Prevalence of neuromyths among pre-service teachers

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***Abstract*—The article discusses the prevalence of neuromyths among future teachers of mathematics, computer science and physics. A brief description of the considered problem in world studies is given. The results of a survey conducted among students of six Russian universities are described.**

Keywords—neuroscience, education, neuromyth, teachers

I. Introduction

Interest in the knowledge of the structure of the human brain and consciousness arose a long time ago, and still does not subside among scientists and people far from science.

The connection between neuroscience and education, at first, seems far away [1]. However, in recent years, various neuroscience research continues to gain popularity, including in Russia.

Over the past 5–6 years, there have been significantly more articles by Russian authors specializing in theoretical and practical issues of integrating neuroscience and education. The terms “neuropedagogy”, “neurodidactics” and “neuroeducation” began to appear actively. Most often, the articles explore the historical background of the emergence of terms and their specification, examples of the use of neuroscience achievements in teaching, in inclusive education [2-6].

In international research, it is possible to highlight works devoted to the study of the spread of neuromyths among in-service and pre-service teachers [7-11]. Neuromyth is a misconception based on misinterpreted neuroscientific facts [12]. Teachers are looking for various ways to improve the quality of the pedagogical process. For example, using the results of neuroscientific discoveries. However, the lack of knowledge in this sphere, as well as the wide prevalence of distorted data in popular sources (non-core sites, forums) is the reason for the active use of neuromyths in educational practice [13, 14].

A similar study was conducted by specialists from the Institute of Age Physiology of the Russian Academy of Education. In their article, the authors identified the prevalence of neuromyths among teachers of different disciplines and levels of education in a large sample (more than 8 thousand participants). According to the results, conclusions were drawn about the insufficient knowledge of teachers about the structure and development of the brain, as well as the cognitive system; simultaneously with an increased belief in neuromyths [15].

In our opinion, the research of neuromyths has become one of the directions for scientific work in the field of integration of neuroscience and education.

In the current study, we would like to present the results of a survey of pre-service teachers of mathematics, computer science and physics.

II. Methods

The survey was conducted among students of six universities. There were 149 future teachers of mathematics, computer science and physics. The average age is 19,82 years. Most of the respondents are in the age range of 18–21 years. There were 69,13% of women in the sample.

The questionnaire consists of 45 questions, 20 of which are facts about the brain, and 25 are neuromyths. It was based on questionnaires of previous studies on this topic [7, 16]. Some of the questions were added by the authors of this article.

The theoretical analysis of the problem was carried out on the basis of neuroscientific and psychological-pedagogical scientific publications. An anonymous online survey of students was used as an empirical method. Participation in the study was voluntary and anonymous.

III. survey results

We will consider the results on two groups of issues separately. The information presented in the tables is sorted.

The answer “I do not know” was added to avoid randomized responses. For half of the facts and neuromyths, the answer “I don't know” turned out to be about 20–45%.

A. Facts about the brain

Out of 20 questions, 12 received correct answers from more than 60% of students. The most recognizable assertions are presented in Table 1.

TABLE I. The most recognizable assertions among the students

Facts about the brain	**Answers**		
	“I agree”	***“I disagree”***	***“I don't know”***
14. Individual learners show preferences for the mode in which they receive information (e.g., visual, auditory, kinesthetic)	94%	3%	4%
1. The environment influences hormone production and, in turn, personality	89%	8%	3%
27. Performance improves with practice	86%	7%	7%
24. It is with the brain, not the heart, that we experience happiness, anger and fear	84%	8%	8%

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The largest number of students (34%) did not agree with the fact of problems with academic performance (Table II).

TABLE II. ASSERTIONS WITH THE HIGHEST NUMBER OF "I DISAGREE" RESPONSES

Facts about the brain	Answers		
	"I agree"	*"I disagree"*	*"I don't know"*
13. Learning problems associated with developmental differences in brain function can be remediated by education	48%	34%	18%
16. When a brain region is damaged other parts of the brain can take up its function.	49%	29%	22%
29. Information is stored in the brain in a network of cells distributed throughout the brain	52%	19%	29%

Most often (41%), pre-service teachers answered "I don't know" to questions about the learning process (Table III).

TABLE III. ASSERTIONS WITH THE HIGHEST NUMBER OF "I DON'T KNOW" ANSWERS AMONG STUDENTS

Facts about the brain	Answers		
	"I agree"	*"I disagree"*	*"I don't know"*
40. Learning occurs through modification of the brains' neural connections.	53%	7%	41%
8. Extended rehearsal of some mental processes can change the shape and structure of some parts of the brain	50%	16%	34%
43. Information passes from short-term memory to long-term memory during sleep	49%	17%	34%

B. Neuromyths

Out of 25 neuromyths, more than 60% of students disagreed with only 5. The most unpopular neuromyths are presented in the table (Table IV).

TABLE IV. NEUROMYTHS WITH THE HIGHEST NUMBER OF "I DISAGREE" RESPONSES

Neuromyths	Answers		
	"I agree"	*"I disagree"*	*"I don't know"*
6. When we sleep, the brain shuts down	8%	90%	3%
11. Any brain region can perform any function	5%	81%	14%
4. Bilingual education leads to confusion and development delay due to the conflict between the two language systems	11%	79%	9%

More than 60% of students agreed with 6 neuromyths. The most popular neuromyth among the respondents was No. 36 on learning styles, with 92% agreed (Table V).

TABLE V. THE MOST POPULAR NEUROMYTHS AMONG THE STUDENTS

Neuromyths	Answers		
	"I agree"	*"I disagree"*	*"I don't know"*
36. Individuals learn better when they receive information in their preferred learning style (e.g., auditory, visual, kinesthetic)	92%	3%	5%
9. Short bouts of coordination exercises can improve integration of left and right hemispheric brain function	80%	6%	15%
38. Differences in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners	77%	9%	14%
35. Environments that are rich in stimulus improve the brains of pre-school children	73%	4%	23%
39. Exercises that rehearse coordination of motor-perception skills can improve literacy skills	73%	11%	16%

The answer "I don't know" was most often given at a neuromyth dedicated to brain imaging methods (50%) (Table VI).

TABLE VI. NEUROMYTHS WITH THE MOST "I DON'T KNOW" RESPONSES

Neuromyths	Answers		
	"I agree"	*"I disagree"*	*"I don't know"*
21. Electroencephalography, magnetoencephalography and magnetic resonance imaging are various ways to visualize the electrical activity of the brain	46%	4%	50%
32. Mental capacity is hereditary and cannot be changed by the environment or experience	17%	46%	37%
26. Attempts to memorize new information, remembering recent events, and recalling distant experiences are different abilities of a single memory system.	27%	39%	34%

Analyzing the articles on the topic, we found that most researchers present general final statistics, without highlighting the subject taught. Therefore, we compared our results with generalized data.

In our survey, the myth of the preferred learning style became the most popular with 92% of consenting respondents. The next are No. 9 and No. 38, about the development of coordination and the dominant hemispheres, with 80% and 77% of respondents. The four leaders are closed by the myth about environments rich in stimuli (73%). The results obtained partially coincide with previous

studies. The article [13] compared the results of several faculties of two universities in Greece. In this study, the myth about styles turned out to be just as popular (94%), however, for the respondents, myths No. 38 and No. 9 turned out to be much less convincing, with 55% and 37%, respectively.

The study [8] involved primary and secondary school teachers from the Caribbean Islands. Despite participating in neuroscience training, 97% of respondents believed in the myth of learning styles, 68% in the myth of differences in the hemispheres, and 63% in the myth of the influence of sweet snacks on children's attention. The authors believe that not just courses about the brain, but specialized courses with an emphasis on educational aspects will positively affect the recognition of neuromyths.

Conclusion

According to the results of our survey, a fairly high belief in neuromyths among pre-service teachers of mathematics, computer science and physics was determined. The most popular of them were the items devoted directly to improving the mental abilities of children and improving the quality of the educational process.

In our opinion, this is a very disturbing symptom. Since it is in school that not only the knowledge base of students is formed (what is called subject learning outcomes in modern Russian educational standards). The main thing is that the formation of personal results takes place in it.

It is impossible to talk about personal competencies as one of the most important learning outcomes in school without understanding the student's development as the main goal of learning. Only understanding that learning leads to development [17], and the development of a child in school occurs in the learning process as a result of the joint activity of the teacher and students, will allow us to build an appropriate system of psychological and pedagogical training of future teachers.

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