and competencies that teachers must possess in order to meet the scientific and professional requirements.

3.6. Serbian perspective

Technical education is taught in Serbian primary education for several decades, first as sole subject, and later in the form of Technics and informatics education subject. Unfortunately, we have witnessed the current uncoordinated signals from the Serbian educational policy makers, where on one side the introduction of dual education is represented as the effective example of incorporating education and the economy mainly by educating personnel in various areas of production-oriented technics/technologies, and on the other hand an ad hoc splitting of the Technics and informatics subject, with the aim of directly reducing the number of hours of technical education and the creation of a new, this time a service-oriented subject named Informatics. It should be noted that this process is not under the control of the professional and academic community, but is led through adopting decrees without clearly defined educational standards, outcomes, projections, and ultimately, accountability.

This kind of “reforms” are not unknown to the Serbian educational system, and often have proven to be failures, so the generations of students were deprived of the opportunity to acquire a variety of competencies, skills, and knowledge. The efficiency and effectiveness of the Serbian educational system is clearly reflected in the PISA and TIMSS assessment results, which is something that should first need to direct resources at.

4. CONCLUSION

Teaching technical education is a major challenge due to the complex spectrum of areas taught and the relations with other disciplines. Attempts on international standardization of the subject did not achieve satisfactory results, primarily because the operationalization on the level of individual countries inevitably highlighted the diversity of socio-economic environments which lead to the limitations.

Technical/technology education is not traditionally considered as the fundamental science, although it directly affects the acquisition of knowledge and skills necessary for future professional performance. Developed countries with the production-oriented economies are making great efforts on the subject development and modernization, and it is often taught in secondary education, also. Industry trend projections show the decrease in the need for academic knowledge, and correspondingly higher demand for skilled, technical/technological literate and IT-competent workforce, which is a clear indicator of importance that technics and technology will take in the future educational settings.

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