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# AI and Cognitive Modelling for Education

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# Preface

Young brains come to school to learn, older brains come to school to teach them. At least, that's the ideal. The rationale for writing this book were the questions: *can cognitive neuroscience tell us anything about how young brains learn from older brains, and therefore how older brains should teach younger brains for optimal effect*? (Geake, 2009); and, additionally: *can AI and the theory of cybernetics add something important to this process?*

The system of knowledge between younger and older brains changes in such a way as to distribute the knowledge between the two. By way of analogy, a similar thing can be said about the system of transferring the knowledge between one brain (the teacher) and several brains (students in a class), which is what goes on in traditional school settings. Since this is true of both biological as well as non-biological systems, the question may be asked, how would it be possible to optimally organize this kind of transfer even between the two, i.e., between biological and non-biological systems, that is, in an interaction between the natural (teachers' and learners') and the "artificial", AI-based brain? Further, we may ask whether the explorations in this field serve as the basis for the further development of mankind as a whole, or whether they apply only to the specific field of AI?

Knowing that, in general, the educational system at the primary level follows social change with a time lag of around 15–20 years (Aberšek et a., 2014), it becomes apparent that in order to track the changes that are going to be brought about by contemporary society, we must adapt our educational systems to them as soon as possible. This is especially relevant in those fields where changes occur most rapidly, one of them being STEM (science, technology, engineering, and mathematics). Knowledge in contemporary societies of the twenty-first century should, in a broad outline, be based on the following:

- *Competency-based developmental knowledge* from the fields of cybernetic physical systems (robots) and the internet of things, connected to the internet of people. In short, we need specialized engineering (STEM) knowledge, upgraded through digital literacy 4.0 (communication between people, communication

between man and machine, and understanding the communication between machines themselves).
- *Interoperability* requires communication competence 4.0, which does not simply refer to communication between people, but also to the skills associated with man-machine communication, as well as the understanding of AI.
- *Competence in systems development* (for as long as this is done by humans, or until such tasks will become a matter of AI), which supports people's decision-making processes in complex situations, by means of visualization and data mining processes. At the same time, we must also develop the competence of solving complex problems in real time (critical assessment, critical decision-making, critical thinking).
- *Decentralized decision-making*, which means that the majority of decisions will be made by machines themselves by means of various algorithms and AI (as is done today by, for example, Google's filters). A person's role will be to make decisions only in "critical, poorly defined situations", when such algorithms (could) fail.

To sum up, the demands placed upon our educational system are clear and unambiguous. In this book, we will embark on the long journey of providing potential explanations of how to meet these requirements optimally. Thus, the primary purpose of this book is to shed light on issues related to teaching and learning based on contemporary trends and approaches from the field of information and communications technologies. Furthermore, our goal is to relate the above to the set-up of modern learning environments, whether they are referred to as intelligent learning materials (e-learning materials), intelligent tutoring systems (ITS), or learning management systems (LMS). With this in mind, a universal meta-model (cognitive machine) for a contemporary transdisciplinary learning strategy (transdisciplinary paradigm) will be proposed, based on cybernetic theory.

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