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IMPLEMENTATION OF INTER-SUBJECT RELATIONS BETWEEN THE DISCIPLINES OF THE NATURAL CYCLE IN THE PROJECT ACTIVITIES OF THE STUDENTS OF THE BASIC SCHOOL AS THE BASIS OF COMPETENT TRAINING OF PHYSICS

Abstract. *The article aims to reflect the results of processing and analysis of experimental data on the development of scientific and mathematical competence of primary school students using interdisciplinary links of physics with the disciplines of the natural cycle in the project activities of students.*
Based on the statistical analysis of the obtained results, all four formulated hypotheses are accepted with a high level of reliability, namely:
1) before the formation experiment, the control and experimental groups were homogeneous in terms of the levels of formation of the studied competencies;
2) after the experiment, the levels of formation of the studied competencies in the control group did not undergo significant structural changes;
3) after the experiment, the levels of formation of the studied competencies in the experimental group changed significantly;
4) after the formation experiment, the control and experimental groups differ significantly in high and low levels of formation of the studied competencies.
Keywords*: physics, project activities, interdisciplinary links, key and subject competencies.*

Statement and substantiation of the urgency of the problem. The Ministry of Education and Science of Ukraine by its order of 07.06.2017 № 804 confirmed the curriculum in physics for grades 7-9 for secondary schools [7] states that “an effective means of forming subject and key competencies of students in the process of teaching physics are educational projects. During the implementation of educational projects a number of different levels of didactic, educational and developmental tasks are solved: students' cognitive skills are developed, the ability to independently navigate in the information space, express their own judgments, show competence is formed. In project activities, it is important to interest students in acquiring knowledge and skills that will be needed in life. This requires taking into account the problems of real life, for the solution of which students need to apply the acquired knowledge”.

Educational and research activities change the emphasis of educational activities on the acquisition of knowledge, skills, research skills and experience, which will help accelerate the adaptation of young people to adult life. Teaching and research activities are an effective form of student learning that allows the teacher to identify and develop personal intellectual abilities of students.

Analysis of recent research and publications. Scientific research [1, p.123], [4, p.15] and others. aimed at finding innovative ways to select, structure and implement the content of school education in programs, textbooks and manuals on the basis of a competency-based approach.

L. Neporozhnya, O. Pinchuk and others. focus on finding forms and methods of forming key and subject competencies.

[5, p.292] investigate the technologies of their evaluation [8, p.149], [6, p.85] - current problems of modernization of basic physical education.

[3, p.364] determined the essence and structure of subject competence and competence in physics, at the same time took into account that from the standpoint of the competence approach the requirements are competencies, and the results achieved by students - the levels of competencies. Different opinions [9], ideas and approaches to the formation of physical competencies, determining their structure, building an appropriate methodology of the interdisciplinary project indicates the relevance of this issue, which requires additional study.

The purpose of the article. In view of the above, the article aims to reflect the results of processing and analysis of experimental data on the development of scientific and mathematical competence of primary school students using interdisciplinary links of physics with the disciplines of the natural cycle in project activities.

The main material of the study. We formalize the hypothesis from the meaningful "implementation of interdisciplinary links between disciplines of the natural cycle in project activities will provide a high level of students' mastery of fundamental science theory and will develop the necessary competencies" in statistical hypotheses based on comparative analysis of competencies:

• Hypothesis 1: the levels of formation of competencies before the experiment in the control and experimental groups did not differ significantly;

• Hypothesis 2: the levels of formation of competencies in the control group after the experiment did not undergo significant structural changes;

• Hypothesis 3: the levels of formation of competencies in the experimental group after the experiment have changed significantly - the number of children with a low level decreased, and with a high level increased;

• Hypothesis 4: the levels of formation of competencies after the experiment in the control and experimental groups differ significantly.

Statistical verification of the formulated hypotheses is performed using angular transformation (Fisher's test), which is used to compare two series of sample values by shifting the frequency of occurrence of a certain feature. This criterion can be used to assess differences in any two samples, both dependent and independent, as well as to compare the performance of one sample measured in different conditions.

Calculations of the observed (empirical) values of the Fisher test are performed according to the following scheme:

1) Percentages are translated into fractions of a unit (by dividing by 100).

2) The fractions of the unit are translated into radians by the formula of Fisher's angular transformation:

$$\varphi_1 = 2\arcsin\sqrt{P_1}\,,\ \varphi_2 = 2\arcsin\sqrt{P_2}\,,$$

where P_1 and P_2 — the corresponding destinies being compared.

3) Calculate the observed value by the formula:

$$\varphi^*_{\text{âí ï}} = (\varphi_1 - \varphi_2)\cdot\sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Where n_1 and n_2 — the volumes of the studied samples.

4) The significance of the obtained criterion is checked by finding the probability of the obtained empirical value in the Student's distribution.

Table 1.

The results of testing statistical hypotheses about the presence of significant changes in the levels of formation of competencies before and after the experiment

	Levels		
	High	Average	Low
Probability with which hypotheses are accepted about the absence of significant changes in the levels of formation of competencies before the experiment in the control and experimental groups (homogeneity of groups)			
1. Scientific and natural competence 1.1. formation of concepts, knowledge of quantities, laws, patterns, models, formulas, equations	0,9283	0,8902	0,9548
1.2. methods of scientific knowledge, experiments, measurements, data processing, calculations, graphs	0,9749	0,8808	0,9169
1.3. solve problems	0,8937	0,9646	0,9432
2. Mathematical competence (ability to solve computational and graphical problems)	0,8937	0,9646	0,9432
Probability with which the hypothesis of the presence of significant changes in the levels of formation of competencies after the experiment in the control and experimental groups			
1. Scientific and natural competence 1.1. formation of concepts, knowledge of quantities, laws, patterns, models, formulas, equations	0,8446	0,9013	0,9999
1.2. methods of scientific knowledge, experiments, measurements, data processing, calculations, graphs	0,9431	0,8664	0,9963
1.3. solve problems	0,9308	0,5349	0,9982
2. Mathematical competence (ability to solve computational and graphical problems)	0,9308	0,5349	0,9982

Table 2.

The results of testing statistical hypotheses about the presence of significant changes in the general levels of formation of competencies before and after the experiment in the control and experimental groups

	Levels					
	High		Average		Low	
	Before the experiment	After the experiment.	Before the experiment	After the experiment	Before the experiment.	After the experiment
Experimental group						
The share of the unit	0,2258	0,3468	0,2016	0,5403	0,6532	0,3065
Angular transformation	0,9904	1,2593	0,9313	1,6515	1,8823	1,1733
The observed value of the criterion φ^*	1,4278		0,7324		2,9513	
Probability of the observed value according to Student's criterion	0,1554		0,4651		0,0037	
The probability with which the hypothesis of the presence of significant changes in the levels of formation is accepted	**0,8446**		**0,5349**		**0,9963**	
Control group						
The share of the unit	0,2143	0,2143	0,2143	0,2857	0,6429	0,6071
Angular transformation	0,9626	0,9626	1,5168	1,5498	1,8605	1,7868
The observed value of the criterion φ^*	0,1338		0,1502		0,1045	
Probability of the observed value according to Student's criterion	0,8937		0,8808		0,9169	
The probability with which the hypothesis of the presence of significant changes in the levels of formation is accepted	**0,1063**		**0,1192**		**0,0831**	

Conclusions. Thus, based on statistical analysis of the results, we can conclude that all four formulated hypotheses are accepted with a high level of reliability, namely:

1) before the formation experiment, the control and experimental groups were homogeneous in terms of the levels of formation of the studied competencies. The hypothesis is accepted with a probability (see Table 1) of at least 0.8937;

2) after the experiment, the levels of formation of the studied competencies in the control group did not undergo significant structural changes - the probability with which the hypothesis of changes can be accepted (see Table 2) is not more than 0.1192;

3) after the experiment, the levels of formation of the studied competencies in the experimental group changed significantly - the probabilities with which the hypothesis of changes for high and low levels close to 1 can be accepted (see Table 2), for the middle level changes are not so significant;

4) after the formative experiment, the control and experimental groups differ significantly in high and low levels of formation of the studied competencies - the probabilities with which the hypothesis of differences for high and low levels (see Table 1), not less than 0.8446; for the middle level, the probability is not less than 0.5349.

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