

# Neuropedagogy as a Scientific Discipline: Interdisciplinary Description of the Theoretical Basis for the Development of a Research Field

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**Abstract**—Recently, more and more scientific disciplines refer to research in the field of neurobiology. Interdisciplinary research procedures are created using modern methods of brain imaging. Neither did the pedagogues start looking for neuronal conditions for various processes. The publications began to show concepts such as ‘neuropedagogy’, ‘neuroeducation’, ‘neurodidactics’, ‘brain-friendly education’. They were and are still used interchangeably. In the offer of training for teachers, the topics of multiple intelligences or educational kinesiology began to be more and more popular. These and other ideas have been actively introduced into the curricula. To our best knowledge, the literature on the subject lacks articles organizing the new nomenclature and indicating the methodological framework for research that would confirm the effectiveness of the above-mentioned innovations. The author of this article tries to find the place for neuropedagogy in the system of sciences, define its subject of research, methodological framework and basic concepts. This is necessary to plan studies that will verify the so-called neuromyths.

**Keywords**—Brain, education, neuropedagogy, research.

## I. ADMISSION

IN recent years we have observed intensive development of modern brain imagining methods. The representatives of numerous scientific disciplines have gradually become more interested in the published results; they include psychologists, and more recently, pedagogues as well. There have been increasingly more publications related to the educational process, which refers to researches in neurobiology [1], [3]-[6], [8], [11]-[14], [16], [17], [20]. Interdisciplinary researches started in the second half of the 20<sup>th</sup> century. Initially they were performed by psychologists and doctors of medicine or neurobiologists within the scope of already existing scientific disciplines. Their themes focused, for instance, on the cognitive aspects of human development, and therefore, pedagogues have also joined the discussion on “brain friendly education” in the recent years. At the same time there are increasingly more attempts to define the theoretical and methodological framework of the newly created discipline – the field of research covering neurobiology, psychology and pedagogy. Due to the size and dispersion of scientific centers dealing with the above mentioned issues, numerous names have been used in the literature, such as neuroeducation, neuropedagogy, educational neurosciences and MBE. They

have often been used interchangeably.

This article is addressed mainly to pedagogues. It is an attempt to define theoretical assumptions of neuropedagogy, which is the essential first step in the research process. Scientific publications are missing the scientific perception of such reality, on the basis of which pedagogues could design paradigms of pedagogical and neurobiological research. The need to publish theoretical assumptions is even more urgent, taking into account that in numerous countries in the world in the work environment there have been increasing more methods of work and tools, which are not included in research, because there are no theoretical frameworks enabling such research – to author’s best knowledge.

This article has a form of short references to the most important issues concerning neuropedagogy and neuropedagogical diagnosis.

## II. HISTORICAL, PHILOSOPHICAL AND EPISTEMOLOGICAL GROUNDS OF NEUROPEDAGOGY

In 2005, and then in 2016, psychologists, neurobiologists and pedagogues met at a conference in Delphi to review the literature published by that time, and together, they decided that the most appropriate name for the new discipline of interdisciplinary research in the fields represented by them is the Mind, Brain and Education Science (MBE). This discipline may be also defined as a field of interdisciplinary research in neuropsychology, educational psychology and neuropedagogy (Fig. 1).

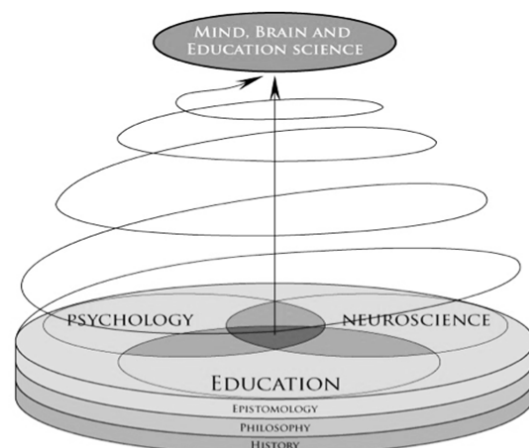


Fig. 1 Outline of the MBE uprising [19]

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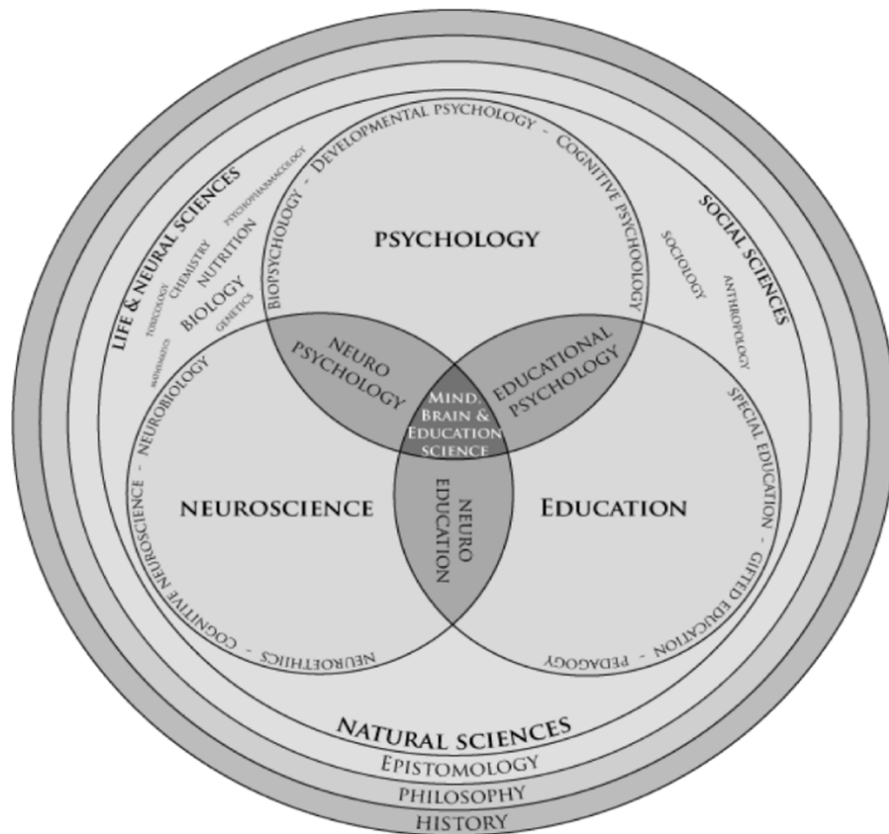


Fig. 2 Diagram of new interdisciplinary research areas [19]

This description is hardly used, since among them only educational psychology has a status of subdiscipline. In the literature on the subject, there are no publications and researches that could contribute to regulation of the scientific status of neuropedagogy. At a 2016 conference, the all of the most important objectives for the following 10 years were defined. One of them is to popularize the assumption that MBE is not the same as neuropedagogy. These notions have various semantic scopes and their interchangeable use is a mistake. Differences between them are presented on a scheme in Fig. 2.

Thus, neuropedagogy is a field of research falling within the scope of pedagogy and neurobiology. Its theoretical grounds are based on the history, philosophy and epistemology of these very different disciplines.

### III. NAME OF THE DISCIPLINE

Another source of misunderstanding among scientists is the controversies surrounding the relationships between notions of “education” and “pedagogy”. Which of them is the subject of research and which one – the name of the discipline? The notion of “pedagogy” is derived from the Greek word (paidagogos – literary “the one who leads a child”) and is older from the historical perspective. But the impact of Western philosophy shaped and disseminated the Roman notion (Latin “ars educandi”) translated as “the arts of

education”. Nowadays, the notion of “education” is commonly used for instance the Western European countries. But, is it right?

To solve the foregoing issues, one should refer to the very rich achievements of the Polish pedagogues. The majority of them (starting from J.A. Komeński, and ending on R. Wroczyński, K. Konarzewski, S. Kawula, M. Nowak, B. Śliwerski, S. Wołoszyn or W. Okoń) have believed and proven that pedagogy is a separate field of science, in which education is the subject of research, and didactics – one of the discipline [7], [9], [10], [15]. Thus, “pedagogy” is the leading notion with a broader meaning. We may call it a field of science belonging to social sciences and including disciplines dealing with development and changes in educational mechanisms throughout the entire human life. It means that the field of interdisciplinary research including pedagogy and neurobiology should be called “neuropedagogy” and become a subdiscipline of pedagogy in the future (prefix “neuro” means reference to the neurobiological theory and tools rather than conducting research in medicine or genetics).

Thus, the tasks of neuropedagogy should include:

- gathering information on neurobiological conditions of educational reality;
- analysis of the reality, relationship and dependencies within it and their explanation;
- disseminating obtained knowledge for the purpose of transformation of such reality.

#### IV. SUBJECT OF RESEARCH

The very notion of education has various definitions. The most meaningful and transparent one seems to be the definition proposed by Śliwerski [18]. He believes that educational activities influence the emotional and motivational processes and cognitive processes. The first ones refer to emotions, motives, attitudes and values, while the latter – to information, skills and efficiency of pupil's actions. Depending on the role of such aspects in designing, execution and assessment of results of an educational activity, we can differentiate between: upbringing (emotional education), teaching (cognitive education) and education (balanced education). Thus this concept of education is the broadest notion including all activities mentioned above. See Fig. 2.

Thus, the subject of interest of neuropedagogues is education that is upbringing, teaching and balanced education, which – both in the formal and non-formal aspects – is embedded in neurobiological conditions.

#### V. METHODOLOGY

During the above mentioned conference in Delphi, scientists made also some assumptions on the methodology. They referred to MBE, but may also serve as grounds for research in neuropedagogy. During the numerous discussions in Delphi it was pointed out that experts in MBE should accept the different historical roots of three disciplines, which means that for instance teachers have to understand that although they have different objectives than the ones characteristic for education, methods and procedures, psychology and neurobiology are equally useful for the organization of the learning and teaching process. Similarly, psychologists practicing the new discipline must recognize that information in neurology and education are equally valuable despite differences in methodology, while neurologists should learn to appreciate the qualitative research. Moreover, Bruno della Chiesa, Vanessa Christoph and Christina Hinton pointed out that scientists practicing MBE must verify their research hypotheses on the basis of methods available for each of these fields of science and received results should be considered important in the same scope. Such an approach is determined by the name of the discipline itself, which suggests a three-way flow of information. It means that if any results are to be adopted in the new discipline, pedagogues, psychologists and neurologists must confirm their hypotheses not only in their own disciplines, but in the other two as well [2].

It may be assumed on the basis of the foregoing, that assumptions or hypotheses adopted by neuropedagogues should be verified by means of methods and tools used in neurosciences and pedagogy. The difficulty in this issue refers to the fact that at the moment there are very large discrepancies between methodologies of research in the above mentioned fields. Neurobiological analyses have very rigorous, structured and fixed process and only quantitative nature. While in pedagogy, standardized tools are hardly available, and dynamically developing stream of qualitative research do not provide a suitable environment at first sight to

execute interdisciplinary projects.

But, if we assume that a person who wishes to perform research in neuropedagogy should have pedagogical education (as the leading one) and education in one of the neurosciences, we may also assume that the methodology of neuropedagogical research will be based on the use of the methods of observation, experiment and action research, in which such tools as EEG, fNIRS, fMRI will be used next to observation, interview, questionnaire or tests.

#### VI. TERMINOLOGY

Terminology is the last issue requiring systematization. Among terms used in neuropedagogy, we may mention the ones that are characteristic for pedagogy: upbringing, education, teacher, care or resocialization. When they are embedded in neurobiological conditions, the main terminology should be developed by the addition of such notions as: brain, nervous system, brain imaging, neural plasticity or mirror neurons (see Fig. 3).

It is essential that only such notions are adopted in relation to neurobiology, which are of scientific value; that is, have been confirmed scientifically. It means that currently teaching styles, multiple intelligences or educational kinesiology should not be defined as neuropedagogical terms.

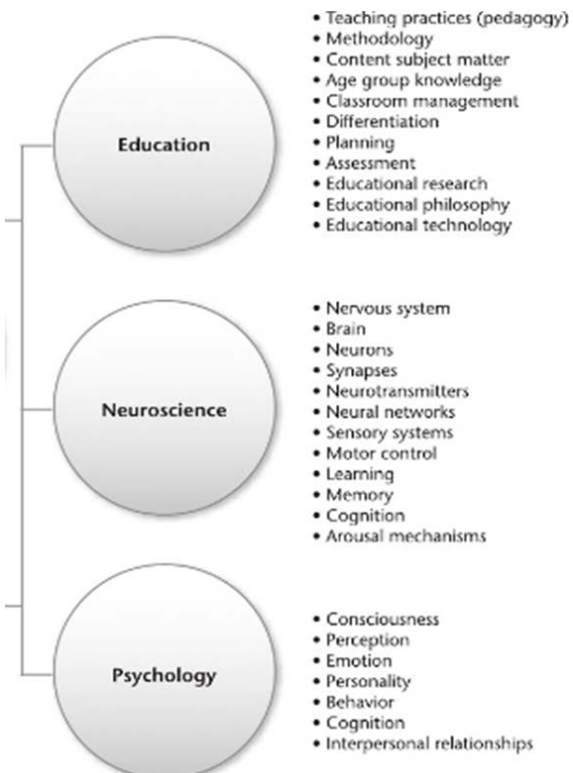


Fig. 3 Terminology of selected scientific disciplines [20]

#### VII. PROPOSED DIRECTIONS OF TESTS

The scope of pedagogy research is currently very wide and multi-faceted. When writing about the directions of research

on neuropsychology, first of all, we should focus on the constantly popular theories aimed at increasing the efficiency of education. You can mention here, among others, the theory of multiple intelligences, educational kinesiology, learning styles or so-called hemispheric dominance. In recent years, these theories have been massively introduced into the education system. In the literature on the subject, you can find lesson plans, a proposal for workshops or entire teaching programs based on the above and often funded by government institutions. Unfortunately, the above-described activities have not been preceded by reliable scientific research. It is not known whether their use does not interfere with the development of children.

Another important issue is the impact of contact with new technologies on the functioning of children. Various hypotheses regarding the above are part of numerous studies. However, the implications of the results obtained to the education system are still missing.

Brain neuroimaging methods may also contribute to the increase of reliability and objectivity of pedagogical research. Until today, teachers have a small number of standardized tools to diagnose the level of development or the effectiveness of teaching children. In schools or kindergartens, pedagogical experiments and introduced innovations are carried out, without previous research that could prove the effectiveness of their application. Some time ago in Poland, the Ministry of Education equipped educational institutions with a biofeedback therapy system [21]. Today, this equipment could be used in neuro scans. Teachers are interested in publications in the field of neuroscience. There are a lot of them on the market, but their scientific quality raises many objections. International research on the perception of neuromics by teachers showed a low level of knowledge about brain functioning among pedagogues. It would be reasonable to prepare, therefore, the preparation of reliable training or seminars based on the results of scientific research [4].

It seems obvious that with the development of technology, there will be more and more intensive development of research on the human brain. The interest in their results is so common that the emergence of new interdisciplinary sub-disciplines is probably only a matter of time.

#### VIII. SUMMARY

We may argue that neuropsychology has a potential to become an independent scientific discipline, which could provide information for instance on threats and possibilities of digitalization of the educational process, efficiency of various pedagogical innovations (teaching methods or programs) or therapeutic programs. Pedagogues may acquire a possibility to confirm or reject adopted theses in an objective and reliable manner. In the case of a discipline that was shaped only in the 17<sup>th</sup> century and has still evolved, it is a chance for more intensive development. It is also essential that at the time of brain research and numerous published results of such research, which arouse interests among representatives of various sciences and teachers, pedagogy must not resign from such reliable sources of information. It is even more important

taking into account that there are many neuromyths popular among teachers, which have no scientific explanation and have not been confirmed in research, and may be threatening for children.

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