

Chapter 28

Computers and Artificial Intelligence in Future Education

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ABSTRACT

This chapter focuses on the role computers and artificial intelligence could play for future education in our modern society of knowledge and globalization. The rapid industrial and technological development of the last 150 years has caused radical changes to the traditional human society. As a result, formal education at all levels, from elementary to tertiary, faces the great challenge of preparing students for the forthcoming era of a new but not yet well-known industrial revolution, characterized by the internet of things and energy and the cyber-physical systems controlled through it. It is concluded that it is unlikely for computers and other “clever” AI machines to replace teachers in the future, because all these devices were created and programmed by humans. It is therefore logical to accept that they will never be able to achieve the quality and independence of human thought. However, it is certain that the role of the teacher will dramatically change in future classrooms.

INTRODUCTION

The rapid industrial and technological development of the last 150 years caused radical changes to our lives and behaviours, transforming the traditional and mainly agrarian human society of the last centuries to a modern society of knowledge and globalization. Machines especially designed for massive industrial production, computers, robots and various other “clever” mechanisms and methods of **Artificial Intelligence (AI)** have already replaced humans in an increasing number of routine jobs. This continuous development of new technologies could create many new, yet unforeseen jobs in the future. As a result, formal education, from elementary school to university, is faced with the great challenge of preparing students for a new way of life in a rather uncertain future of the forthcoming era of a new, but not yet explicitly known, industrial revolution, as the outcomes have not yet been fully determined.

DOI: 10.4018/978-1-7998-7638-0.ch028

The objective of the present work is to express some thoughts about this challenge and the difficulties connected to it. In no case, however, can this chapter be considered as an attempt to fully analyse the topic mentioned above, because such an effort requires hundreds of pages, as most of the subjects related to education need to be integrated. The focus here is turned mainly to the role computers and AI could play in future education and the risks associated with this perspective.

The rest of the chapter is organised as follows: In the Background Section the traditional learning theories and teaching methods are exposed and a connection is made between the past industrial revolutions and the forthcoming new one, which could be characterised as the era of the *Internet of Things and Energy (IoT & E)* and the *Cyber-Physical Systems (CPS)* controlled through this type of advanced Internet. The Main Focus of the chapter discusses the role of computers and *Computational Thinking (CT)* in modern education, the recent developments and perspectives of introducing methods and mechanisms of AI to education and in particular of *Case-Based Reasoning (CBR)*, *Bayesian Reasoning* and *Fuzzy Logic (FL)*. Future directions of research and final conclusions follow, and the chapter closes with a list of references and additional readings, as well as a summary of the key terms and definitions contained therein.

BACKGROUND

Traditional Learning Theories and Teaching Methods

Learning is one of the fundamental components of the human cognitive action. In psychology and education, it refers to a process that combines cognitive, emotional, and environmental influences for acquiring or enhancing one's knowledge and skills. Volumes of research have been written about learning and many theories and models have been developed by the specialists for the description of its mechanisms. There are three main philosophical frameworks under which learning theories fall:

- **Behaviorism**, a theory established by the American psychologist John B. Watson (1878–1958), which considers learning as the acquisition of new behavior based on environmental conditions and discounts any independent activities of the mind (Cherry, 2020).
- **Cognitivism**, which replaced behaviorism during the 1960s as the dominant theory for the process of learning and argues that knowledge can be seen as a process of symbolic mental constructions and that learning is defined as change in individual's cognitive structures (Wallace et al., 2007). More explicitly, the learning process involves representation of the stimulus input, i.e., use of the contents of one's memory to find the suitable input information, interpretation of the input data to produce the new knowledge, generalization of this knowledge to a variety of situations and categorization of it in the already existing learner's cognitive schemas. In this way the individual becomes able to retrieve, when necessary, the new information from his/her proper cognitive schemas and to use it for solving related problems. Changes in the learner's behavior are in fact observed, but only as an indication of what is occurring in his/her mind. In other words, cognitive theories look beyond behavior to explain the brain-based process of learning.
- **Constructivism**, a philosophical framework based on Piaget's theory for learning and formally introduced by von Glasersfeld during the 1970s, which suggests that knowledge is not passively received from the environment, but is actively constructed by the learner through a process of ad-

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