Chapter 6
Continuity in the Development of Technical Thinking

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ABSTRACT
This chapter addresses the development of students’ technical thinking using modern technological tools. The aim of the chapter is to show for academics of technical subjects how to increase the efficiency of the learning process with the help of ICT according to the realization of the requirements of the basic principles of didactics. Emphasis is placed on the need for consistency between general education and higher education institutions (HEI) in designing and developing technical thinking and the structure of the technical thinking and its components and how different components of thinking vary in different learning methods. The use of virtual and augmented reality learning environments to enhance student interest and learning motivation and to develop spatial thinking is discussed. Many didactic opportunities and economic advantages of using a web based remote laboratory (RL) and virtual laboratory (VL) are discussed.

INTRODUCTION
The rapid development and availability of information and communication technology (ICT) tools to schools has created a situation where education at any level is not expected to be a learning process without ICT tools. New teaching technology makes learning more interesting and increases the motivation of students (Gordon, Grey & Brays, 2015; Bogusevschi, Muntean & Muntean, 2019). It has also made the work of teachers and academics easier and more efficient when these tools are skilfully used. Researchers and practitioners who claim that ICT alone cannot improve the learning process can be accepted, but ICT can create and enable new methods to make learning more effective and to motivate students to educate themselves (Trepule, Tereseviciene, & Rutkiene, 2015).

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The rapid development of aforementioned information technology systems has been achieved specifically due to the implementation of digital technology in radio electronical circuits and the digital signal processing in circuits. However, there is one discrepancy between the rapid development of digital technology and its teaching. There is little research on technical thinking in learning digital technology and designing new systems. This chapter explains the difference in between technical thinking abilities that occur when dealing with digital and analogue systems and learning.

The aim of this chapter is to deal with the use of technology mediation in consistent design and development of young people’s technical thinking in general education and technical schools. In order to achieve this, the didactic possibilities of these tools have to be exploited and new solutions should be sought which will allow a further development and wider use of these tools in education.

Academics of technical subjects at HEIs are mostly educated in engineering and able and motivated to acquire new learning techniques independently and use the technical possibilities. However, often novice academics lack the pedagogical knowledge and experience. Considering this, the chapter focuses on possibilities of the technical tools, the skilful use of which promotes the realization of didactic principles in learning process and ensuring a student to acquire the materials effectively.

This chapter consists of four main parts. The first introduces goals for using ICT tools in learning process and a need to realize basic principles of didactics. The second gives an overview of structure of technical thinking and technical thinking in digital and analogue technology. The third discusses use of VR and AR in learning. The fourth explains web-based RL and VL experience.

BACKGROUND

The term “technical thinking” was first used by an engineer and philosopher P. K. Engelmeyer in his book “Filosofija tehniki 1” (Philosophy of Technology, Vol. 1), which was published in Moscow in 1912. He refers to the thinking of technology as a value that ensures success in technical learning and the creation of new technology, but he does not explain technical thinking and its characteristics (Muhina, 2012).

In this chapter, technical thinking is understood according to Muhina (2012) as a complex of intellectual processes and resulting results, which assure the solving of assignments in the field of technical professional activity.

Successful learning and action in the technical field requires good technical abilities, especially technical thinking, which must be developed by preparing specialists in the field. The necessity for the need of developing technical thinking in young people has been pointed out by several researchers (Kudryavtsev, 1975; Autio & Hansen, 2002; Menger, 2010; Muhina, 2012; Nigmatov, 2015; Sniadkovski & Maj, 2015; Fuchsova & Korenova, 2019). It is particularly important to develop technical thinking while training engineers in higher education (HE). In order to educate engineers effectively, it is important that continuity in the design and development of technical thinking in general education and higher education is assured (Nigmatov, 2015; Mäeots & Umborg, 2017).

Nowadays, besides the problem of technical thinking, discussion on possibilities of artificial intelligence have more actively emerged in society because of rapid developments in robotics. Once again, the question been fascinating for several generations is raised: can human create a thinking machine?

During the period of 1960 until 1970ies, there was a significant rise in the research activity on the field of technical thinking. Then the widespread development of computing technology began, first communication satellites were launched to orbit that enabled the development of global communication...
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