The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy

ISSN: 2357-1330

https://dx.doi.org/10.15405/epsbs.2018.09.02.21

EEIA-2018
2018 International Conference "Education Environment for the Information Age"

MAIN TRENDS IN COGNITIVE RESEARCH IN EDUCATION IN USA, CANADA AND FRANCE

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Abstract

The article deals with basic trends in cognitive research in education, which is in the progress in the USA, Canada and France now. The subjects of research are connected with emotions, memory, attention, thinking, educational problems, IT technology, etc. Lately much attention was paid to projects studying the role of emotions in the educational process and their influence on students' cognitive development. The article describes various research carried out in the countries mentioned above, i.e. American courses in neuro-education, which may help teachers to use the results of cognitive research to work out their own methods of solving real educational problems. In Canada and France, much attention is devoted to studying factors influencing educational effectiveness and optimization of remembering processes. In France, there are a number of researches, which may help understand brain functions of younger schoolchildren in reading and mathematics. The results of these researches are published regularly, and every teacher may use it in his / her regular work. However, not all teachers wish to introduce the results of neuroscience research into their practice, and the governing bodies cannot impose on them to work in such a way. Therefore, in all countries engaged in cognitive research in the field of education, there is the problem of transferring knowledge from the field of neuropsychology and neuroscience to teachers that may be useful to them.

Keywords: Cognitive sciences, neurosciences, neuro-pedagogy, neuro-education.

https://dx.doi.org/10.15405/epsbs.2018.09.02.21
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Selection and peer-review under responsibility of the Organizing Committee of the conference
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1. Introduction

Cognitive sciences represent an interdisciplinary synthesis of sciences connected with a unified set of problems: intelligence – brain – language. In the second half of the twentieth century, a real cognitive revolution took place, which became possible due to the advent of computer technology and the successes of parallel progressing cybernetics, linguistics and computer science (Chernikova, 2011). In the 80-s of the 20th century, psychologists and neurobiologists began to interact more closely, which led to the emergence of a new science - cognitive neurobiology, which uses brain imaging techniques (computer, magnetic resonance, positron emission tomography) that empirically connect mental processes with the physiology of the brain. This fact has significantly changed the research field and the scope of cognitive sciences. To conduct research, now it is necessary for scientist to be involved in additional disciplines (mathematics, physics, computer science, neuroscience, etc.). Thanks to their contribution, it has become possible to carry out multi- and interdisciplinary studies of the nervous system in its most complex integrated functions: behaviour, emotions, cognition and psyche.

An important feature of neuroscientific studies at the end of the 20th and beginning of the 21st century was the separation of cognitive neuropsychology and cognitive neuroscience. Cognitive neuropsychologists focus on cognition, while in cognitive neuroscience more attention is paid to brain research, especially the work of neurons and the functioning of various parts of the brain (Dudko, Kurdyumova, Suhin & Suhina, 2017).

The new discipline “neuroeducation”, which appeared in West European universities in 2007, is the result of unification of neurosciences and educational arts. Neuroeducation is regarded as a new approach to educational research differing from behaviourism, cognitivism and constructivism.

Neuroeducation differs from other approaches because it analyses educational problems at the brain level using visualization methods. “Neuroeducation” as a subject course is on the programme of all the prestigious universities, such as Harvard or Cambridge, and is actively developing in such countries as Finland and Canadian Quebec (Association pour la recherche en neuroéducation, 2018). There are courses of professional teacher development in neuroeducation in these countries; interdisciplinary bases of neuroresearch data in the field of education are being worked out, etc.

In Canada and France, the term “neuropedagogy” is in broad use. Neuropedagogy was born in different countries simultaneously: before the beginning of the 21st century, there were many official attempts to unite various interdisciplinary concepts in education. The goal of neuropedagogy is to define how to raise efficiency and quality of education with the help of modern knowledge about human brain (Houdé, 2016). In France, neuropedagogy is taught in pedagogical high schools (ESPE) and Normal Higher Pedagogical School (Ecole normale superieure).

2. Problem Statement

There are some traps which students and teachers fall into in the process of education due to ignorance of certain features of brain functioning and mechanisms of thinking, attention, memorization, etc. Acquaintance with the latest data of neuroscience can help teacher more adequately apply teaching methods, avoiding traditional mistakes. Meanwhile, the latest knowledge about the brain and 3D research data raise numerous controversies around the possibility of applying the results of neuroscience in the

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classroom. The problem lies in the reliability of the experiments and in determining knowledge from the field of cognitive neuroscience and neuropsychology that are necessary for the teacher to optimize training as much as possible. Teachers' own motivation and interest are also of great importance.

3. Research Questions

What is the application of neuroscience in modern education? How is it applied in English-speaking and French-speaking countries?

4. Purpose of the Study

to introduce basic problems and themes of modern cognitive research (neuroresearch) in the sphere of education in the developed countries like the USA, Canada and France.

5. Research Methods

Comparative analysis, synthesis, abstracting and concretization, generalization, interpretation.

6. Findings

6.1. Neuroeducation of the American universities

Like in other countries, in the US, neurosciences have been evolving separately from education for a long time, however, the understanding that learning is closely linked to the development of brain functions has led to intensification of interdisciplinary research linking neuroscience and education in recent decades (Carew & Magsamen, 2010).

American neuroscientist and psychologist Lucas Konopka believes that when developing educational programs, it is necessary to take into account and understand the biological, psychological, social and spiritual processes that accompany the child's development. It is important to take into account the individual characteristics of students and understand that not everyone learns in the same way and the same pattern, even if they belong to the same social stratum. Neuroscience can help find the strengths and weaknesses that affect the cognitive abilities of a student. For example, if a child has difficulties in hearing information processing, then his/her strong suit is visualization, and it is possible to build a style of his/her learning that will bring the greatest benefit and develop the cognitive abilities of a particular child. Developing curriculum based on brain research, it is possible to avoid the difficulties that occur when the student is forced to solve a problem that does not correspond to his/her abilities and capabilities. (Konopka, 2014).

Co-founder director of the School of Education of the United States Neuro-Education Initiative and Vice-dean for the educational issues of the Johns Hopkins School of Education, Mariale Hardiman, also emphasizes the importance of dialogue between teachers and researchers in the field of neuroscience in the development of new educational projects (Materialy saita "Johns Hopkins School of education", 2018).

Thus, by now, leading American universities have developed courses and programs on neuroeducation for teachers. Harvard Graduate School of Education offers one of the first Master's programs "Mind, Brain, and Education" for teachers and researchers. This program integrates the knowledge of biology, cognitive neuroscience, psychology, neuropsychology and social sciences for a

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better understanding of how people learn and develop. The training course promotes the development of interdisciplinary thinking and analysis. Integrated knowledge can help teachers in educational practice or in the case if they wish to continue their scientific work on studying the influence of human sciences of education (Materialy saita "Harvard. Graduate School of Education", 2018).

There are also autonomous free online courses and seminars. For example, "Neuroscience & the classroom: Making Connection" or the online course "Gateway to Neuroeducation Studies" of the University of Portland. Such courses introduce educational neuroscience and make teachers rethink their pedagogical practices. The courses are developed by professional researchers in the area of neuroscience, psychology, medicine, education and are designed for those who want to know more about innovations in education. One of the most visited free educational internet resource is "The Annenberg Learner: Teacher resources and professional development across the curriculum", which presents the results of neuroscience that can be used in the learning process. (Materialy saita "Annenberg Learner", 2018). Such resources provide teachers with the most successful learning strategies; help them learn how to use effectively research data to develop their own methodologies for solving specific educational problems (Annenberg Learner: Teacher resources and professional development across the curriculum, 2018).

American scientists emphasize the importance of emotions in learning and their impact on cognitive development. Research of the American Committee on Children, Youth and Family has shown that younger children with higher levels of empathy tend to be less aggressive, more socially adapted, and more successful in learning. (Durlak, Weissberg, Dymnicki, Taylor & Schellinger, 2011). Neuroscientists say that positive experience significantly stimulates brain development, so it is necessary to focus on creating a positive and stimulating learning environment that will help to understand better the new teaching material. "The Annenberg Learner: Teacher resources and professional development across the curriculum" confirm that emotions are necessary for our survival. Most of us tend to perceive emotions as ordinary feelings (although often strong), such as joy, sadness, anger or fear. However, from the standpoint of cognitive science and evolution, emotions are behavior and thoughts that automatically work under certain conditions, both real and simulated. Researchers of the above-mentioned course say: when emotions are cut off from rational thinking, the ability to think, make decisions and learn is violated. Emotions and thinking cannot be separated from each other: they must work together to understand the world and its rational functioning. For example, students who solve mathematics or another problem rely on memories of their experience in search of strategies that can be applied to a new problem. Approaching the solution, the student experiences a series of small emotional "pushes" that allow him/her to feel that he/she is on the right track, and enjoy his/her work.

One more example: we set ourselves the task to study chemistry and become a doctor. If the problem does not matter to us, then we quickly lose interest in it. However, if the chemistry score is important to us, we will most likely study the strategies for obtaining a good rating without intensive chemistry studying. (Annenberg Learner: Teacher resources and professional development across the curriculum, 2018). Educational programs on neuroeducation allow teachers to enroll students with different cognitive abilities, because any educational technology cannot work equally for all students. The developers of educational university programs for teachers admit the prospect of using the results of neuroscienties in practice,

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because neuroscience provides insight into how students can learn better by connecting each student to the most effective methods based on knowledge of the human brain.

6.2. The main areas of neuroscience in education in Canada and France

In early 2018, the French Ministry of Education has undergone changes that allow us to hope that the results of the neuroscience will finally cross the threshold of the school and be adopted by the teachers. Education Minister Jean-Michel Blanquer announced the creation of a special scientific council, which should focus on cognitive research in the field of education. The main task of the council is to offer recommendations on the teaching of school subjects in accordance with the latest achievements of science, as well as on the content of textbooks and the teacher-training program, taking into account the data of neuroscience. The head of the National Scientific Council for Education was Professor Stanislas Dehaene, who is currently considered one of the leaders in neurobiology and the chair of experimental cognitive psychology at the famous Collège de France.

Turning to the results of PISA research, the scientist believes that the poor results of France in the field of reading are largely due to the wrong approach to learning the French language. Earlier, back in 2007, on the basis of numerous experiments, Stanislaus Dean proved that only a consistent movement from smaller units (letters, phonemes) to larger ones (words, phrases) ensures the acquisition of satisfactory reading skills in children, because it stimulates the corresponding brain functions, which with this type of learning are better adapted. All experimental data and conclusions were published in the book “Reading Neurons” and presented for review to the previous Minister of Education (Dehaene, 2007). However, an outdated global method of teaching is almost universally used in French schools.

Now, taking the top position in the National Scientific Council for Education, the neuroscientist intends to move on to unification of the neuroscience with the sciences of education and plans to change the approach to teaching reading in schools. Dehaene finds the situation unacceptable when teachers are more aware of the functioning of their car than about the functioning of the brain of the children they are training. Therefore, it proposes a systematic review and reassessment of textbooks and training practices, which should be based on the latest scientific evidence. As, for example, it is done in medicine, when the effectiveness of a new drug is tested (Les neurosciences au service de la pedagogie, 2018). Dehaene suggested that the scientific council together think about what knowledge it is necessary to transfer to the teacher so that he can independently develop a training route that maximally increases the mental and thought processes available to the child (Ropert, 2018).

For example, it is known that memorization and forgetting are simultaneous competing processes. Therefore, it is necessary to develop such learning strategies, in which memorization would “benefit” from forgetting. Scientists have established that for this it is necessary to know certain regularities, which are revealed experimentally. In France (under the direction of Olivier Houdé) and in Canada (under the leadership of Adele Diamond) in schools experiments were conducted with educational activities of this type. As a result, the main traps were identified, in which the pupil and the teacher usually get in the process of training. Experiments have convincingly shown that the rate of training that is practiced today in schools, even for healthy children, is too fast, and the training programs do not provide enough time to consolidate knowledge. This is the first trap. The stages of learning leading to the understanding and assimilation of

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new topics and complex concepts, as a rule, are not sufficiently divided into separate units, this is the second trap. A significant part of the concepts (up to 50%) leads to misunderstandings and confusion, very destructive for further training, - here is the third trap. As a result of the experiments, certain curves of successive repetition were discovered, on which the teacher can rely, building the learning process. It was concluded that repetition is indispensable in training. Previously almost rejected, it is now fully rehabilitated (Les neurosciences au service de la pedagogie, 2018).

The research findings were published, and if desired, each teacher can use them in their work. However, no one can force teachers to do this without fail. On this occasion, Stanislas Dehaene comments that the teacher should observe certain fundamental principles that do not contradict pedagogical freedom. And he adds that it is necessary to pay attention to the fact that the child does not know or does not understand, be able to discover causes and reduce gaps. The further work with schoolteachers is planned in this direction (Ropert, 2018).

In connection with the understanding of the need for more extensive use of the latest achievements of cognitive neuroscience in educational institutions, in 2017 one of the grants was allocated by the French Ministry of Education for studies that should provide an understanding of the mechanisms of brain functioning in reading and counting, as well as studying the factors affecting on the effectiveness of teaching children of primary school age. Professor S. Dehaene is leading the grant. The French public is following with interest the development of the Ludo project. The Ludo project is a software for a fascinating study of the fundamentals of numbers and reading in kindergarten. The software will be presented in the form of a set of tablet games and integrates all the ideas that have positively proven themselves in the research of cognitive sciences in the study of the mechanisms of reading and counting.

Researchers note that ICT in conjunction with neurosciences can be a major support for increasing the effectiveness of teaching all children, including children with special educational needs. Together, they provide an opportunity to improve the quality of learning by activating the 4 main stages of the knowledge acquisition process: 1) attention, 2) co-participation in the learning process, 3) feedback, 3) knowledge consolidation (Materialy saita “Initiatives et Innovations Pedagogiques”, 2018). However, at the same time, there are numerous contradictory opinions regarding the use of digital, computer and information and communication technologies, without which it is difficult to imagine the modern process of education. The use of the latest ICT and digital devices allows developing variative training programs, addressing the issues of differentiation and individualization of training, taking into account individual requests, physical and intellectual abilities of students. As usual, despite the obvious advantages, there are serious cons. For example, many children are able to control touchscreens, but feel a lack of dexterity of fingers, since many hours are spent behind tablets. In this regard, many high school students cannot cope with written examinations of traditional form, because their memory is broken due to the excess of the use of modern screen technologies. However, teachers are forced to take into account that modern children are born and live in a world where digital devices are an integral part of daily life. The search for a balance in using the achievements of neuroscience, digital, computer and ICT technologies is now an important problem for scientists and teachers.

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7. Conclusion

Numerous research findings and hypotheses have been forgotten because they were detached from the global vision of education in which they were to be integrated. The use of neuroresearch results causes an effect, which stimulates teachers' trust and their eagerness to find out more and move further on in the cognition processes capable of improving the teaching-learning efficiency. Many researchers agree that it is only confidence that steps up teachers' initiative, but not prescriptions. A wish to introduce into practice the latest results of neuroresearch, a striving for improving the instruction process, for self-development, have become a powerful driving force towards development for many teachers (Stordeur, 2015). Neurosciences give teachers a possibility to understand the ways and means of constructing educational strategies using their students' best qualities. As for students, an important stimulus is success which is achieved due to the use of effective methods based on the knowledge about human brain. And success, in its turn, brings forward enthusiasm and striving to know more, leads one to the willingness and need to learn throughout one's lifetime, which is an important factor of personal growth and the main factor of modern society successful development

Acknowledgments

This article has been prepared within the frame of the State Assignment of the Institute for Strategy of Education Development of the Russian Academy of Education on the 2017-2019 project No 27. 8520.2017/BCh.

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