

## IMPROVEMENT OF TRAINING EFFICIENCY ON THE BASIS OF INTERDISCIPLINARY INTEGRATION OF PROFESSIONAL TRAINING OF FUTURE ENGINEERS

**Umarova Gulchekhira Abitovna**  
Associate professor, PhD in  
Pedagogical sciences  
Andijan Machine-building Institute  
Andijan, **Uzbekistan**  
gulchekhira.u@mail.ru

### ABSTRACT

This article presents a discussion of research and development in the field of engineering education, with a particular focus on the enhancement of future students' learning through interdisciplinary integration. It describes various approaches to combining different subjects, such as mathematics, physics, and computer science, with the goal of developing complex skills and abilities in students. The paper proposes the integration of curriculum and practical assignments as a means of promoting deeper understanding of the material and developing creative thinking in engineering students. By integrating different disciplines, students can gain a better understanding of complex problems and develop the skills necessary to succeed in their field.

**Keywords:** Integrative approach, professional activity, innovative approach, interdisciplinary integration, modernization, improvement of professional competences.

### INTRODUCTION

The process of modernizing the continuing education system is currently underway. Significant efforts are being made to enhance the quality of education and incorporate advanced technologies into the learning process. Furthermore, efforts are being made to integrate educational content in order to provide students with a more comprehensive and relevant learning experience.

In order to adequately prepare professionals for the demands of a modern market economy, it is essential to develop their skills, independence, and responsibility. These qualities contribute to an increased demand for higher education among future vocational teachers.

Higher education institutions face an important task in training individuals who are highly qualified, educated, socially active, and have a high level of professional mobility. It is therefore imperative that these individuals be developed and equipped with the necessary skills and knowledge to succeed in the modern world. The integration of scientific disciplines is evident in academic fields, which represent the foundation of scientific knowledge in a specific field. All branches of modern science are interconnected, and thus academic disciplines cannot exist independently from each other.

It is imperative that interdisciplinary integration be employed in the context of professional training in order to facilitate a comprehensive and in-depth understanding of the fundamental principles of science. This integration facilitates the more effective assimilation of knowledge, the development of scientific concepts, the optimization of the learning process, and the creation of a holistic scientific outlook among students. Furthermore, interdisciplinary

approaches assist in enhancing students' scientific literacy and developing their logical thinking and creativity. By avoiding the duplication of program material and optimizing the learning outcomes, these methods facilitate the acquisition of knowledge, skills, and abilities by students in a more efficient manner.

## LITERATURE REVIEW

The study of the problem of interdisciplinary integration has been the subject of the work of numerous scientists. For instance, V. N. Maksimova, V. I. Zhilin, I. D. Zverev, P. N. Novikov, and V. I. Alekseentsev, A. Khodzhabaev, B. Abdullayeva, B. Mirzakhmedov, A. Choriev, M. Baratov, O. Musurmonov, and S. T. Alikulov, among others, have made notable contributions from the countries of the Commonwealth of Independent States (CIS).

The study of interdisciplinary integration presents a complex landscape of approaches and pedagogical concerns. This diversity has led to a multitude of definitions and classifications of interdisciplinary integration, each with its own nuances and implications.

A significant number of authors have observed that the introduction of interdisciplinary integration contributes to the realization of all learning goals, including educational, developmental, and interesting goals. One of the most effective methods of implementing interdisciplinary integration in the learning process is the completion of practical, descriptive tasks.

N. Novikov defines a complex task of an interdisciplinary nature as follows: The condition and requirement of this task is a problem that includes components from both basic and relevant disciplines, which contribute to a deeper and more comprehensive understanding of the scope and nature of concepts that define integration between disciplines. The solutions and analyses of these problems are provided.

P. N. Novikov divides such issues into three categories, depending on the relationship between the subjects of fundamental and specialized sciences.

- Formal query: In the formulation of such questions, there are parameters (such as terms, symbols) related to other fields that do not directly contribute to solving the problem.
- It is important to consider that in the context of this issue, other scientific fields are not prepared to address it, and even without their input, it would be impossible to come to a solution. The formal approach necessary to solve such a question in the context of scientific discourse is presented in an open form.

The author underscores the pivotal significance of the second category of questions, which, at their most optimal, "promote the development of competence in an independent and logically sound choice of a subject from an interdisciplinary field."

The integration of disciplines across general professional, specialized, and other academic fields ensures a practical focus of learning.

The issue of interdisciplinary integration in education primarily concerns the coordination of the sequence of subjects within the curriculum and the formation of a meaningful, logically completed system of knowledge, methods of behavior, and personal qualities among students. O.A. Abdukudusov posits that the following factors to a certain extent impede the implementation of interdisciplinary integration [2].

1. Inconsistent use of terminology and concepts within the relevant fields of knowledge;

2. Lack of clear differentiation between ideas, theories, problems, or concepts presented in educational materials;
3. The inability to take into account the internal relationships between scientific knowledge;
4. It seems that academic disciplines do not pursue a single goal.

In his dissertation, V.I. Alekseentsev provided the following definition of interdisciplinary integration: A pedagogical concept, the purpose of which is to establish the synthesis and integration of objects, phenomena, and processes of reality into the content, methods, and forms of the educational process, as well as the performance of educational, developmental, and educational functions within a single structure.

In the dissertation research by I.D. Zverev and V.N. Maksimova, the following definition is employed: "Interdisciplinary integration represents a pivotal element in the advancement of contemporary learning experiences, educational and cognitive activities among students." By enhancing the overall learning process to a higher level, interdisciplinary integration has a multifaceted impact, ensuring the harmonious achievement of learning goals in the field of development and education.

## **METHODOLOGY**

Interdisciplinary integration is a process that results in the creation of a unified system that is in constant contact with its components and is influenced by them.

Interdisciplinary integration occurs at various levels. These include:

- At the level of academic fields belonging to different categories (general education interdisciplinary or intersectoral integration);
- Within the category of academic fields (internal integration);
- At the level of the national academic field.

The content and methods of implementing these elements undergo a transformation as a result of interdisciplinary integration (Fig. 1).

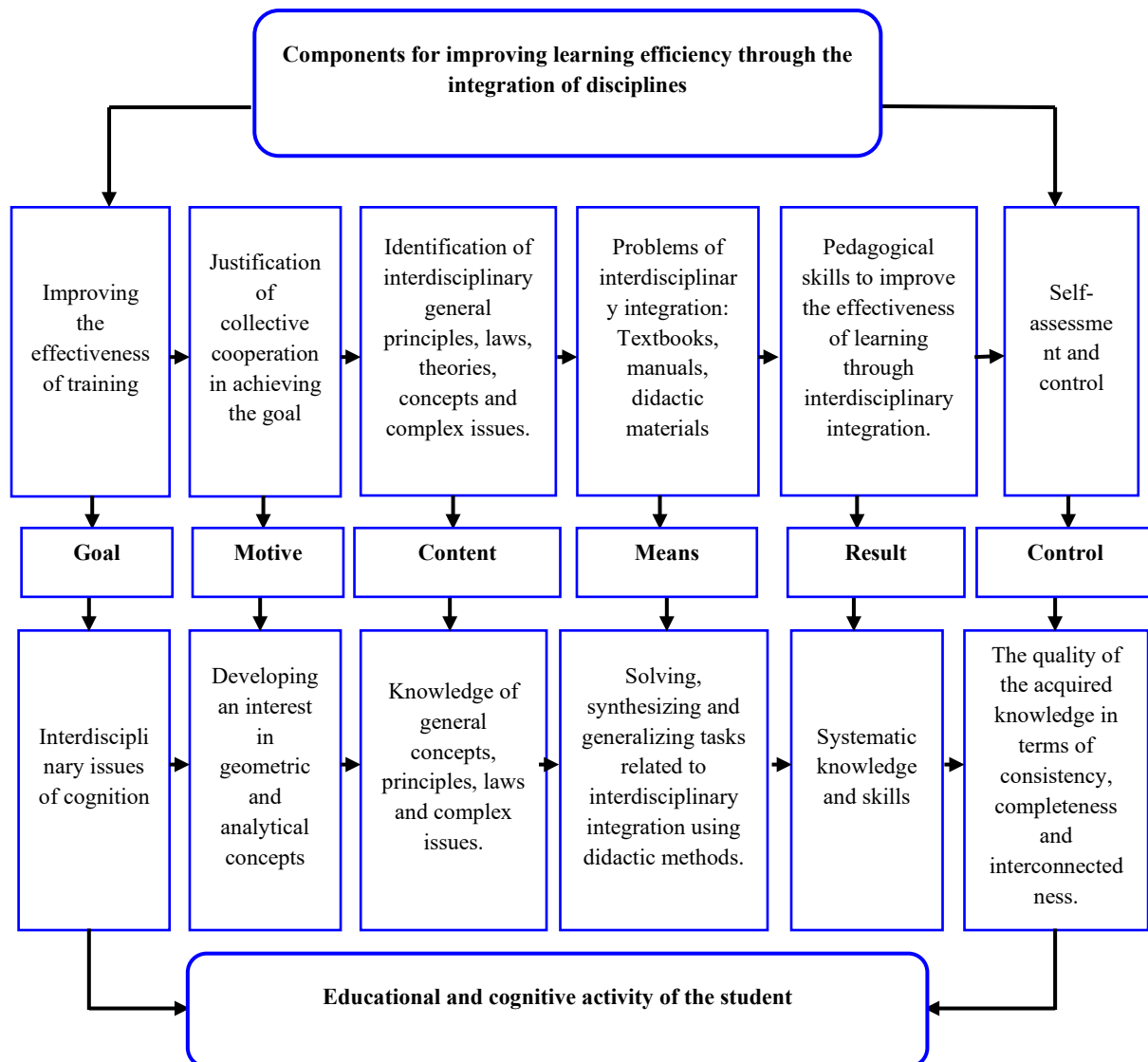


Fig.1. Components of improving the effectiveness of learning through interdisciplinary integration

In the target component of the activity, the instructor establishes a unifying objective that aligns with the overarching educational objectives and is of significant consequence. The objective is then presented to students in the form of an interdisciplinary question that combines educational and cognitive aspects. It is expected that students will comprehend the interdisciplinary nature of these issues and will be able to analyze their components and master the relevant basic concepts from various disciplines.

Concurrently, the instructor's focus is not solely on the student's readiness and thought process in acquiring new knowledge; it also encompasses the development of skills such as knowledge synthesis and reproduction, as well as the nurturing of personal qualities, skills, and interests. Consequently, the initial phase of the process is designated as the target stage [5].

With regard to the direction and motivation of the activity, the teacher, guided by the motive of joint cooperation in achieving the common goal of comprehensive and balanced personal growth, increases students' interest in analytical knowledge and the ability to generalize concepts from related disciplines. Consequently, students' intrinsic motivations for learning are aroused and channeled towards the expression of their own volition.

Subsequently, he proceeds to the core of the lesson. The teacher introduces new educational material through interdisciplinary integration, thereby activating fundamental concepts from various academic disciplines at the level of general knowledge, concepts, laws, theories, and ideas.

The methods of establishing these connections may vary (explanations with the help of a teacher, conversations of a repetitive or research nature, independent creative activity of students), and as a result, the nature of educational and cognitive activity of students changes with the implementation of interdisciplinary integration.

In addition to the assimilation of the content, the operational aspects of the activity are carried out. Consequently, the instructor employs visual learning tools that assist students in summarizing their knowledge across various subjects. These tools facilitate the assessment, synthesis, reproduction, and activation of new conclusions based on established values. In this process, previously acquired knowledge and skills are utilized, as well as new, generalized skills are developed [7].

The subsequent component, effective learning, entails the formation of conclusions and generalizations, which are subsequently incorporated into the system of scientific and secular knowledge. Additionally, the acquisition of new skills and the establishment of new connections are also recorded. The activity of the teacher and the student concludes with a stage of repeated control. Concurrently, educators across disciplines ascertain their students' preparedness in related subjects through self-assessment and introspection, as well as the assessment and evaluation of the quality (consistency, completeness, and interconnectedness) of newly acquired knowledge.

The aforementioned components will be integrated and considered in a dynamic structural aspect within the educational process. The principal manifestations of cognitive activity among students correspond to their specific functions. At the same time, general issues pertaining to learning within any given link are resolved, including the assimilation of knowledge, the development of thinking, speech, memory, and other aspects.

The integration of disciplines facilitates the enrichment of each student's learning experience, the diversification of their cognitive processes, and the expansion of their interactional scope in the application of knowledge across various subjects.

## RESULTS

Independent work on interdisciplinary integration presents a valuable opportunity for students to engage in higher-order cognitive activities. Such work enables students to apply their knowledge and skills in several subjects simultaneously. The variety of methodological approaches available for the implementation of interdisciplinary integration renders these methods highly effective when employed in conjunction with the evolving and intricate nature of educational tasks in the classroom [8].

### 1. The integration of operations performed within various disciplines.

This interdisciplinary approach fosters the development of a unified set of skills and prior knowledge that is inherently interdisciplinary in nature. The curriculum encompasses a multitude of disciplines typically studied in vocational colleges with a socio-economic orientation. Nevertheless, we posit that the disciplines of physics and specialty, when studied in conjunction, facilitate the formation of unified constructive, technical, computational, and

measuring skills, as well as the initial acquisition of professional skills. This process is accompanied by the development of oral and written communication abilities.

## **2. An interdisciplinary integration based on the application of methodological approaches.**

Such an interdisciplinary approach enables students to perceive science not only as a body of knowledge but also as a set of behavioral techniques.

## **3. The organization's interdisciplinary integration.**

Additionally, training sessions in physics and other special disciplines are conducted using traditional educational technologies and virtual laboratory work.

It is important to note that there are numerous approaches to implementing interdisciplinary integration within the learning process. Such methods include the use of questions, individual tasks, problem-solving situations, cognitive activity, research, and experimental approaches. In addition to the term "interdisciplinary integration," the concepts of interdisciplinary and educational connections between scientific fields are employed. These three terms are often used interchangeably, as they all pertain to the integration process. Nevertheless, there are some distinctions to be made in their categorization. The term "interscientific integration" is defined as the potential to gain new knowledge through a unified approach to research, as well as the opportunity to study similar objects from different disciplinary points of view.

It can be argued that interdisciplinary and inter-scientific educational integration are essentially synonymous, in that academic disciplines and academic subjects are perceived to have a similar meaning. It is, however, important to note that there is a distinction between these terms. The term "academic discipline" is employed to describe an approach to the organization of the educational process, whereas "academic subject" is used to refer to a specific area of knowledge or study.

## **CONCLUSIONS**

Consequently, professional adaptation can be defined as the harmonious integration of various aspects of processes that contribute to the development of the future specialist's readiness for teaching. This integration encourages a responsible and innovative approach to the aforementioned processes, motivates social values, and forms a personality-oriented orientation.

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