Challenges and Transformation of Education for 21st Century Schools

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Edited by

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PREFACE

Contemporary society, the society of the future, will require us to develop entirely new knowledge, skills and competencies. The qualitative leap from the Industrial society into Society 4.0, also known as the information society, has already been marked by computers and their processing power in virtually unlimited memory capacity. Humans, as intelligent beings, on the other hand, have yet to make progress over the last few centuries in terms of information processing and storage. Given their limited processing power and memory capacity, the shift to a super-smart society, i.e., Society 5.0, can hardly be imagined with just humans as the central characters in these changes. The society of the future, the super-smart society, is undoubtedly (going to be) a technological society, a society of independent and intelligent systems, which are going to be managed and directed more or less by artificial intelligence (AI) because this is the only way (see Figure P_1) to arrive at the so-called super-smart society. In such an environment, it will be vital for humans, who will be increasingly dependent on technology, to communicate with their equals, i.e., other humans, and to understand technology and AI and communicate with it in some way or another.

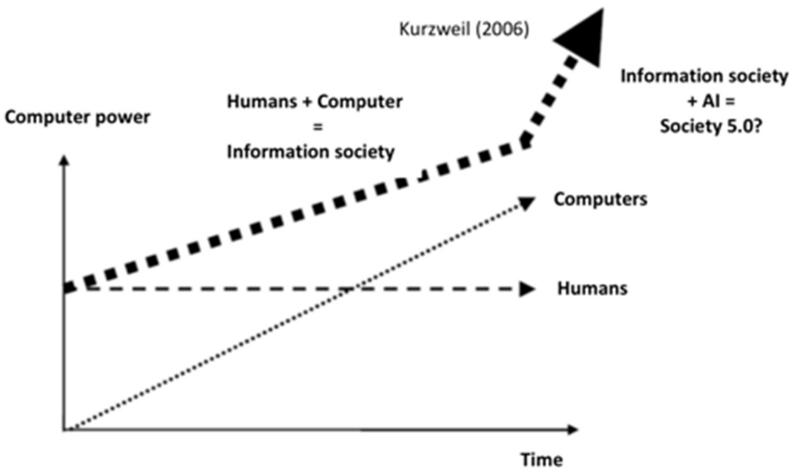

Figure P_1. The development of society in space-time.

In this book, various education experts tried to expose the guidelines for developing education and educational sciences in the future society in Society 5.0. So, the text in front of you is divided into three parts, each containing multiple chapters that discuss various aspects of contemporary society, education paradigms, and knowledge transfer strategies.

Part 1 focuses on 21st-century society, education paradigms, and strategies.

Chapter 1 emphasizes the need for the educational system to train youths for life by equipping them with knowledge, skills, and problem-solving abilities. It highlights the importance of cognitive competences, cooperativeness, and social competences for lifelong learning and employability. Flexible forms of learning are proposed to achieve these goals.

Chapter 2 discusses the development of technology and the importance of technological and digital literacy. It defines technology and engineering literacy and organizes them into three major areas: technology and society, design and systems, and information and communication.

Chapter 3 introduces the concept of learning spaces, which are mathematical structures that model cognitive states. It explains how learning spaces can be used to optimize psychological resources, foster creativity, and model processes like teacher intervention in cyberbullying detection.

Part 2 focuses on contemporary learning environments.

Chapter 4 explores the factors that predict teachers' intervention in cases of cyberbullying and highlights the potential of artificial intelligence in suppressing cyberbullying.

Chapter 5 discusses the inclusion of children and adolescents with behavioral and emotional disorders in residential treatment centers. It reviews classifications of these disorders, indicators for their onset, and potential programs for their prevention and treatment.

Chapter 6 examines the necessity of digital technology in practical fieldwork in biology. It emphasizes the importance of hands-on laboratory work and field experiences in promoting cooperative learning and interest in science subjects. While digital technology can enhance biology classes, it cannot replace the quality of hands-on work.

Chapter 7 explores the effects of digital environments on children's empathy and attention capacity. It highlights the decline in empathic capacity due to exposure to digital environments and the need for educational systems to develop social competences that may be lacking in digital environments.

Chapter 8 focuses on the information literacy of early childhood education teachers and teacher assistants. It evaluates their competences in identifying, selecting, managing, and evaluating information and resources. The importance of information literacy in the education system is emphasized.

Chapter 9 investigates the correlation between socio-emotional learning beliefs and attitudes toward artificial intelligence. It explores the potential synergistic effects of combining AI and SEL principles in education. The study examines the attitudes of prospective teachers toward AI and SEL and their potential correlations.

Chapter 10 examines the attitudes of Slovenian teacher educators and student teachers toward the use of digital technologies in education. It assesses their self-reported proficiency in using digital technologies and explores the relationship between attitudes and proficiency.

Chapter 11 explores technology access and support for secondary mathematics teachers in Slovenia and Turkey. It compares the availability of technologies and contextual support for mathematics teachers in both countries and examines the impact of the Covid-19 pandemic on teachers' readiness and competence in using technology.

Chapter 12 discusses the use of digital technology in teaching mathematics. It presents the benefits of using digital tools in mathematics education and emphasizes the importance of thoughtful and didactically appropriate use of technology. The role of teachers and the curriculum in mediating the use of technological tools is highlighted.

Part 3 focuses on contemporary methods of teaching.

Chapter 13 examines the effectiveness of mindfulness practices in education and addresses potential concerns and critical perspectives. It highlights the positive effects of mindfulness interventions on students' well-being, emotional regulation, and academic engagement.

Chapter 14 discusses the role of kindergartens in early prevention of developmental disabilities in children. It emphasizes the importance of high-quality and developmentally appropriate environments in supporting the social-emotional development of preschool children. The pyramid model is presented as a universal model for early treatment of problems in the social, behavioral, and emotional fields.

Chapter 15 explores the development of an agile mindset among teaching staff. It discusses the relevance of the agile mindset concept for the field of education and compares the attitudes of preschool and elementary school teachers in Slovenia. The results indicate that elementary school teachers have a more positive orientation toward agile mindset.

Chapter 16 investigates teachers' predictions of their emotional interactions with robots in the learning process. It explores teachers' perceptions of robots in education and their comfort levels with emotional interactions with robots. The study reveals differences in attitudes based on educational period and highlights the ethical dimension of using robots in education.

Chapter 17 examines the use of micro-credentials in tourism education. It discusses the advantages of micro-credentials, such as accessibility and flexibility, in addressing upskilling needs in the tourism industry. The challenges of formal recognition and transformative changes within the industry are also discussed.

Chapter 18 focuses on experiential learning from the perspective of classroom teachers. It explores classroom teachers' attitudes toward experiential learning and their assessment of their own competency to teach. The study reveals that teachers who value experiential learning more highly have higher evaluations of their own competency and more positive attitudes toward teaching and the profession.

In focusing on the book, it seems fair to assume that the explanations, our points of view and the content of this book will differ, on many occasions, from notions generally true. We hope that because of this, we will be able to provoke cognitive dissonance/intellectual unease in the reader, which will encourage them to try to update and internalize some of the "theories inside their heads," which have been embedded there since their school years. For teachers and researchers to internalize such encouragements permanently, certain conditions and encouraging environments need to be created and accompanied by new experiences of alternative practices, which are rare today. Creating conditions for gaining this kind of experience in teaching and research is politics' primary function and fundamental mission in education research and development. Such politics takes us back to the beginning of human civilization, philosophy, rhetoric, paradigmatic changes and our society. And now we are in front of real challenges and needs for transformations of education.

Editors

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PART 1.

21ST CENTURY SOCIETY, EDUCATION PARADIGMS AND STRATEGIES

CHAPTER 1

SCIENCE AND KNOWLEDGE FOR SOCIETY 5.0 AND AI

BORIS ABERŠEK AND ANDREJ FLOGIE

Abstract

One of the problems of contemporary society is that the educational system must be able to train youths for life, equipping them with not only knowledge and different skills, but in particular teaching them how to confront everyday challenges and problems, and in turn, how to resolve them. Young people have to develop their cognitive competences, but also cooperativeness and social competences, since these are one of the basic conditions for life-long learning and improved employability. In order to achieve this, flexible forms of learning have to be implemented.

Introduction

Attempts to understand how science works, how we acquire knowledge, and how our mental states and awareness are created have been challenging since ancient times. David Hume dreamed of a scientific psychology in which mathematical laws would govern the mental sphere, just as Newton's laws govern the material sphere (Hume, 2000). The universal force of gravitation, where bodies act proportionately to their mass, could be replaced by the universal force of association, where ideas act proportionately to their similarity. The dynamics of spirit would be placed parallel to the dynamics of matter. Hume's dream, however, is not the first such vision of the mind inspired by the discoveries of science. Modern physicists have discovered straightforward and elegant mathematical laws, the mathematical solution of which is highly complex (Glynn, 2010, Aberšek, 2015). One of the early pioneers of this theory was Thomas Hobbes, who developed his model of the mechanism of mental operations, starting from the assumption that thoughts are a symbolic calculation, a rule-directed manipulation of symbols inside the head (Hobbes, 1651/1994).

Myths from ancient times and speculations of the 17th century became science in the 20th century. Hobbes's idea develops into a computational hypothesis (CH), and cognitive agents become digital computers. Perhaps the most famous explanation of this becomes Newell and Simon's (1972) doctrine, stating that: "The physical, symbolic system fulfils a necessary and sufficient condition for the generalized activities of intelligence." (Newell, Simon, 1972: 116) They proposed this hypothesis as a law of qualitative structure, comparable with the cell doctrine in biology or tectonic plates in geology. It expresses central insights into the research paradigms that have dominated cognitive science for nearly forty years.

In recent years, however, Hume's alternative has suddenly received renewed attention. One of the essential developmental turning points is the re-emergence of connectionism, which models cognition as a dynamic system (Smolensky, 1995).

Similarly significant was the emergence of cognitive neuroscience and the dominance of dynamic theories within it. Dynamic forms are becoming part of the general framework for many works in psychophysics, perception, developmental psychology, cognitive psychology, robotics and autonomous agent research, artificial intelligence, and social psychology. They are central to many general models, such as ecological psychology, synergy and morpho dynamics. (van Gelder, 1999)

Dynamic systems theory is used for research in neuroscience and cognitive development, especially in Piaget's theories of cognitive development. According to Piaget, physical theories can better represent cognitive development than theories based on syntax and artificial intelligence. Piaget's work also represents the belief that differential equations are the most suitable tool for modelling human behaviour outside of it, in the field of non-human intelligence, which is known today as artificial intelligence. These equations are interpreted to represent an agent's non-human cognitive trajectory through state space. Suppose we put it in other words or dynamics. In that case, it proves that psychology should be a description (with differential equations) of the cognition and behaviour of an agent in a specific environment and under internal cognitive factors, for which the language of chaos is also often used (Aberšek, Borstner, Bregant, 2014). Regardless of how we look at the problem of cognitive development, the essence of all development is adaptability, the coexistence of adapting to newly created situations, and learning, which imprints these new patterns in the individual's permanent memory and the entire society's historical memory.

Learning, Cognition and Society

As is true of all complex systems, society, too, is defined by the interrelations between its elements, i.e., the individuals that form it. These interrelations are highly complex and, thus, cannot be addressed in their entirety, which is why this social reality can never be understood entirely. In order to be able to understand society, at least partially, we need to examine how it is influenced by the physical environment, culture, and interpersonal relations – since each of these generates social values and institutions that in return change society; for example, education affects the attitude towards one's surroundings (it ultimately also affects the economy) and thereby changes cultural relations and the entire society. In this context, we are mostly concerned with the social development of an individual and their behaviour (Aberšek, 2018). In order to balance our behaviour, we, human beings, have developed a sophisticated nervous system that informs us of the following:

- the needs of our *internal environment,* and
- about what is going on in our *external environment.*

Some of our behaviour types are very elementary and do not need to be adapted, since adaptations already happened in the past and they are now simply an automated way of responding to internal and external stimuli, or they are a part of our historical memory. Other, more sophisticated types of behaviour demand the recall of pleasant or unpleasant past experiences and the development of a suitable reaction based upon them. These represent the majority of one's obtained social and cultural knowledge. The third type of behaviour demands more elaborate planning, which also includes imagination and an abstract manner of thinking, whereby a strategy that ensures a less unpleasant or painful action is developed.

Throughout human history, man's nervous system has always adapted to our existing needs and possibilities. Humans are perhaps the most adaptable creatures, as we are able to work and live in even the most impossible (inhospitable) environments. During the process of adapting to various environments, humans display what is perhaps our most important property

– the *ability to learn*. Education, and the method of schooling and studying, do not provide the youth of today with a competitive advantage, i.e., employability, anymore. Therefore, in today's society, the young must be equipped with fundamental competences that are general in character (e.g., learning how to learn, how to solve problems, critical thinking) and are, thus, transferable between different areas (generic competences). Skills, and technical-vocational knowledge, must be added to this (UNESCO, 2007). The results of the 'Progress in International Reading Literacy Study' (PIRLS) suggest a model of quality teaching composed of three fundamental *dimensions*; each of them being composed of six *elements*:

- *Intellectual dimension* (Elements: deep knowledge, deep understanding, problematic knowledge, higher-order thinking, metalanguage, and substantive communication).
- *Learning environment* (Elements: explicit quality criteria, commitment, high expectations, mutual support, students' self-control, and student-teacher joint decisions), and
- *Making learning meaningful* (Elements: prior knowledge, cultural sophistication, knowledge integration, inclusion, and narration).

And if we would like to build an e-learning environment, all these dimensions and elements must somehow be incorporated, through the use of different, let's call them 'learning management systems (LMS)'.

Learning and Knowledge

Four types of learning, with different names but the same research-based philosophy underpinning them, will probably prevail in competence-based teaching in the 21st century: *project-based*, *problem-based (team problem-solving), inquiry-based, design-based* and *research-based* learning (Barron, et.al., 1998, Aberšek, 2018). These will provide students with more comprehensive learning processes in order to be able to use competences obtained in school (knowledge, skills, etc.) for problem-solving in real life. Research-based approaches are important for nurturing communication, collaboration, creativity, and critical thinking. It must be noted, however, that research-based learnings are greatly dependent on well-structured assessment and testing for understanding, as regards defining learning tasks and the evaluation of learned content.

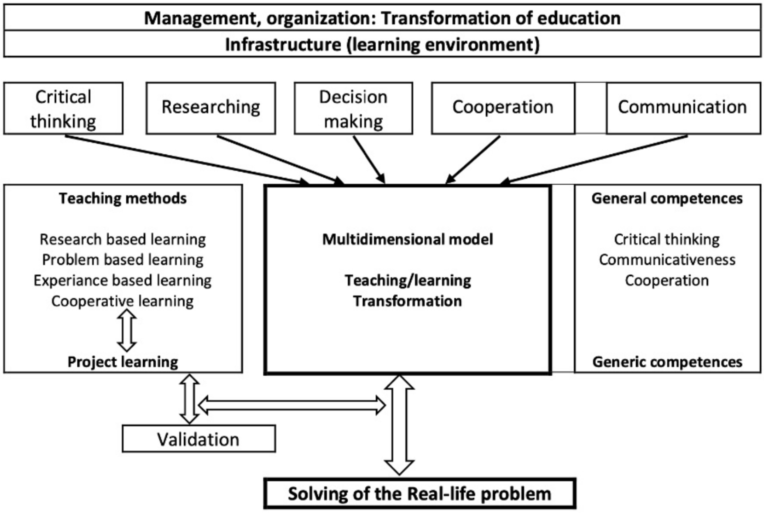

Figure 1_1: Systemic approach to education

The success of different research approaches is, of course, very much dependent on the knowledge and skills of those performing them. It is therefore not out of place to note that all such reforms must include teacher training before they commence work in schools.

Learning and Competences

Dreyfus and Dreyfus (1986) introduced a nomenclature for the levels of competence in competency development. The process of competency development is a lifelong series of doing and reflecting. As competences apply to careers as well as jobs, lifelong competency development is linked with personal development as a management concept. The four general areas of competency are:

1. *Meaning Competency*: The person assessed must be able to identify with the purpose of the organisation or community, and act from the preferred future in accordance with the values of the organisation or community.
2. *Relation Competency*: The ability to create and nurture connections with the stakeholders of the primary tasks must be shown.

3. *Learning Competency*: The person assessed must be able to create and look for situations that make it possible to experiment with the set of solutions that make it possible to complete the primary tasks, and reflect on the experience.
4. *Change Competency*: The person assessed must be able to act in new ways when promoting the purpose of the organisation or community, and make the preferred future come to life.

The focus of this chapter is on the last two, *Learning Competency* and *Change Competency.* In this framework of competences, we draw special attention to two "social" competences, which are very important in schools, the 'attribute' and the 'awareness' competency, shown in Figure 1_2. (Aberšek et al., 2017)

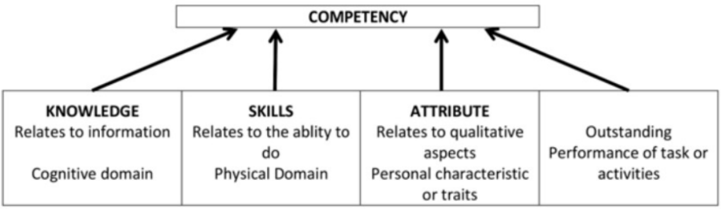

Figure 1_2: Elements of competency

These four areas of competences, therefore, entail the need for specific skills in today's schools, as shown in Table 1_1 (Anderson, 2010, Aberšek et al, 2017).

21st century skills' implementation requires the development of *core subject knowledge* and understanding among all students. Those who can think critically, and can communicate effectively, must build on a base of core academic subject knowledge. Within the context of core knowledge instruction, *students must also learn the essential skills for success in today's world, such as critical thinking, problem solving, communication, and collaboration*.

Table 1_1: Competences for the 21st Century

Competences for the 21st Century				
Analytical skills	**Inter personal skills**	**The ability of realizing**	**Information processing**	**Ability of changing/ learning**
Critical thinking	**Commu-nication**/ Messaging	Initiative, self-regulation	Information literacy	**Creativity/ innovation**
Problem solving	**Collaborating**	Productivity, efficiency	Media literacy	**Adaptability/ learning to learn**
Decision-making	Leading and responsibility		Digital citizenship	**Flexibility**
Research and development			ICT procedure and concepts	

Learning and Cognition

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 chapter was the question: *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)

Cognitive neuroscience on the base of psychology entails a century-long worldwide research endeavor to understand how the human brain functions. The crucial shift in the relationship between psychology and neuroscience has been the development of modern methods of observation and recording of the structure and activity of the brain, such as a multichannel electroencephalography (EEG), magnetoencephalography (MEG), single photon emission computed tomography (SPECT), and positron emission computed tomography (PET) and functional magnetic resonance imagining (fMRI). These techniques have enabled a complex and integrated view of the brain's activity but required conceptual tools in order to be meaningfully explained which neuroscience has not had. The intensity of this scientific enquiry has notably increased during the past decades. With a concomitant increase in public interest in possible applications of brain research beyond the laboratory and hospital, neuroscientists and educators have asked: *How can cognitive neuroscience usefully inform education and, for that matter, how can education usefully inform cognitive neuroscience?* So, we will point out only some basic ideas, especially those related to contemporary teaching and learning techniques and the use of intelligent learning environments and learning management systems (LMS) based on artificial intelligence.

The brain is our primary tool for learning. It is the seat of thought, memory, consciousness and emotion. So, it only makes sense to match your eLearning design with how the learner's brain functions. Remember, you cannot argue with your brain. It follows its own rules. For optimal learning, what your learners need most is brain-friendly content. The good news is, brain-friendly learning is no rocket science. It's made up of building blocks that will help learners understand information deeply and retain it in their long-term memory.

So, we send our children to school to learn things they might not learn without formal instruction, so that they can function more intelligently outside school. If this is indeed so, recommendations for school reform should explicitly appeal to and implement our best, current understanding of learning and intelligence. In the public debate on school reform, this is only sometimes the case. Common recommendations – raising standards, increasing accountability, testing more, creating markets in educational services – are psychologically theoretical, based at best on common sense and at worst on naive or dated conceptions of learning.

Approximately fifteen years ago, John G. Geake (2009) put forward five arguments in favour of the development of an educational neuroscience. Each of these arguments has certain caveats.

The 'in principle' argument
Humans are biological entities – at appropriate levels, human behaviour is biological too. Human brains are biological entities – brain behaviour is neurobiological. Brain behaviour includes learning memorization, epistemology, literacy, numeracy, creativity, reasoning, intelligence, emotion, in other words, the stuff of education is neurobiological. However, a neuroscience account of learning may not always be the most appropriate perspective for classroom application.

The professional imperative argument
School teachers are interested in brain functioning relevant to learning and development in children, but for the education profession to benefit from such research, teachers must be able to make appropriately informed

interpretations of the science.

The 'in practice' argument
It is possible to draw implications and suggest applications for education from research to date. Cognitive neuroscience research has produced evidence for brain function along a number of non-exclusive polarities. The current conceptual synthesis is that the brain operates through dynamic, task-appropriate neural systems. This also includes learning at school.

The self-interest argument
Although neuroscientists have for some time been active in researching learning, memory in general, and literacy and numeracy in particular, teachers have not thus far been widely consulted. The education profession therefore needs to extend its dialogue with neuroscientists to enable educational applications to be realized.

These five arguments are admittedly of educational self-interest, but, why not, especially if education is to remain the lynch pin of most political agendas for social improvement? And if teachers don't become involved in the educational neuroscientific enterprise, could they find themselves even further professionally marginalized than some politicians and education bureaucrats seem intent on pushing them? In other words, applying evidence from neuroscience to education could provide a means for teachers to reclaim eroded professional autonomy.

The opportunistic argument
There are many more neuroscientists alive and experimenting today (one estimate is 200,000) than the cumulative total over the entire history of neuroscience. Each year, neuroscience conferences feature hundreds of presentations on educational applications and implications. To summarize these arguments, the education profession could benefit from embracing rather than ignoring cognitive neuroscience.

But our belief underpinning this chapter is that relevant and useful professional and classroom applications of educational neuroscience will increasingly become available as we gradually come to understand more about brain function through neuroscience research which answers educational questions about learning, memory, motivation, and so on.

Successful Teaching

To be a good teacher, you need to acquire a large set of different kinds of interdisciplinary knowledge, each of which binds an idea of the causal relation, cause and consequences, possible antecedents and causes, possible developments and consequences, and possible interventions to the strategy of teaching. Education for teachers and trainers consists in part of learning the language of education, and the appropriate skills. A deeper understanding of judgments and choices also requires a richer vocabulary than is available in our everyday language. Learning is closely connected to the body-mind relation; and it is connected to our way of thinking (Aberšek, Borstner, Bregant, 2014).

As many authors point out, such as Howard-Jones et al. (2007), Aberšek (2015), Dolenc, Aberšek (2016) and Fletcher (2003), with the use of intelligent learning environments based on artificial intelligence, through *individualisation* and *differentiation*, creative thinking, critical thinking, and problem solving, are developed. However, intelligent learning environments which only develop the cognitive domain are not enough in the process of learning and teaching. Using them can only help to develop one aspect of a well-rounded personality, which is cognition. Schools, however, must also be responsible for developing the affective domain (awareness, self-awareness, attitudes towards oneself and the others), as well as the psychomotor domain (physical skills and abilities). The question arises of *what exactly happens within the affective domain of learning (students' social skills and their social competences), and whether we can increase social competences gradually, step by step?*

From our own research, as well as from the research conducted by many other researchers (Kim, Baylor, 2006; Lepper, Chabay, 1985; Van Lehn, 2011) it is obvious that with intensive individualization and differentiation of the teaching/learning process using ICT (one-on-one tutoring), as presented schematically in Figure 1_1, a drastic decrease in social skills of the whole student population has been observed.

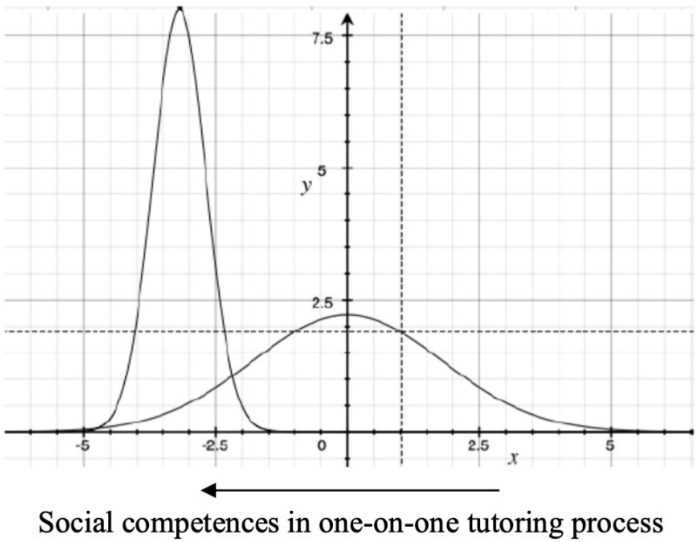

Figure 1_3: Are students losing their social skills?

We must therefore develop this awareness in every individual; we must "change" or establish the specific way of thinking (creative, critical, and conscious thinking); and it is very important to begin this process with students of the youngest possible age. These competences must be developed step by step, which enables us to deal with the day-to-day needs of others, and which helps raise the awareness. If you get the impression that thought is not proprioceptive in itself, but rather, that it *requires* proprioception, then this could begin to touch the synapses in the brain, which command those reflexes. To be aware of one's own thought – this is the way to a higher taxonomical level of knowledge. Within problem- and research-based learning, we automatically develop critical thinking processes. Moreover, apart from critical thinking processes, we also develop social skills and competences when working and conducting research in groups, with the aim of solving a problem together, as a team (Bohm, 2004, Kahneman, 2011, Pešakovič, Flogie, Aberšek, 2015).

Education and Future Society

Today, the current opinion and understanding is that the knowledge that formed the basis of progress in the 19th and 20th centuries is insufficient in the modern world (the 21st century). It will be even less so in the future, when the fourth industrial revolution will be reached, called Industry 4.0 (World Economic Forum, 2017), designed with four basic principles in mind. These principles support the economy and determine the scenarios of their implementation. The principles are as follows:

- *Interoperability*: the ability of machines, devices, sensors, and people to connect and communicate among each other and on the Internet of Things (IoT), as well as on other internet (global) connections.
- *Informational transparency*: the ability of information systems to create virtual copies of the physical world (various simplified, clear models) by connecting large databases and various sensor systems, which, for example, is done today in weather forecasting.
- *Technical support*: the first form is the technical support of support systems displaying a large amount of data in a clear, visual manner (for example, tables turned into appropriate graphic representations), which aids in fast and competent problem solving. The second form is the ability of Cyber-Physical Systems (CPS) to support a person carrying out unpleasant, tiring or dangerous tasks, such as the use of robots in the search and disposal of mine fields.
- *Decentralised decision-making*: the capability of CPS to make decisions and carry out their given tasks as quickly as possible, and in an automated, independent manner. A person needs to intervene only if the CPS is not capable of independent decision-making.

Knowledge, Skills and Competences Needed in the Future

There is no doubt that Industry 4.0 is a reality. Since the general opinion is that the education system at the primary level does follow social changes with a significant delay, which is realistically about 15 to 20 years, it becomes clear that, if society wishes to follow these changes brought on by Industry 4.0, it will need to adjust the education system as soon as possible. This is especially true in the area of Science, Technology, Engineering and Mathematics (STEM), where changes happen more rapidly (Flogie & Aberšek, 2015). The knowledge of modern society as presented by Industry 4.0 should be as follows (World Economic Forum, 2017, Aberšek, Flogie, Kordigel Aberšek & Šverc, 2017):

- *Competency-based development knowledge* in the area of CPS and IoT, connected to the internet of people. In short, we need specialized engineering (STEM) knowledge upgraded with digital literacy 4.0.

- Interoperability requires *communication competence 4.0*, which includes not only the skills of human-human communication, but also the skills of human-machine communication and the understanding of machine-machine communication.
- *The ability to develop systems* that support people when making decisions in complex situations by means of visualization and processing large amounts of data (data mining), as well as the *ability to resolve complex* problems in real time (critical judgement, critical decision-making).
- Decentralized decision-making means that most decisions will be made by machines with the help of various algorithms (such as Google filters). A person's role will be to make these decisions only in "critical, badly defined situations", when these algorithms fail.

The collaboration of various scientific branches is welcome, but it is no longer enough. The quality and value of the competences, skills and knowledge of an individual are the basis for creating their competitive advantage in the global world, and, consequently, increasing their prosperity as an individual and that of the entire society. Nair (2003) also thinks that the classical school paradigm is a relic and a remainder of the first industrial revolution. The education system established in the first half of the 20th century, which unfortunately is still the foundation of most educational processes, is outdated, since global economic policy has changed so significantly. On the other hand, the development of modern production technologies, information and communication technology, as well as findings in the field of cognitive science and neuroscience, are the basis of modern methods of teaching. All of this affects the employment needs and potentials of tomorrow's society, that is, the education systems that must consider the needs of such a society. Recognizing that the education model of the 19th and early 20th century was based on the following needs in the field of employment:

- 20 % professionals,
- 30 % merchants and office workers,
- 50 % physical labourers,

then we can say that a model catering to the employment needs of the 21st century would need to adapt to the following employment needs:

- a minority of unqualified, temporary and seasonal workers (approximately 1/8) and
- hardworking, self-educated workers with the initiative to manage their own work and time (approximately 7/8) (Dryden & Vos, 1999), which calls for the *development* and *achievement of higher taxonomic and cognitive levels of competency*.

It is obviously necessary to connect the principles and concepts of various scientific branches in the field of the development of modern concepts (Okasha, 2002). The foundation for modern innovative education in the 21st century is now based on current knowledge of the brain and its processing of information and on the field of cognitive science (Aberšek, Borstner & Bregant, 2014). More and more questions are arising similar to those asked by British scientist Tony Buzan:

> "At school I spent thousands of hours studying mathematics, thousands of hours learning languages and literature, thousands of hours learning geography and history. Then I asked myself how much time I spent getting to know how my brain works. How much time did I spend learning about how my eyes work? How many hours did I spend learning about how to study? How much time did I spend learning about the functions of my head? How many hours did I spend learning about the mechanisms of thinking and how thoughts affect my body? Unfortunately, the answer is very simple – *none*!" (Dryden & Vos, 2005, p. 73).

Boekaerts (Dumont, Istance, & Benavides, 2010) calls for a thorough reform of teacher education programs in order to provide them with a more comprehensive understanding of how cognition, motivation, teaching and learning relate to each other. It is also necessary to provide future teachers with training and experience in order to use their knowledge effectively in practice. Richard Mayer says (Dumont et al., 2010) that only a few of the many claims that the use of new technologies allows for a thorough reshaping of what we understand as learning are convincingly supported by research. The main reason for this is that these claims are all too often followed by "technology-oriented" rather than "learning and learner-oriented" teaching approaches. A more compelling contribution to the theory of how people can learn using technology would be the following three important lessons: the existence of "double channels" (people process sound and visual images separately), "limited capacity" (people can only handle a small amount of information at one time – symbols, sounds or images) and "active processing" (meaningful learning is dependent on proper cognitive processing) (Dumont et al., 2010). In the research presented, the focus was primarily on the influence of modern technologies on social competences and the psychosocial effects of technologies as the basis of competences for Industry 4.0/Industry 5.0 or Society 5.0 on an individual and societal level. It should be stressed that, if the aim is to create a society of equal opportunities, or if all young people should be given equal opportunities, new and effective approaches in education are required. So, the main research problem is to study what influence *innovative didactic teaching approaches* exert on students' psychosocial and cognitive abilities, and the main research questions are:

- Do innovative didactic teaching approaches supported by modern information and communication technology change the traditional form of teaching and the learning environment for students?
- Do they offer a large contribution to achieving higher psychosocial and higher cognitive competences?
- Are there statistically valid differences, according to students, between traditional (today's school) and innovative lessons (say, Education 4.0)?

Education in the Era of Industry 4.0/Society 5.0

The use of contemporary learning strategies, such as previously mentioned research- and problem-based learning in relation to collaborative teaching/learning, and brain-based techniques based on cybernetics theory and on information-communication technologies and AI, have provided scholars from diverse disciplines, with an unusual opportunity to observe possible flaws in their own thinking (Aberšek, Borstner, Bregant, 2014). The choice of method was crucial: if we were to report results obtained only through conventional, standard behaviouristic methods, our work would have been less noteworthy, less critical, and less memorable. This is why we did not choose demonstrations over standard methods, because we wanted to influence the entire spectre of audiences. We preferred *problem- and research-based methods* and *collaborative learning,* because they were more fun for students, and we were lucky in our choice of method, as well as in many other ways. We used the *brain-based technique* because it provides the educator with an understanding of what happened, and of how to react during the lecture. The spontaneous search for an intuitive solution for a complex problem sometimes fails – neither an expert solution, nor a heuristic answer comes to mind (Kahneman, 2011). The responsibility of the teacher is to equally develop all ways of problem solving, critical