The Impact of Innovative ICT Education and AI on the Pedagogical Paradigm

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Andrej Flogie and Boris Aberšek

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FOREWORD

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 everyday language. Learning is tightly linked to the body-mind relation, i.e. it is closely connected to our way of thinking. When you are asked what you are thinking about, the answer is usually not very complicated. You believe you know what goes on in your mind, which often consists of one conscious thought leading in an orderly way to another. But that is not the only way the mind works, nor indeed is that the typical way. Most impressions and thoughts arise in your conscious experience without your knowing how they got there. You cannot imagine how you came to the belief that someone loves you, or how you detected a hint of irritation in your spouse's voice on the telephone, or how you managed to avoid a threat on the road before you became consciously aware of it. The mental work that produces impressions, intuitions, and many decisions goes on in silence in our mind. It is almost like our thoughts have their own thoughts and language, the language of thought. (Fodor, 2008).

The use of contemporary learning strategies, such as research- and problem-based learning, in relation to brain-based techniques, artificial intelligence and information-communication technologies, has provided scholars from diverse disciplines with an unusual opportunity to observe possible flaws in their own thinking (Aberšek, Borstner, Bregant, 2014). In the preparation of this book, the choice of method was crucial: if we had reported results of only conventional, standard, behaviouristic methods, our work would have been less noteworthy, less critical and less memorable, so we did not choose demonstrations over standard methods because we wanted to influence the entire spectrum of audiences. There is a huge number of opportunities to introduce novelties such as problem- and research-based learning in the learning process simply by being

creative. Students can be engaged, for example, by means of games and simulations that require them to apply information in unfamiliar contexts. Settings and activities such as e-learning environments, role play, energizing online discussions and quick serious games, have the effect of adding sensory stimuli, reducing restlessness, and reinforcing information.

In short, on a systemic level the education system needs to consider the individual as the basic building block of society, and further take into account the individual's consciousness related to their emotional intelligence. Because a person's consciousness is something entirely singular and inherent to the individual, some kind of generalization will have to be constructed, which will be better than nothing and still contribute enough in terms of novelty and progress, to make it innovative enough for the purposes of teaching and learning, i.e., for the formalization of automated processes of individualization and differentiation within intelligent tutoring systems.

The book is organized into nine chapters.

Chapter 1: Introduction
Chapter 1 introduces the evolution of the education process, and the mind as an information processor, by sketching out some of the key moments in the history of education and the science of mind. It highlights how the foundations for sciences of education and mind were laid in psychology, mathematical logic and linguistics, pointing out that theories of *what mind does* have to co-evolve alongside theories of *how the brain works.*

Chapter 2: Philosophical concepts as a basis for education systems
This part of the book points out that there are different branches of philosophy, which serve as the basis for philosophies of learning of a certain period. From a philosophical point of view, they provide a solid enough foundation for understanding various modern approaches in the field of learning, and creating new ones. In this chapter, some of the more important philosophies related to education systems, and indirectly to learning and teaching, are highlighted.

Chapter 3: Key learning concepts of the 20th century – learning paradigms
This part of the book points out that learning theories are usually divided into several paradigms, which represent individual views of the learning process itself. Theories within the same paradigm have a common initial

or identical basic view of the learning process. Chapter 3 discusses some of the most established and accepted learning/philosophical paradigms.

Chapter 4: Defining didactics
This chapter provides an overview of the history of educational sciences, which began as far back as ancient times. The term *didactics,* which is nowadays accepted in all professional circles, stems from the Greek and later Latin word *didáskein.*

Chapter 5: Challenges of 21st century education
Creativity, innovation, critical thinking and the meaningful use of modern information-communication technologies in connection to artificial intelligence, are the key factors in creating a new, added value of the school environment, and represent the main challenges of 21st century education.

Chapter 6: Cognitive science
This part of the book explicitly describes new cognitive models. These are associated with two different research programs proposed by cognitive scientists, partly moving beyond the basic assumption that the mind is either a symbol manipulator or a connectionist network. The first (called the hybrid model) is a combination of two traditional approaches to mental architectures, the symbol system hypothesis and the connectionist network hypothesis; the second (called the dynamical model) is associated with the dynamical systems hypothesis in mathematics, including the situated/embodied cognition movement.

Chapter 7: Competences
A continuous development of the abilities, skills and knowledge of the individual is of key importance for their existence and progress on the market in today's competitive and rapidly changing world, which means that a need for developing new competences and skills will also continue to be present.

Chapter 8: Innovative models and methods of learning
The task of modern school is to inspire and help students recognize their uniqueness, in order to be able to reach and achieve their full potential. In this chapter we discuss some of the most established and accepted innovative models and methods of learning.

Chapter 9: Innovative learning environments and AI or education 4.0
Given the possibility to create an intelligent autonomous adaptive system capable of learning, adapting to new circumstances and performing (critical) self-evaluation, this chapter points out that the human-machine reductive correlation is possible, despite the so far unsuccessful attempts to prove it, but also that there exists a major problem related to the notion of ethics and morality within such an AI-based autonomous adaptive system.

1

INTRODUCTION

A country's education system is the basis for its progress and the groundwork for its future. Changes in education, however, occur very slowly, since education systems are some of the largest and most complex systems in every society and are impossible to change overnight. One of the key reasons for an education system's success is its close connection to the history and development of a specific society. In the European sector, the educational models can be divided into two large groups: *Anglo-Saxon* (Great Britain, Scotland, Ireland ...) and *Central European* (Germany, France, Austria ...). If we can claim that the Anglo-Saxon model is based on outcomes then we can say that Central Europe is heavily regulated and mostly process-orientated. Surely both models are successful in specific cultural areas but are not directly transferable to other societies (Archer, 2013).

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. Collaboration between various scientific disciplines is welcome, but it is no longer enough. The quality and added value of an individual's competences, skills, and knowledge represent a basis for developing competitive advantages in the global world, and, in turn, increase the well-being of the entire society. It is in this spirit that Prakash Nair contemplates, when he says that the classical school paradigm is a relic, a remnant from the first industrial revolution. The educational system that was operational in the first half of the 20th century is outdated because of the fundamental changes in global economic policies, and because of the boom in the development of modern information-communication technologies. All of this affects the employment needs and potentials of our contemporary society. A country's development and employment prospects represent one of the cornerstones of the development of society and its educational

system. Thus, the educational system has an indirect impact on the prosperity and state of society as a whole. Research from the field of education policies shows that European education systems are falling behind in comparison to other regions of the world (COM 654 final, 2013).

A common feature of successful education systems is the balance between tradition and the capacity to be flexible and able to adapt to current social trends. Every successful education system stems from a certain philosophy and is not the random outcome of current ideology or political ideas. An exception among the great philosophers is Socrates, who never initiated a school of his own. It is true, however, that on the basis of his thought, his followers established two schools with the common goal of "educating", though distinguished by what was to be understood by the term *education* and the ways of achieving that. Plato took regular meetings with his students to another level, establishing the first school known as The Academy. In fact, this was the first philosophical school with a schedule (an organized list of lectures). Plato's student, Aristotle, later established an independent philosophical school called the Peripatos (Kimball, 1986).

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 is reached. We will have to make a step forward in the field of knowledge, skills and competences of a modern society of the future. Germany was the first to make a partial step in this field. Qualification and competences probably represent the foundation of German competitiveness (Maver, 2014). The quality and added value of an individual's competences, skills, and knowledge represent a basis for developing competitive advantages in the global world. Prakash Nair, an internationally appraised expert in the field of innovative schools and educational techniques, thinks in the same way when he says: "Classical school paradigm is a relic; it is a remnant from the industrial revolution, one that requires a lot of effort from the teacher for a relatively small effect in the area of competences, skills and knowledge. Classroom orientated education does not allow reaching expected results needed for employment in the 21st century" (Nair, 2003, p. 23).

The educational system that was operational in the 19th century, and in the first half of the 20th century, is outdated because of the fundamental

change in economic policies; in the field of development, big steps were made, consequently changing employability. If we can say, that the model of the 19th and early 20th centuries were based on the fact that the field of employability required:

- 20% experts,
- 30% merchants and office workers,
- 50% physical workers,

then, we can say that the model, which answers to the needs of the end of the 20th century, and the beginning of the 21st century, needs to be adjusted to the following employability needs:

- Minority of unqualified, temporary, and seasonal workers (approx. 1/8).
- Self-acting, self-learning, self-initiative managers of their own work and time (approx. 7/8) (Dryden and Vos, 1999).

If it is true that the educational system from the 19th and 20th centuries is outlived and uncompetitive, the same cannot be said for natural of scientific reasoning. The primal basis or the nature of scientific reasoning, on which also modern scientific and philosophical models are based - for example, deduction and induction, reasoning according to the best explanation - Hempel's scientific explanation's covering law model ... are still in use today. Also, certain fields, which have been occurring for a good part of our history (for example, the traditional feud between scientific realism and antirealism or instrumentalism), continue to be a part of modern philosophical debates even today. Philosophy of science, philosophy of technology and other philosophical approaches, set the foundations of the development of modern society. It is more than obvious that in the field of development of modern concepts (both technological and educational), principles and concepts from different scientific disciplines need to be interconnected into a unified whole (Okasha, 2002). Both in theory and in practice, these developments should be considered on a systemic level, while taking into account the dynamic systems theory.

The driving force for the development of educational systems is, among other things, presented and determined by the developmental and employability possibilities in each society. Thus, for example, the sector of information-communication technologies (ICT) is the fastest growing sector in Europe. "In 2008, it created 8.3 million jobs and made 574 billion

USD of additional profit. This concretely translates as 4.7% of global BDP, which is even more than the entire sector of transport, which contributes only 3.7% of the entire BDP and has 5.1% of employees" (Turlea et al., 2011, p. 28).

A rapidly developing society that is founded on information-communication technologies also represents a big challenge in the field of educational systems. It is a fact that the development of educational systems is falling behind the needs of the economy and modern society, which is evident from several research studies (Ionescu and Cuza, 2012; Jarrar, 2016; EUROSTAT, 2015). Slovenia is one of these countries, and one of the effects it experiences is a large pool of qualified staff; however, these people are unemployable. This also raises the question of their competences, which are required in modern workplaces. Some countries have already adopted national guidelines for using modern technology in individual segments of school children, for example, how to use ICT technology in deprivileged groups of learners to facilitate their entry into the labour market (Kozma and Wagner, 2006).

The way to innovative modern education in the 21st century is definitely paved by the field of *cognitive science*. "Cognitive science tackles the fields of the human psyche in an interdisciplinary, even transdisciplinary way – by connecting insights from all disciplines that could shed some light on cognitive occurrences. Cognitive science thus brings together neuroscience, psychology, philosophy, linguistics, computer science, artificial intelligence, and social sciences. It seeks to address the human mental processes comprehensively in order to arrive to a deeper understanding of the field, which is empirically closest to us. The questions that cognitive scientists are attempting to answer are not new; they have been posed by philosophers and scientists from various disciplines over time. They would explore the given cognitive phenomenon at a level, which corresponded to their scientific field, and by using methods pertaining to their discipline. Because they remained closed in their own disciplines, it would occur too often that they were unable to usefully include knowledge from other disciplines. By developing an interdisciplinary approach, cognitive science attempts to overcome these obstacles and arrive to a more comprehensive insight" (Kordež and Markič, 2007, p. 3).

"In the last decades, cognitive science has experienced rapid development. Especially because of the advancements in neuroscience, we are gradually

beginning to realize that it is possible to scientifically research mental occurrences, and even consciousness – a field, which was until recently, reserved only for mystics. Cognitive scientists are trying to transfer their findings into practice – especially in the field of learning and teaching, processes of collaborative work, and in the field of machine learning and deciding. Cognitive science developed from the cybernetics movement of the 1950s and has since undergone a number of paradigmatic changes. Study programs of cognitive science, which have blossomed in important universities worldwide over the last twenty years, are most often presented alongside some constitutive discipline (e.g., cognitive linguistics, cognitive neuroscience, cognitive anthropology, etc.). However, it is becoming increasingly clearer that only an equal consideration of all fields can ensure a comprehensive discussion of mental and learning processes and consequently also the processes involved in teaching" (Aberšek, Flogie and Šverc, p. 11, 2015).

What we need are fresh and effective approaches in education and upbringing, if we want the "modern world" to provide equal opportunities for everyone.

If the 1970s were a period of discovering space and the 1980s a decade of greed, then we can say that the 1990s were marked by a re-discovery of the inner world (a time of appreciating anew and exploiting the really vast capacities of the human brain). As for the first years of the third millennium, we can say that this is a time of searching for synergistic effects of using modern approaches and methods of teaching in the light of enhancing an individual's competences. Namely, we are all aware that "lifetime" jobs and workplaces no longer exist, and that knowledge (especially in the fields of natural sciences and technology) develops and changes so fast, that currently topical findings may well be "history" in only a matter of a few years. We are increasingly focusing on questions such as the ones asked by British scientist Tony Buzan, who wondered, among other things: "At school I spent thousands of hours studying mathematics, thousands of hours studying language 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 and Vos, 1999,

p. 73). Tony Buzan, expert on speed reading, inventor of mind mapping and other methods for unlocking the potential of the human brain, believes that most of us use only one percent of our brain's capacity (Buzan, 2006).

2

PHILOSOPHICAL CONCEPTS AS A BASIS FOR EDUCATION SYSTEMS

In the introduction, we pointed out that there are different branches of philosophy, which serve as the basis for philosophies of learning of a certain period. From a philosophical point of view, they provide a solid enough foundation for understanding various modern approaches in the field of learning, and creating new ones. In the following chapter, we will highlight some of the more important philosophies related to education systems and indirectly to learning and teaching.

Essentialism

According to this concept, schools should be teaching only basic knowledge in a relatively well-thought-out number of subjects. Essentialism was founded already by Plato in ancient Greece (Ellis, 2001). His curriculum for philosophers consisted of altogether only seven subjects, which can be divided into two groups, namely:

- the first group consisting of subjects to promote a healthy upbringing,
- the second group consisting of subjects which transmit methods of studying common core knowledge to the learners.

In addition, these subjects were carefully chosen according to different levels of education. History, natural sciences, foreign languages and art were to be taught at the basic level, and mathematics, history, science and foreign languages. In medieval Europe, when education was not available to the masses, this concept was very much present. Traces of essentialism can be found to this day at colleges and universities across the UK. Its followers believe that the right education can be achieved by teaching a few core subjects (Oxford, Cambridge). Such schools educate future

leaders, and are sometimes referred to as "elite schools". The essentialist view of education anticipates hard work, with the realization that every beginning is hard (and this also applies to learning). The concept of essentialism opposes the idea that the education system should be adapted to the needs and interests of the individual. Each individual must first pass through a difficult initial phase of learning – the learning discipline is emphasized as a highly important segment. Essentialism places the teacher at the centre of the pedagogic process, who thus becomes responsible for an individual's initiative to learn. From the social perspective, education is considered as a transmission of cultural heritage. From the point of view of the individual, the goal of essentialist education is to help them achieve intellectual discipline and an increase in the physical and emotional potential (Sahu, 2007).

Encyclopaedism

The greater part of Europe adopted an education system based on the principle of textbooks, which was founded by Czech theologian and pedagogue Jan Comenius (Sadler, 1966). The fundamental idea behind this concept is diametrically opposed to essentialism and is based on the premise that the learning content should be captured in separate and illustrated textbooks (the content of education should include all human knowledge (Jerami, 2007). The best learning follows the principles of "education according to nature". Since learning takes place first through the senses Comenius's curriculum was designed to develop these first. The principle of education advocated by Comenius had a great influence on French schools, where the curriculum included more than ten subjects. Germany, too, followed Comenius' proposals, and upgraded them through their Lutheran protestant ethics (Schroder et al., 2002). The effects of this can still be observed today – a large number of apprentices, whose educational path combines academic education and practical training. This was the ground for Adolf Kolping's idea of establishing "apprentice schools", which grew into a movement called the Kolping Association, adding the social dimension to the apprenticeship (concerned with vocational training for financially weaker families) (Jones, 2000).

The sensory model

This educational model is based on early learning through sensory perceptions. The pioneer and initiator of this movement was philosopher Jean Jacques Rousseau (18th century). Jean Jacques Rousseau believed

that the key to successful education was the development of the child's senses. He was an advocate of the "inner guide", which means that children have within themselves a so-called inner self, a sense of themselves, which they upgrade through work, and become able to "feel" themselves and recognize what stage of development they are at, which enables them to realize their inner goals of development (Rousseau, 1979). If we transfer Rousseau's way of thinking into a realistic Montessori environment, we could say it is about the interest that attracts the child (Montessori, 1912). The child can work, for example, with sandpaper letters, and, because it feels pleasant, they might suddenly want to learn how to write, too. The environment itself supports this, and the educator/teacher is there to help the children achieve it. The child has a desire to work, an interest, which guides him or her towards new discoveries (this is the child's inner self/guide).

Learning in a Montessori environment is different from traditional schools, when on a specific day according to the schedule all children must learn, for example, the letter *a*. Rousseau, too, was against memorizing facts; he advocated the belief that children learn through experience, and thereby develops their personality and themselves. The whole working-with-hands experience builds up the child's gross and fine motor skills and everything associated with them. Rousseau believed that by working with their hands, the children indirectly develop their brain. The "hands-on" approach has permeated the entire Montessori pedagogy, which Maria Montessori designed in stages, starting from the child's earliest years (age 0–3), the next stage (age 3–6), and throughout the child's elementary school years, where children learn through working with their hands and with the use of concrete Montessori materials about ideas, which would otherwise be entirely abstract to them (Hainstock, 1968).

Since children performs activities on their own, using their own hands and appropriate materials and tools (e.g. for learning addition, subtraction, multiplication, etc.), the shift to abstract thinking that follows will be much easier. The child knows how to imagine ideas because of this experience of working. Children taught according to the Montessori principles are generally better at making sense of the world around them and developing their ability for logical thinking, and they approach problems in a different way.

Pragmatic learning

While *encyclopaedism* and *essentialism* were developing in the European space, a philosophical tradition called pragmatism, which occurred in the USA, inspired the educational approach of pragmatic learning. This concept puts the child at the centre of education. We can definitely say that pragmatic learning tries to provide an answer to the question of what kind of knowledge is the most valuable (i.e., useful). On the basis of this philosophy or *progressive theory*, one of the key philosophers of that period, John Dewey (1859–1952), laid two foundations. The first is the idea that education must be centred around the child and that *experience* is crucial. In other words, the curriculum must be prepared in a way that best meets the needs of each individual child (Chambliss, 1996). Dewey's definition of experience is rather complex. He believed that experience in the course of the learning process is not necessarily directly linked to knowledge, and most certainly not to human existence and life. In his terminology and his view, life is seen as a constant interaction between the individual and the environment. Becoming intelligent and knowledgeable is merely a consequence of experience, bearing in mind the vision that especially cognition and communication are an important part of experience. Dewey also advanced the idea that philosophy has to be practical, useful in the everyday life of people, rather than being just a scientific-theoretical view of certain things. We can say that Paulo Freire is a supporter of the view that the school system is the foundation for society's reconstruction (Elkjaer, 2005).

Functionalism

Functionalism is a theory of the mind in contemporary philosophy, developed largely as an alternative to both the identity theory of mind and behaviourism. Functionalism is one of the major proposals that have been offered as solutions to the mind/body problem. It is based on the idea that mental states (beliefs, desires, being in pain, etc.) are constituted solely by their functional role – that is, they have causal relations to other mental states, numerous sensory inputs, and behavioural outputs. Functionalism is a theoretical level between the physical activity (implementation) and the behaviour of an individual. Functionalism sees the different parts of society as a system of closely interconnected elements that work together as a whole. Institutions are structures made up of individual and interconnected roles and norms. In order for a society to exist and function, there has to be a fundamental agreement between its members.

This is called a value consensus. Functionalism was intensely developed in the period between 1960 and 1980 (Block, 1996). From the point of view of cognitive science, it is built on the groundwork of common-sense psychology. "This is a theory that has already been used by ancient Greek philosophers to interpret the behaviour of people, and has remained in use in our everyday lives to this day. It is based on a premise that human behaviour is caused by desires and beliefs. In common-sense psychology, mental states have both, causal and semantic content, and the sequence of thoughts largely maintains the reality of these mental states. With his representational theory of the mind and with the help of the computer metaphor, Fodor demonstrated that there was a mechanism, which is able to mediate between the causal and semantic properties. In understanding and applying this philosophical principle, problems were identified concerning the concrete failures in modelling, e.g. recognizing visual or hearing patterns, categorization, movement in space, thinking with background knowledge, and generally all those tasks, for which we know no specific rules. It is precisely for this reason that this paradigm was forgotten relatively quickly." (Aberšek, 2014).

3

KEY LEARNING CONCEPTS OF THE 20TH CENTURY – LEARNING PARADIGMS

Learning theories are usually divided into several paradigms that represent individual views of the learning process itself. Theories within the same paradigm have a common red thread – a common initial or identical basic view of the learning process. In recent times, the following have become some of the most established and accepted learning/philosophical paradigms:

- behaviourism,
- cognitivism,
- humanism,
- constructivism,
- connectionism.

The following chapter presents the rudiments of these philosophical paradigms and the key differences between them in the field of education.

Behaviourism

The underlying view of *behaviourism* assumes that there is no single accepted definition of learning, since the learning process depends on the perspective of the learning paradigm. The most commonly accepted definitions of the learning paradigm suggest learning as a visible change of one's behaviour that can be measured, or as:

- an active process of acquiring knowledge and developing an appropriate mental structure (including insight, information processing, memory, perception),
- the natural desire of people for self-fulfilment and the development of personal potential,

- an active, socially enhanced knowledge-building process, based on its own subjective interpretation of objective reality, and
- the process of connecting and maintaining information sources that contain useful knowledge.

Other definitions of behaviouristic learning include the following:

- obtaining new knowledge or changing existing knowledge, behaviour, abilities/skills, values or characteristics, which may include the synthesis of different types of information,
- the activity or process of acquiring knowledge or skills through studying, practising or experiencing something,
- any relatively permanent behavioural changes resulting from experience but not associated with fatigue, growing up, drugs, injuries or illness (Leonard, 2002).

Behaviourism is a learning paradigm with its roots dating back to the second half of the 19th century. The groundwork for modern behaviourism was laid by Ivan Sechenov (1829–1905) and Vladimir Bekhterev (1857–1927), whose works gained significant attention in the first half of the 20th century. The most central premise of behaviourism is that, in order to make psychology a real science, it must be orientated on what is observable and measurable. According to one of the key behaviourists, John Watson (1878–1958), "psychology, as the behaviourist views it, is a purely objective, experimental branch of natural science which needs introspection as little as do the sciences of chemistry and physics" (Graham, 2016).

Behaviourists saw the mind as a “black box” and did not attempt to analyze its inner processes like thoughts, feelings, or motivation. Instead, they saw learning as a visible change in one's behaviour which, unlike mind processes, can be measured. From the behaviourist perspective, a learner starts off as a clear state and simply responds to environmental stimuli. Those responses can be shaped through positive and negative reinforcement (usually a reward for desired and a punishment for undesired behaviour), increasing or decreasing the probability of repeating the same behaviour. Forming stimulus-response (S-R) associations which result in observable behaviour is for behaviourism the most significant form of learning (Watson and Kimble, 2013). Historically speaking, this learning paradigm can be divided into two stages:

- behaviourism (1910–1930) and
- neobehaviourism (1930–1955).

Neobehaviourism outgrew classical behaviourism by attempts to formalize the laws of behaviour (sometimes in forms of mathematical expressions) and beliefs that learning can also occur indirectly through observing. Neobehaviourists, such as Burrhus Frederic Skinner, Clark Hull and Edward Chace Tolman, are sometimes considered a transitional group that shifted the dominant learning perspective toward cognitivism. Behaviourism today mostly lost its influence and let cognitivism take its place as the dominant learning paradigm. Critics of behaviourist learning usually argue that behaviourism does not explain all kinds of learning since it ignores inner mind activities and more or less negates modern discoveries of cognitive and neuroscience. We can say that it offers a very limited view on learning since it ignores internal factors such as emotions or motivation, ignores fact that learning depends on learner's inner subjective representation of environment and learning history.

Cognitivism

One of the first criticisms of behaviourist learning approach came from gestalt psychologists during the first decades of the 20th century and was related to behaviourist dependencies exclusively on overt, predictable behaviour. It was the gestalt views on learning that influenced new approaches extending beyond behaviourism and setting the basic principles of what is today known as cognitive learning theories. In the 1960s behaviourism was as a dominant learning paradigm slowly replaced by cognitivism. The cognitive approach to learning, unlike behaviourism, sees learning as the active acquisition of new knowledge and developing adequate mental constructions, it sets the learner as the locus of control and not just as a passive participant in the process of learning. In doing so, it attempts to open the “black box” of his mind and explain the complex cognitive processes and architecture of this phenomenon, emphasizing the role of prior knowledge and experiences for learning outcomes, and seeing the learner as an organized information processor (Leonard, 2002).

If human cognitive architecture is to be analyzed, then the role and properties of the human memory system should also be accounted for. Memory is often defined as an organism's ability to store, retain, and recall information and experiences. Since the beginning of its intensive development during the 1960s various critics of cognitivism have

emerged, challenging its assumption that mental functions can be compared to an information processing model. Some authors like John Searle or Roger Penrose claim that computation, due to its inherent limitations, can never achieve the complexity and possibilities of human mental functions and therefore cannot be successfully used to describe them. One could say that this is one of the key critiques of cognitivism itself, and it is supported by concrete examples. A well-known example is one of Gödel's incompleteness theorems which claim that "*within any given branch of mathematics, there would always be some propositions that couldn't be proven either true or false using the rules and axioms… of that mathematical branch itself. You might be able to prove every conceivable statement about numbers within a system by going outside the system in order to come up with new rules and axioms, but by doing so you'll only create a larger system with its own unprovable statements*" (Smith, 2013). Oversimplified, this means computers will never be capable of human-like cognition since they are limited to a limited set of axioms. The information-processing model should therefore have a limited application in case of humans. Kurt Gödel proved his two theorems of incompleteness in 1931 (Gödel, 2006). Turing's halting problem is another example: it claims that given a description of a program, it is impossible to decide whether the program finishes running or continues to run forever for any given program input. This theorem proven by Alan Turing in 1936 shows how some things are naturally non-computable. During the 1970s humanism evolved as an opposing view to both behaviourism and cognitivism beginning with the holistic approach, belief in the power of an individual and view learning as a way of fulfilling his potentials (Leonard, 2002).

Humanism

Humanism as a learning strategy was being developed in the 1960s as a contrast to behaviourism and cognitivism. The perception of a human being become an object in scientific inquiry. Main premise of humanism starts from the belief in inherent human goodness and contrasts Sigmund Freud's (Elliott, 1999) and biological approaches, which claim human behaviour and cognition are determined by experience and prior events. Carl Rogers and Abraham Maslow were most important humanist authors that shaped theory of humanism. Works of Rogers and Maslow were mostly orientated on understanding of personality. Humanists emphasize the importance of responsibility for individuals actions, the present