

# Scientific and Pedagogical Foundations of the Project Method in Robotics

Nasriddinov Dadakhon Kamiljanovich

*Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, Uzbekistan*

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**Abstract:** In today's educational landscape, teachers are presented with numerous learning strategies and technologies to foster innovation in the learning process. This abstract explores the challenges and opportunities associated with creating engaging and dynamic learning environments. Project-based learning emerges as a promising approach, encouraging active participation and goal-oriented activity beyond traditional classroom settings. Moreover, problem-based learning offers a methodology centred on inquiry, research, and reflection, empowering learners to tackle complex problems autonomously. Through collaborative efforts, students not only develop critical thinking skills but also enhance their ability to work in diverse teams. Drawing from theories by Vygotsky and Dewey, collaborative group work is emphasized as a means to cultivate essential interpersonal skills. The abstract also discusses practical considerations for implementing project-based and collaborative learning, including group formation, resource allocation, and assessment strategies. By embracing innovative teaching methodologies, educators can create enriching learning experiences that foster creativity, critical thinking, and collaboration among students.

## 1 INTRODUCTION

The idea of project-based work is that schools use them in the educational process to initiate “activity with a goal”. Projects help create an enriching learning environment that goes beyond the classroom. One of the notions of formal education is that it should take place within the classroom, which is countered by the project-based approach.

In addition to its practical focus on a specific result, the project method has signs of scientific character in the research activities of students. Experiential experimentation enables students to understand how scientists create new knowledge. Educators must also be innovators, as they must convey modern scientific knowledge to students, as well as train them to “accumulate knowledge” on their own.

The scientific training of students is a problem that has attracted the attention of researchers for several decades. One of the popular pedagogical technologies used in this direction is problem-based learning.

## 2 LITERARY REVIEW

Problem-solving learning is a methodology focused on learning, research and reflection that is carried out by learners in order to arrive at a solution to a problem posed by the teacher.

As a rule, as part of such an educational process, the teacher explains part of the educational material, and then offers students activities to apply such content. However, problem-based learning is a means for students to apply knowledge to solve a specific problem. In this methodology, the main actors of learning are the learners themselves, who take responsibility for active participation in the educational process.

Through problem-based learning, students can develop their critical thinking and ability to identify and characterize problems by integrating knowledge gained from various fields. In the process of solving problems that arise in projects, an awareness of one's own learning is created, which contributes to dedication and self-esteem. Thus, students follow the path of research that will allow them to improve their skills in finding, managing and preserving

information, and force them to plan strategies for solving problems, increase the effectiveness of their own reasoning and their level of creativity.

Here is an example of an algorithm for considering the problem:

- Familiarization with the problem.
- Brainstorm.
- Make a list of what is known.
- Make a list of what is unknown.
- Make a list of what needs to be done to solve the problem.
- Problem definition.
- Getting information.
- Presentation of results.

To implement problem-based learning in the educational process, the teacher must prepare and think through problem situations that students will work on. These problem situations should be correlated with the goals that students should achieve in the process of activity. It is necessary to provide for the possibility of both individual and group work of students, which allows them to exchange ideas, identify difficulties and directions for solving the problem. Time in solving the problem should be limited, given the complexity of the problem.

Group work is a method often used by teachers. It can be organized both with the distribution of responsibilities, when each member of the group is responsible for performing a specific task, and at the final stage, all participants unite, or jointly, when all members of the group simultaneously perform all the necessary tasks.

Learning at school requires teamwork and cooperation. Thus, students develop their individual and group skills. The discussion processes inherent in the activity prepare team members to defend their ideas on the basis of consistent arguments, as well as learn to accept the ideas of others.

In accordance with the learning theories of Vygotsky, Dewey and other educators, collaborative group work prepares students to:

- Actively participate in collective activities.
- Accept and fulfil group commitments.
- Help others and ask when needed.
- Put your individual strengths at the service of others.
- Accept the opinions of others.
- Understand the needs of others.
- Establish contacts with others, including representatives of other cultures.
- Set goals, objectives, resources, roles, etc.
- Critically and respectfully listen to your interlocutors.

- Express your ideas and approaches in a reasonable manner.
- Accept valid criticism from other people.
- Develop interpersonal skills, etc.

Many studies show that groups that include people with different types of thinking demonstrate the greatest efficiency in work, rather than those with the same type. Collaboration in project work arises from the recognition that there are activities that cannot be done alone. Therefore, in order to increase the effectiveness of the results of the practice-oriented activity based on the project method, it is necessary not only to generate one's own knowledge, but also share them with other members of the group.

Thus, learning is about taking responsibility for the process of acquiring, processing, analysing information and organizing the transfer of results to others. The teacher is responsible for informing students about this and showing them help in creating suitable conditions for learning.

Groups can be formed based on the following factors:

- Restrictions on the quantitative composition of the group (more often, as the optimal composition of 3-4 people is recommended).
- Combining into groups, taking into account the personal sympathies of students.
- Grouping by the teacher based on pedagogical goals.
- Random grouping.

When organizing the educational process, it must be taken into account that each group consists of students of different performance. However, it is recommended that the average performance of each group should be the same. A balanced distribution of group composition by gender is also recommended.

Robotics projects can be developed using a variety of tools. Analysis of projects allows you to highlight important aspects in this activity.

### 3 CONCLUSIONS

In general, a collaborative research project consists of a planning phase, an implementation phase, and an evaluation phase, which will be described in detail below. However, in the process of developing such a joint project, students may need to work both in groups and individually. It should be noted that the usual classroom space may not be enough for this. Some of the participants may need to go to the library, others to the computer lab. The classroom or student workplace expands its boundaries because the learning objectives expand. It is necessary to take into

account and study the advantages and disadvantages of moving from a traditional organization to planning and implementing joint projects.

Collaborative learning differs significantly from the theory and practice of traditional classroom learning and requires a different approach to working with children. Collaborative learning does not exclusively include tasks aimed at “production”, where the elements are specific and predictable results, and where the achievement of the “product” determines the activity. In collaborative learning, although skills may be specific, it is not always possible to specify their results.

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