DEVELOPING STUDENTS' SKILLS OF EVALUATING MATHEMATICAL RELATIONSHIPS AND DEPENDENCIES THROUGH INTERDISCIPLINARY APPROACH

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Abstract: *the article is devoted to collaborative research conducted using intersubject communication in order to develop the skills of assessing mathematical relationships and students' dependencies. The study examined professional issues, problem-solving questions, research tools, and the research process. The analysis of Math teachers' intersubject cooperation with teachers of natural science is carried out. Integrated tasks and learning methods made it possible to develop students' research skills. The object of research is defined, the analysis of results and conclusions are given.*
Keywords: *intersubject communication, natural sciences, evaluating skills, mathematical dependencies.*

РАЗВИТИЕ НАВЫКОВ ОЦЕНИВАНИЯ МАТЕМАТИЧЕСКИХ СООТНОШЕНИЙ И ЗАВИСИМОСТЕЙ У УЧАЩИХСЯ ЧЕРЕЗ МЕЖПРЕДМЕТНУЮ СВЯЗЬ

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Аннотация: *статья посвящена коллаборативным исследованиям, проводимым посредством использования межпредметных связей в целях развития навыков оценивания математических взаимосвязей и зависимостей у учащихся. В ходе исследования были изучены профессиональные проблемы, вопросы, направленные на решение проблем, инструменты исследования и процесс исследования. Проведен анализ межпредметного сотрудничества учителей математики с учителями естественных наук. Комплексные задания и методы обучения позволили развить исследовательские навыки учащихся. Определен объект исследования, приведены результаты и выводы исследования.*
Ключевые слова: *межпредметная связь естественные науки, навыки оценивания, математические зависимости.*

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Professional problem:

- The analysis of external summative assessment test results of graduates in 2017 showed the need for the common understanding of scientific concepts and a need to develop mathematical relationships and dependencies;
- It was clear that students wanted to choose a future profession in natural sciences, and most importantly to conduct a research project on the selected subjects.

The authors have been searching for ways to solve these obstacles for several years, but certain steps were taken to solve them only within the framework of this research work.

To be a skilled professional competing in the international market, it is necessary for students to develop the skills necessary for their use in everyday life and acquiring new knowledge starting from the school threshold. In the curriculum, it is suggested to help students develop applied forms of literacy during the lesson, during extracurricular lessons [12,4 p.]. Moreover, all famous teacher-scholars noted the interdisciplinary approach as a main solution. For instance, Comenius said that "All that is connected with them, should be trained in this regard", while I. G. Pestalozzi highlighted the same "All that is connected mutually with each other, in the form of connections they are in nature, should be in the same relation and connection in your mind". Furthermore, K. D. Ushinsky defined the notion of interdisciplinary studies in the following way "Despite the corresponding

special concepts in accordance with the characteristics of each discipline separately, there are concepts common to all Sciences". And I. M. Sechenov expresses his opinion, "Understanding the external world is the same with the identification of the connections and dependencies between objects that live outside the world". After the study of these ideas and opinions, it was decided to develop students' skills of evaluating mathematical relationships and dependencies through interdisciplinary approach.

The authors of this work understood the importance of ensuring the unity of the basics of scientific and theoretical knowledge provided to students in order to develop students' skills in evaluating mathematical relationships and dependencies. After all, in turn, it teaches students to think, to look for the best way. To implement the research project, the authors looked for answers for the following research questions:

- *Why do students struggle in identifying the mathematical relationships and dependencies in solving interdisciplinary problems?*
- *How can be students' skills of evaluating mathematical relationships and dependencies in solving interdisciplinary problems be developed?*

In order to undertake the research project, the following research tools were used: document analysis, questionnaires, and external monitoring of the lesson. In order to comply with the ethical standards of research, written permission was taken from parents. 16-17 years old students of Grade 11 were selected as the object of research. These students had chosen natural sciences subjects as compulsory.

In the scope of the study, the authors were very convinced that in order to improve students'skills of evaluating mathematical relations and dependencies, it is necessary to reveal the practical and applied role of mathematics, and demonstrate its interdisciplinary relationship. In this regard, on Math lessons, by strengthening interdisciplinary connections, the teachers understood that it is necessary to instill students in making a project work. In order to awaken the students ' ability to write a project, it was useful to write an essay with interdisciplinary content on the lesson. However, during the project, the authors were ensured that students were open, flexible and adapted to the news quickly.

The impact of the project as a whole was three-way: to the students, the school, and the professional development of the authors. Thanks to the ideas derived from the students' essays, an environment was formed in which they could write and discuss about their research projects which were mainly related to their future professions. Students started to talk about weaknesses and achievements in the educational process. It contributed to the level of learning. The second influence of research work is that while teaching students to make plans of their projects, the authors themselves got used to the systematic implementation of daily work, managing time, planning thoroughly every stage of the lesson and tasks, they understood that they could achieve certain results. It also had a great impact on the school. Relationships between colleagues have improved. The values of trust and mutual cooperation have stabilized, and professional interactions have been systematized.

The rubrics were used to measure students' achievements in the development of skills of evaluating mathematical relations and dependencies. An evidence of the research aim achievement is the mastering and implementation of the knowledge by students.

To determine the specific steps of research work, the opinions of graduates about learning and teaching were taken into account [1, 15 P.], which was gathered through an online questionnaire. In the discussion of this questionnaire results, the basics of mathematical analysis appeared to be useful to apply the rules of differentiation and integration in solving problems of physics, chemistry, and to calculate the probability of formation of mutational descendants in biology. At the same time, graduates had difficulties in applying algebraic formulas, applying logic in computer science, data analysis, concentration and other concepts, and in calculating integrals of the mass of thin materials. This confirmed that in order to capture the unity of the basics of theoretical and scientific knowledge of students, it is necessary to improve the students' skills of evaluating mathematical relationships and dependencies. Furthermore, on the basis of the questionnaire, it was decided to ask a question the graduates "What difficulties were encountered in higher educational institutions?" in order to avoid the possible educational obstacles in the future. It helped to revise the long term plan of the subject. The analysis of the questionnaire results showed that students faced difficulties in completing practical tasks and graduates highlighted the need for doing coursework. In this regard, several literature sources were reviewed.

One of the ways to reveal the practical and applied role of mathematics is its interdisciplinary relationship (G. Kozhabaev, 1998).

According to V. G. Kosherov and L. T. Iskakov(2015), it is necessary to tell students about the relationship of phenomena and processes around us in the world, to tell about the use of knowledge, skills and abilities gained on other subjects during the study of new educational materials[1,18 P.].

Based on the analysis of the theories [2, 6-8b], [3,11-13P], [4,18 P], [5,218 P], [6,184 P], [7, 208P] to improve students' skills of evaluating mathematical relationships and dependencies, it was decided to use interdisciplinary approach in the classroom, to conduct a comparative analysis of the curriculum of natural science subjects and mathematics. It was agreed that interdisciplinary approach should be applied when revising the learning objectives of these subjects.

It is planned to ask problem-based learning questions and questions of interdisciplinary content during the lessons. Moreover, interdisciplinary approach was applied to home task content, exercises, texts and visuals used on the lessons. Reflections on the lessons showed that it is necessary to prepare questions with interdisciplinary content, problem-based learning questions and problems to solve, passages to read, through which students knowledge and understanding of the relationship between natural phenomena and society would be expanded. These actions contribute to the collaborative interdisciplinary work of the authors with teachers of natural sciences subject teachers. The specific steps and time of the integrated lessons were determined according to the methodology book [1, 136], [9]. These lessons gave their results, the aim was partially achieved, and there was a clear link between the subjects of mathematics and natural science subject. Students' feedback on the lessons and rubrics used during them showed that students could sharpen and master their knowledge about the connections between subjects and phenomena on the behalf of the interdisciplinary approach.

This showed an increase in their cognitive abilities, and contributed to further actions. While observing the lesson, it was noted that students had cutting-edge ideas and could make new initiatives.In this regard, it was suggested to use writing on Math entry to deepen students' learning (V. Urquhart, 2009). After studying different literature about this, we were convinced that writing essays could awaken students' research abilities [6, p. 184]. Thus, it was planned to prepare essay topics to assign as homework of this content.

Thanks to the ideas derived from the essays of students, 30% of them formed an environment in which they wrote research projects related to their future professions.

Result and conclusion:

The project had a three-way impact.

Teaching natural sciences and Mathematics relating to each other, creating an interdisciplinary communication, has improved the students' performance in all these subjects. It triggered the development of students' cognitive abilities and research skills.

This research contributed to the improvement of authors' experiences and professional development. They understood that one of the ways to solve the contradictions between subjects is the interdisciplinary approach and teacher collaboration. During the course of the project, by changing and managing the action plan, discussing obstacles, increased authors' self-confidence.

On the "Fair of Ideas", organised at school, a lesson planned by all teachers jointly was demonstrated.

At the same time, another result of interdisciplinary approach, thanks to the ideas derived from the students' essays, an environment was formed in which 30% of students could write and discuss about their research projects which were mainly related to their future professions. Grade 12 students took part in an international project works competition "Zhas Galym" ("Young scientist") and were awarded first and third places. Two more students of this grade participated in the "STEAM NIS Taraz-2019" science project from Mathematics.

At the same time, they were convinced of improving their assessment skills. It helped to define some aspects of students' intelligence. In general, it is important to search, research, integrate the lesson with real life, and strengthen the interdisciplinary connections through the management of student activities. Taking into account all the aforementioned, it is suggested to pay attention to the following actions:

- While teaching mathematics, the impact of it on natural science disciplines should be aimed, learning objectives should be shared throughout the time;
- Interdisciplinary approach should be included into midterm planning, as well as daily lesson plans.

To develop students' skills of evaluating mathematical relationships and dependencies homework with interdisciplinary approach should be assigned. Assigning essay topics with interdisciplinary approach, promotes the development of individual abilities of students, and conducting research skills. Therefore, colleagues are suggested to give homework and essay topics with interdisciplinary approach.

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