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Math anxiety prevention. The pedagogical experiment.

Summary

The subject of the doctoral dissertation is the math anxiety. This phenomenon has been described from three perspectives: biological (neuronal), psychological (emotional) and social (cultural). The author has repeatedly emphasized the multifaceted nature of the math anxiety and the non-uniform etiology of this phenomenon. This topic was chosen because aversion to math is quite common. Some of the people who show are averse to mathematics are affected by a math phobia.

Mathematics phobia can have a big impact on life choices, including educational and career choices. This is an argument for the need to introduce prevention of the development of mathematical phobia into general education. Therefore, as part of the doctoral thesis, a pedagogical experiment aimed at such prevention was carried out. The experiment was carried out in one primary school in Poznań, among 6-7 year old children (two classes participated in the study, the third was a control group). The study consisted in solving everyday tasks supporting the development of mathematical competences, spatial imagination, shaping logical thinking, focusing attention and working memory. The results of the experiment are not unambiguously, but the experiment can be repeated on a larger sample of subjects and improved in the future.

In the first chapter, the author defines anxiety in terms of culture, treating mathematical phobia as one of the types of phobias found in society. Then the author proceeds to general remarks concerning the math anxiety, emphasizing its complicated etiology. In this chapter, the biological connotations of math anxiety are described in detail, attention is drawn to some of the research in the field of neuroscience, which describes, among others, the functions of counting or the functioning of areas of the brain related to mathematics, e.g. carry effect or changes in the amygdala associated with math phobia. The relation between performing mathematical operations and working memory was also described, and the SNARC effect and the Mental Number Line were described not only in the neural but also in the cultural context. In the first chapter, the author also draws attention to the relation between the math anxiety and motivation, as well as to stereotypes related to mathematics and science in general, not forgetting the conclusions regarding the consequences of these stereotypes. The first chapter ends with a subsection devoted to the language of mathematics, especially metaphors and numerical representations. The author reaches here, among others, to the theory of metaphors by Lakoff and Johnson or the theory of bootstrapping, the approximate number system (ANS) was also mentioned.

The second chapter is an original theory presenting the language of mathematics as one of the language games (which is a direct reference to the philosophy of Ludwig Wittgenstein).

This chapter is the philosophical justification of the experiment conducted as part of the doctoral thesis. The author asks three important questions:

- How do numbers/numbers connect to words?
- How does math connect to the world?
- What is the ontological status of mathematical entities?

In an attempt to answer the above questions, the author justifies why she understands the language of mathematics as a language game played within a language as precisely and logically bounded as the vision shown in *Tractatus logico-philosophicus* by L. Wittgenstein shows.

The second chapter also focuses on animal communication, reconstruction of the psychogenesis of language by Willard Van Orman Quine, and issues in the field of neurolinguistics. The author draws on the cortico-hippocampal theory and compares the language of mathematics to language in general. This chapter also develops the topic of metaphors that was raised in the first chapter.

The third chapter contains a description of an experimental research project. The research plan, the methodology of the experiment, as well as the content of the tasks that the participants of the experiment were solving are described in detail. In addition, this chapter describes the entire educational path substantively justifying its sense.

The last (fourth) chapter of the doctoral thesis is devoted to the analysis of the research results. All the questionnaires that the participants and their parents filled out during the experiment were analysed. The author also justified the selection of a few participants whose work was looked at more closely. After the analysis, the author performs a meta-analysis of the course of the experiment, critically assessing some of its elements. It also emphasizes the educational value of the tasks that the participants of the study solved and the potential to develop the implemented ideas in a broader perspective, as an element of school and pre-school mathematical education. Checking the assumptions, the author introduced a temporary educational project in a group of pre-school children aged 3-4. Positive opinions on the course of the project were expressed by the teacher teaching in this group and the vice director of the institution.