MOTIVATIONAL TRAINING FOR STUDENTS OF PEDAGOGICAL UNIVERSITY BASED ON AN INTERDISCIPLINARY APPROACH

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Abstract. *The study relates to the creation of innovative pedagogical technologies aimed at increasing the interest and motivation of the new generation to engage in natural and technical sciences, creating conditions for quality education available to all students, regardless of health status, and other reasons that impede education. The possibility of training creative pedagogical staff, actively introducing new pedagogical achievements into everyday practice, is shown. The results of a study of factors increasing the motivation for professional and pedagogical activity of future teachers, the involvement of students of pedagogical universities in active scientific and pedagogical activities, the study of the components of motivation for education, and possible ways to create integrated learning methods are presented.*

The results of solving the following problems are presented:

Studying the impact of the learning environment on motivation;

Study of the components of motivation, interest and involvement;

Exploring the possibilities of interdisciplinary teaching methods;

Application of the experience of project education;

The use of information and computer technologies in education.

The novelty of the study lies in the fact that, having studied the components of quality education, it was possible to realize a real interest and create an internal motivation for research, both among students of the Pedagogical University and among students of secondary schools. It is shown that the combination of the method of the history of sciences with project-based learning has improved the quality of knowledge in many subject areas: history, the history of the development of science, chemistry, physics, astronomy, mathematics, computer science, and biology. The integration of these subjects in the educational process has taken place in a natural and exciting way.

Keywords: *quality education, health status, integrated learning, learning environment.*

1. Introduction

Background: Every student, every child, regardless of their health or social status, has the right to a quality education and caring attitude of teachers. One of the components of quality education is interest. The task of the subject teacher is to create such interest. The purpose of this study was to develop a methodology for motivating the study of the subject of physics and astronomy using the methodology of an interdisciplinary approach, testing this methodology and creating a phenomenological study on this basis. An innovation was an interdisciplinary approach based on a combination of the project method with the methods of the humanities - the history of

physics. An additional objective of the study was to test the possibilities of increasing students' motivation for self-education and scientific work in the field of pedagogy using this technique.

The subject of the research was the development of a combined educational methodology - project education and the methodology of the history of sciences. Therefore, in this study, the tactics of a mixed interdisciplinary approach is applied: the introduction of a combined educational methodology - the method of project-based learning and the methodology of the history of science, which considers the prerequisites for the emergence of the most important scientific discoveries in different historical eras. The study was conducted jointly with students of the Pedagogical University in the specializations: "Physics" and "Methods of teaching physics and astronomy". Our students participated in this study by combining the method of projects and the history of sciences in relation to students of general education schools during their educational teaching practice. To process scientific research results, we used MS Excel software, which is the best universal software product in the world for processing analytical information. We used MS Excel tools for statistical data.

Another direction of this research was also the study of the effectiveness of self-education and motivation of students on the basis of teaching by the method of educational projects in a general education school using the method of the history of physics and astronomy.

A comparative analysis of the historical method and project activities will make it possible to trace the development of various inventions across countries and continents, to understand the peculiarities of making scientific and technical decisions by people who inhabited different territories at different historical moments, and to form students' analytical and creative thinking. Along with project methods and methods of historical science, information and computer technologies were used, giving students the opportunity to reproduce the technologies of ancient researchers by multimedia means, to visit some of the world's famous museums using the «Virtual Museum» program.

2.Objectives

Scientific problems and relevance of the work. *The main problem of the educational process is the decline in the interest of young people in the natural and technical sciences observed in recent decades on a global scale.* As you know, the well-being of our civilization has been achieved thanks to the scientific and technical creativity of individuals with creative thinking and engineering abilities. These are the great and strong personalities of their time, who entered or did not enter history for various reasons. Various factors contributed to shaping the personalities and abilities of these geniuses. Studying the history of science and biographies of scientists and researchers, we come to the conclusion that not all of them were endowed with talents and physical strength by nature. Considering similar biographical examples of Isaac Newton and Thomas Edison, we see that as young children they were in poor health, differed from their peers in physical development, came from single-parent families, experienced financial difficulties in childhood and were discriminated against on these grounds, both from outside classmates and school teachers. However, in their youth they decided to prove that they are in no way inferior to their prosperous peers from complete families. We all know how positively this decision of theirs influenced scientific progress, and what a contribution they made to the prosperity of mankind as a whole. There are many such historical examples.

Thus, each student, each child is able to become a full-fledged personality, this requires the attentive attitude of teachers, their professionalism. Some problems of a personal nature and

spiritual oppression in children can fade into the background when there is a powerful motivation and interest in studies, in creativity. There are no children who cannot be motivated, it all depends on our pedagogical abilities and desire. The desire to mold a researcher or scientist, or simply a positive and positive person out of childish malleable material. Humanity still needs creative minds. After all, far from all the problems of our life that require a technical and polytechnical, humanitarian plan have been resolved. Along with the convenience and comfort of life, such vital problems remain unresolved as providing present and future generations with sources of environmentally friendly and highly profitable energy, clean drinking water, harmless food, new technologies in the field of healthcare, in the field of pedagogy and development, and many other tasks. To solve all these problems, it is necessary to train scientific and scientific-pedagogical personnel, specialists capable of skillfully coping with the questions posed and educating researchers who are necessary for the present and future generations. However, the interest of young people in the natural and technical sciences is weakening, and sometimes disappears altogether. This is probably due to the fact that the new generation of children is more mercantile and chooses higher-paid professions than engineering for their future careers.

Currently, such specialties as a marketer, designer, IT specialists, and doctors are in trend. Engineering and technical specialties remain, as it were, unclaimed by young people. On the other hand, life is changing rapidly, new technologies are emerging, and educational technologies do not always correspond to the spirit of the times. The educational material and teaching methods presented in many textbooks are obsolete. Looking through school textbooks on various subjects for different years, both domestic and foreign, one can come to the conclusion that in most cases only the external design of books changes from year to year. The content, sequence of presentation, methods are slightly corrected. Added new names of authors. But, in general, the educational material remains the same. And this is a global problem. The educational process becomes uninteresting to students. Modern children prefer the digital world to the real one. Reduced live communication, sociability, sociality. All this encourages governments and pedagogical associations to develop new, progressive pedagogical technologies that can interest and lure the younger generation into technical and natural science creativity. In this regard, many new educational programs are being developed. Over the past two decades, the global scientific and pedagogical community has managed to achieve some success in training specialists with an emphasis on the STEM educational methodology proposed in the USA. This technique gradually began to be introduced everywhere in the world educational process. One of the components of the STEM educational methodology is the project based learning.

3.Methods

Methodology: Our research was carried out by mixed methods: a combination of quantitative and qualitative approaches.

Our study relied on data obtained from direct observations, interviews and questionnaires performed in a confidential conversation with all participants in the study. Therefore, the data of our research included interpretive and phenomenological analysis, we considered our specific experience and tried to present it with minimal losses. The objects of our study were the conditions that were created by our students for their scientific and technological development. The study also paid attention to data collection. Here we consulted with all participants in this study in order to trace the viability of the task. Our students-participants of the study had experience of teaching

in the middle and senior classes of general education schools during their teaching and teaching practice.

The study participants were asked certain questions in order to get the most information from the unstructured interview. During the search for solutions to creative design tasks, the participants formed their own ideas, which became very valuable and were used in the study.

4.Theoretical analysis of the problem

To find solutions to *the motivation of teaching students of pedagogical universities on the basis of an interdisciplinary approach,* a literature review was carried out. Since, in addition to finding motivation for students of pedagogical universities to study physics and astronomy in applications to pedagogical sciences, we have set ourselves an additional task - *the formation of professional self-sufficiency.* We also adhered to some philosophical and humanistic approaches to learning. *We considered our students as developing personalities and believed that in the process of education they should receive not only knowledge, but also become harmoniously and comprehensively developed personalities, with a breadth of interests and the a rich outlook.* Here we were guided by similar approaches of the researcher of pedagogy Abraham Maslow. This approach also aims to develop intrinsic rather than extrinsic motivation. On the education and recognition of their own self-esteem and personality. So (Cherry K, 2021) in the theory of self-sufficiency argues that people are motivated to intellectual growth and change by three innate (and universal) psychological needs: self-reliance, competence, and a sense of need for other people. Students are more likely to achieve academic success by focusing on external rewards, such as praise from teachers and parents, material rewards, prizes, and the desire to become famous. This is called extrinsic motivation. The theory of self-sufficiency emphasizes the development of intrinsic motivation, such as the need to increase subject competence and acquire any skills or independence - intrinsic motivation. The more students study and work, the more they gain experience and become independent. And here the need for the development of internal motivation becomes obvious.

Simply put, it looks like this: one of the students likes to do natural sciences, due to the fact that since childhood he was interested in experiments and was interested in nature. Such a student is engaged in order to learn more for himself, he is interested in it and he focuses on acquiring knowledge. Another student is not interested in the subject itself, but in academic performance in this subject: a high score, a commendable diploma, a place in the competition, praise from parents. Such a student will try at any cost to get what he needs. However, having hastily memorized and hastily forgotten. "Soon lerned-soon forgotten". In the case of the first student, we are talking about intrinsic motivation, and in the second case, we are talking about extrinsic motivation.

What becomes a source of motivation for pupils and students? Neurobiological discoveries (Jaak Panksepp, 2018) argue that the source of motivation for learning is the desire to search - this is what drives a person's actions, making them forget about sleep and eating, and this need to know is akin to curiosity. Curiosity and search are indispensable components of motivation (Hole, K. O, 1988). Another factor in increasing motivation is engagement. How does this affect the acquisition of knowledge? Educators prefer to give a classic example. Benjamin Franklin once said, "Tell me and I will forget, show me and I will remember, work with me and I will learn." (Charles William Eliot. - 1994). Thus, involvement in work has a great educational value. Engagement is also the subject of research by educators and psychologists and is studied at various levels:

schools or universities;

school or university life (extracurricular activities, circles, electives and student communities);

environment (relationships with peers, teachers);

learning process.

There are different types of involvement at each level. The most effective are:

emotional (affective);

behavioral;

cognitive;

academic.

According to (Ellen Skinner, 2016), all types of involvement are closely interconnected: emotional flows into behavioral. And the simultaneous low level of emotional and behavioral involvement leads to a deterioration in the behavior of students and the assimilation of knowledge by students.

It is very important that students independently acquire knowledge when they interact with teachers and other specialists (for example, visiting professors), take part in educational events, visit various enterprises to enrich their experience and technological knowledge. In addition, the educational institution must create a suitable educational environment so that students feel they belong to their student community. It is necessary to help teachers in organizing student communities with a scientific and cultural developmental orientation, capable of developing interest in the educational process. This may be called a student association or student society. Here students can organize student scientific laboratories and circles, student conferences, invite famous scientists and engineers, organize quizzes and olympiads, contact other student communities, develop the exchange of experience and cultural programs, student festivals. Students may also have their own student printed or online publications, in which they can publish the results of their research. This is how interest in student life and science develops.

Interest is a component of many well-known theories of motivation. These are relatively recent theories: expected value, self-determination, and social cognitive career (Lent, Brown, & Hackett, 2002; Ryan & Deci, 2000; Wigfield & Eccles, 2000). Interest has been experimentally shown to be the cause of student academic success (Schiefele, Krapp, & Winteler, 1992) and influences the development of concentration, memory (McDaniel, Waddill, Finstad, & Bourg, 2000), self-efficacy, and goal setting. You can also add that interest is important for the feeling of happiness and pleasure. Any business started without interest is doomed to failure. Studying with interest is the key to a successful career in the future. Of course, self-sufficiency and professionalism of the teacher is of great importance in maintaining interest in learning and activities. In this case, teachers also need to work on their self-improvement, develop their interdisciplinary and technological knowledge. This is especially necessary for teachers leading classes with STEM integration of subjects (Berland, L.K. (2013)).

Teachers also can increase interest and motivation in learning by using project-based learning (PBL) (Collins, A., Joseph, D., & Bielaczyc, K. (2004)). John Dewey is an early proponent of design education and its principles through his idea of "learning by doing". Project-based learning allows students to test the power of their knowledge and practice in a project to create real-life results, while the experience gained lasts a lifetime. It is obvious that project-based learning promotes strong interdisciplinary learning and is aimed at educational motivation of students and schoolchildren. Teaching according to the project method, unlike classical education,

contributes to the fact that students and schoolchildren independently work on a project and plan their time, the type and forms of their work (individual or group), research or cognitive, the teacher is only a coordinator of projects and ideas. Blumenfeld & Krajcik (2006) presented research findings showing that students in project-based learning classes achieve higher scores than students in a traditional classroom.

Beforehand, the teacher must creatively work out, think over and select project assignments that are really interesting and useful, can bring real benefits when making a decision, a result that the student will be proud of later, even after graduation from school or college, and perhaps remember forever.

Thus, having done a literature review, we strengthened our belief in the possibility of stimulating interest and motivating learning by solving project tasks. We decided to combine the design method with the methods of historical science, to create a guideline for students of pedagogical universities to develop design tasks for students of general education schools using a mixed method, its application in practice was the aim of our study.

5. Results

Participants and procedures

The number of project assignments and questionnaires were distributed in the spring of 2021 to students undergoing teaching practice in schools in the area where our university is located. Students independently developed project assignments and coordinated the implementation of design work for 8 weeks. A total of 42 project assignments were drawn up. Students of the Department of Methods of Teaching Physics and Astronomy participated. To form an idea for a project assignment, classes were conducted according to the following methodology. When planning classes, a calendar-methodical lesson plan on the history of physics and astronomy was used, consisting of 17 thematic lessons. Of course, it is useful to conduct classes in the history of science using the maximum amount of visual information. And of course, a projector and photographs alone are not enough here. Therefore, each lesson was conducted using the multimedia program "Virtual Museum", with viewing the expositions of history museums in various cities. The program is also interesting and useful because not all children have a real opportunity to get acquainted with museum expositions. Very interesting in this regard, not only for children, but also for teachers, is acquaintance with the British Museum (the exposition includes more than 8 million exhibits of various historical and archaeological exhibits of various times and peoples). It is also useful in cognitive and developmental terms to get acquainted with the National Museum of Korea and the Pergamon Museum in Berlin. However, we managed to get acquainted with only a part of the expositions. The use of the program "Virtual Museum" also has such advantages as the opportunity to join the cultural and historical values of people with disabilities, various social categories. All you need is a computer connected to the Internet and a projector. At the present level of development, this can be done in any school and in any educational institution. For more detailed excursions, of course, software developments will also be needed. The presence of an audio guide is also positive. Although so far these are very short excursions, they also have a great motivating value. Further classes were held "live" in the building of the real Museum of the History of Uzbekistan and the Polytechnic Museum in Tashkent. The non-traditional form of classes, visual associations, and the fascinating story of the guide contributed to the emergence of ideas for project assignments. Thus, the topics were formulated: "Reproduction of ancient technologies", "Model of Heron's fountain", "Simple mechanisms of

antiquity", "The emergence of glass casting and glass blowing technologies", "Robotics in the 10th century AD in the East", "The use of a magnet in ancient medicine" and many other project assignments, in total, students coordinated the implementation of 42 project assignments carried out by school students.

Course design and procedures

When developing the design of the course, we were guided by the motto:

"A person will be involved if he is in an atmosphere that supports his needs for independence, competence and relevance to society."

The course design contained at least three features. First, the instructors distributed the relevant training over time and across the three existing curricula. This included an initial project-based lesson on the proposed approach and two follow-up lessons organized while other topics were discussed. The second feature was to build instruction in the methods course based on PBL's own learning. In order to understand PBL-based learning processes, three diagnostic tests were performed along with two prompts that informed about the relevant course instruction, such as what a learning project is for a school student. This is an opportunity to maximize your creative qualities. This is work that allows you to realize either your individuality or the ability to cooperate, the opportunity to test yourself by completing a useful and interesting development.

For the teacher, the educational project is an integrative didactic tool for the development of students. This method makes it possible to teach and acquire the basics of design, in which it is necessary to be able to formulate the task and goal of the project, plan actions towards a solution, formulate an algorithm for solving the problem, independently solve, make a report and presentation. In the course of work on the project, existing competencies are used, and the missing ones are acquired independently. Thanks to such work, the qualities of a special way of thinking - creative - are developed. At the very beginning of the course, for clarity, teachers demonstrated approximate project assignments and discussed them in the audience with presentations. This was due to the fact that at the moment there are not enough teaching aids on PBL. The projects were classified by types of educational projects and by sections of physics and astronomy.

6. Discussion

Discussing the results obtained, we can say that working with their students according to the project method, students and schoolchildren became more socialized, i.e. became more sociable, which is especially important for young people who grew up in the world of digital communication. Sociability and sociality are also very important qualities necessary for a teacher. All participants acquired very valuable qualities of working in groups, which can become a prototype of a scientific team or laboratory. This is more than just acquiring the skills of scientific research. The PBL method, combined with the methods of humanitarian research, made a great contribution in schools where the motivation to study natural science subjects was reduced. A positive result was also obtained among students who, for some reason, had low self-esteem or had any problems in the family. Thanks to multimedia programs, they had the opportunity to visit the best museums in the world, as well as to get acquainted with them in the future. Both pupils and students were able to raise their self-esteem, gained confidence in their abilities. The result was analyzed by the method of questioning and data processing. The survey participants refused to give anonymous answers, so the interview was held in the form of a confidential interview, the questions for which were proposed by the students themselves.

Here are excerpts from some of the interviews:

- “To be honest, I could not even imagine that I could make a device for assessing the strength of a magnet with my own hands”;

- “It was unexpected that in ancient times people used libraries and wrote down their information on scrolls of paper. It turns out that for eternal preservation, the paper was pasted on silk fabric and thus preserved for centuries.”;

- “The fountain I made is in our yard. The neighbors are sitting by the fountain on a hot day and I am already tired of their praise addressed to me. I can’t imagine that my classmates and I made it so quickly and easily. You need to dig into history and pull out more similar, useful things from there. It turns out that the new is the well-forgotten old”;

“There were a lot of obsolete magnets in the school class that lost their power. In fact, they were just pieces of iron, painted blue and red. It was just a picture of magnets. We fixed them and they are working now! Wow! We did it! Now these are real magnets with which you can conduct various experiments for elementary grades. I didn't think it was that easy!”;

- “Broken glass and a mirror fixed with glue inside a tube with a highlight, rotate by attaching a battery to a simple engine and a virtual snowfall in the room!”;

“Every year in the spring we had to deal with weeds in the school yard. It got enough. Now everything is much simpler - we just close the seedlings from solar ultraviolet radiation and there is no need to waste so much time!”;

“Now I can observe the stars with a telescope of my own making. With a little thought, I can connect it to a laptop. The design is of course very simple and if there was a school museum, I would donate it to the school.”

Students and their schoolchildren learned more, improved their competencies. PBL allowed them to acquire new knowledge in many subject areas: history, the history of the development of science, chemistry, physics, astronomy, mathematics, computer science and even biology. The integration of these subjects occurred in a natural and fascinating way. The skills of search work are acquired and the ability to think outside the box is developed. Students and their students were able to find answers to many questions and combine them, found many useful and practical solutions. As for the pupils of the above-mentioned general education schools, their interest in studies and the subject has significantly increased. The number of absenteeism has been reduced. The results of control test tasks have increased.

And here is how this practice influenced future teachers.

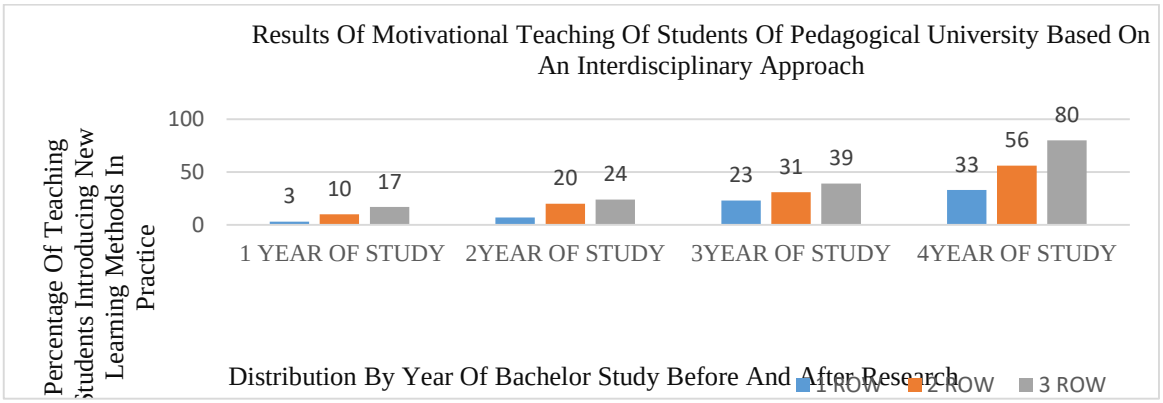

Figure 1. Average assessment of the involvement of undergraduate students in teaching activities in physics and astronomy.
(blue color (first row) - involvement before the start of the study, gray color (third row) - after the internship using the project methodology)

7. Conclusion

A cause-and-effect relationship of increasing students' motivation for scientific and pedagogical activity was the practical use by students of their own proposals for project topics and an increase in pedagogical competence during the passage of educational and pedagogical practice in general educational institutions. Theoretical and practical conclusions are made, such as the demand for independent educational and project work done by students and the acquisition of competence, which serves as a powerful motivational factor. Moreover, students became involved in scientific and pedagogical work. In addition to the project method, other methods and techniques developed independently began to be used. So in 2022, our students used their own method, called the method of analogies, to increase motivation and interest in the educational process among schoolchildren. The results of this method have been submitted as an article for publication (Zhamil Mavlonov, Durdona Dadamatova, 2022). The use of new methods in teaching the physics of astronomy allows not only to increase the interest of students in subjects, but also to really improve their academic performance. The teacher, using creative teaching methods in his practice, can really achieve the main goals and objectives of pedagogy.

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