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A MODEL FOR ENHANCING STUDENTS' PHYSICAL AND TECHNICAL ABILITIES USING P5BL TECHNOLOGIES

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Abstract
This article presents a model for developing students' physical and technical abilities using P5BL technologies. The model is based on project-based and problem-based approaches, helping students link theoretical knowledge with practical application. The findings demonstrate the approach's effectiveness in fostering technical skills, creative thinking, and teamwork.

Keywords: P5BL, technical abilities, innovative education, STEM, project-based learning.

МОДЕЛЬ РАЗВИТИЯ ФИЗИЧЕСКИХ И ТЕХНИЧЕСКИХ СПОСОБНОСТЕЙ УЧАЩИХСЯ С ИСПОЛЬЗОВАНИЕМ ТЕХНОЛОГИЙ P5BL

АННОТАЦИЯ
В статье представлен модель развития физических и технических способностей учащихся с использованием технологий P5BL. Модель основана на проектном и проблемном подходах, которые помогают связывать теоретические знания с практической деятельностью. Результаты исследования показывают, что данный подход эффективен для развития технических навыков, креативного мышления и навыков работы в команде.

Ключевые слова: P5BL, технические способности, инновационное обучение, STEM, проектное обучение.

INTRODUCTION

The issue of widely implementing innovative pedagogical technologies in the development of the education system of the Republic of Uzbekistan is of urgent importance today. The Presidential Decree of the Republic of Uzbekistan No. PF-5712 dated April 29, 2019, on the "Approval of the Concept for the Development of the Public Education System of Uzbekistan Until 2030" and the "Law on Education" emphasize the necessity of applying innovative approaches in the education system [1].

From this perspective, the model for developing students' physical and technical abilities through P5BL technologies holds significant value as an approach aimed at forming essential skills for the new generation of students. The uniqueness of this model lies in its integration of project-based and problem-based teaching methods with extracurricular practical activities.

This article aims to propose a model for developing students' physical and technical abilities using P5BL technologies and to analyze the main stages and principles of this model. This approach is designed to prepare students for modern technologies and solving real-life problems.

METHODS

The theoretical foundation of P5BL technologies is based on the constructivist approach. Scholars like J. Dewey and J. Piaget developed the principles of constructivism, emphasizing that knowledge is formed through practical activities and experience [2]. C. E. Hmelo-Silver analyzed problem-based learning and demonstrated that this method enhances students' ability to connect theoretical knowledge with practice [4]. In STEM and STEAM approaches, P5BL technologies are presented as an essential tool for enriching students' technical skills.

Research on the application of this technology in Uzbekistan indicates its effectiveness. Z. Mirzayeva highlighted the efficiency of the P5BL approach in teaching technical and natural sciences [9]. U. Hasanov emphasized the positive impact of STEM technologies on creativity and technical thinking [10]. Building upon these scholars' works, we propose a model for developing students' physical and technical abilities using P5BL technologies. Below, we analyze the main principles of this model:

Project-Based Learning (PBL): Students work on projects to solve real-world problems. For instance, creating mechanical devices or studying physical laws helps enhance their technical abilities.

Problem-Based Learning (PBL): Students are presented with real-life technical challenges, such as developing energy-efficient technologies.

Product-Based Learning: Students create finished products, reinforcing their theoretical knowledge and improving technical skills.

Person-Based Learning: This approach considers each student's individual abilities and needs.

Development of technical and creative skills: Extracurricular laboratory work and creative technical projects are utilized to foster these skills.

The Presidential Decree of the Republic of Uzbekistan No. PF-5712, dated April 29, 2019, "On the Approval of the Concept for the Development of the Public Education System of Uzbekistan Until 2030," identifies the integration of advanced technologies and the development of students' technical skills as key priorities [1]. Consistent with the goals of this decree, P5BL technologies enhance the educational system in the following areas:

Improvement of education quality: Innovative methods make the learning process engaging and effective.

Practical orientation: Students gain opportunities to test their theoretical knowledge in practical settings.

Development of technical knowledge: Integration with STEM directions ensures comprehensive development.

The Presidential Decree No. PF-5712 also focuses on improving the teaching of technical subjects [1]. Within this strategy, P5BL technologies demonstrate their effectiveness through the following aspects:

Preparing students for technological advancements.

Developing creative and technical thinking.

Building the ability to solve real-life problems.

The P5BL model for enhancing students' physical and technical abilities encompasses principles of theory, practice, and personal development.

RESULTS

Below, we review all stages of this model (Figure 1).

Stages of the model for developing students' physical and technical abilities using P5BL technologies

1. **Preparatory stage** The preparatory stage is one of the most critical phases ensuring the successful implementation of the learning process. During this stage, the individual characteristics of students are considered, and initial preparation activities forming the foundation for project-based activities are conducted. This stage encompasses the following key activities:

Analyzing students' needs and abilities: This process begins with a detailed analysis of the students' current knowledge levels and capabilities. The teacher gathers the following information about each student:

Knowledge level: Assessment of theoretical knowledge and practical experience. For example, determining how well students understand basic principles in physics.

Interests: Identifying students' interests in fields such as technology, mechanics, programming, or other areas. For instance, recognizing students interested in technical devices or robotics.

Psychological characteristics: Observation of personal activities and working styles. Some students prefer working in teams, while others favor working independently. For example, monitoring students' communication levels and creating an effective working environment tailored to their preferences.

Process organization: Students are assigned simple experiments or tasks, such as measuring mechanical motion, assembling parts of an electrical circuit, or analyzing basic mechanisms.

The creativity and independence exhibited by students in completing the tasks are observed.

Based on the analysis results, students are grouped, or individualized approaches are planned.

For instance, observing students during simple experiments helps determine their skill levels.

Defining educational goals: During the preparatory stage, the objectives of the educational process are defined. These goals aim to develop students' knowledge and skills and include both short-term and long-term targets:

Short-term goals: Achieving specific results at certain project stages. Example: “Students should understand the basic components of an electrical circuit and learn how to assemble a simple electrical device.”

Long-term goals: Developing the knowledge and skills students should acquire by the end of the project activity. Example: “Students should acquire the ability to independently design and develop simple technical devices.”

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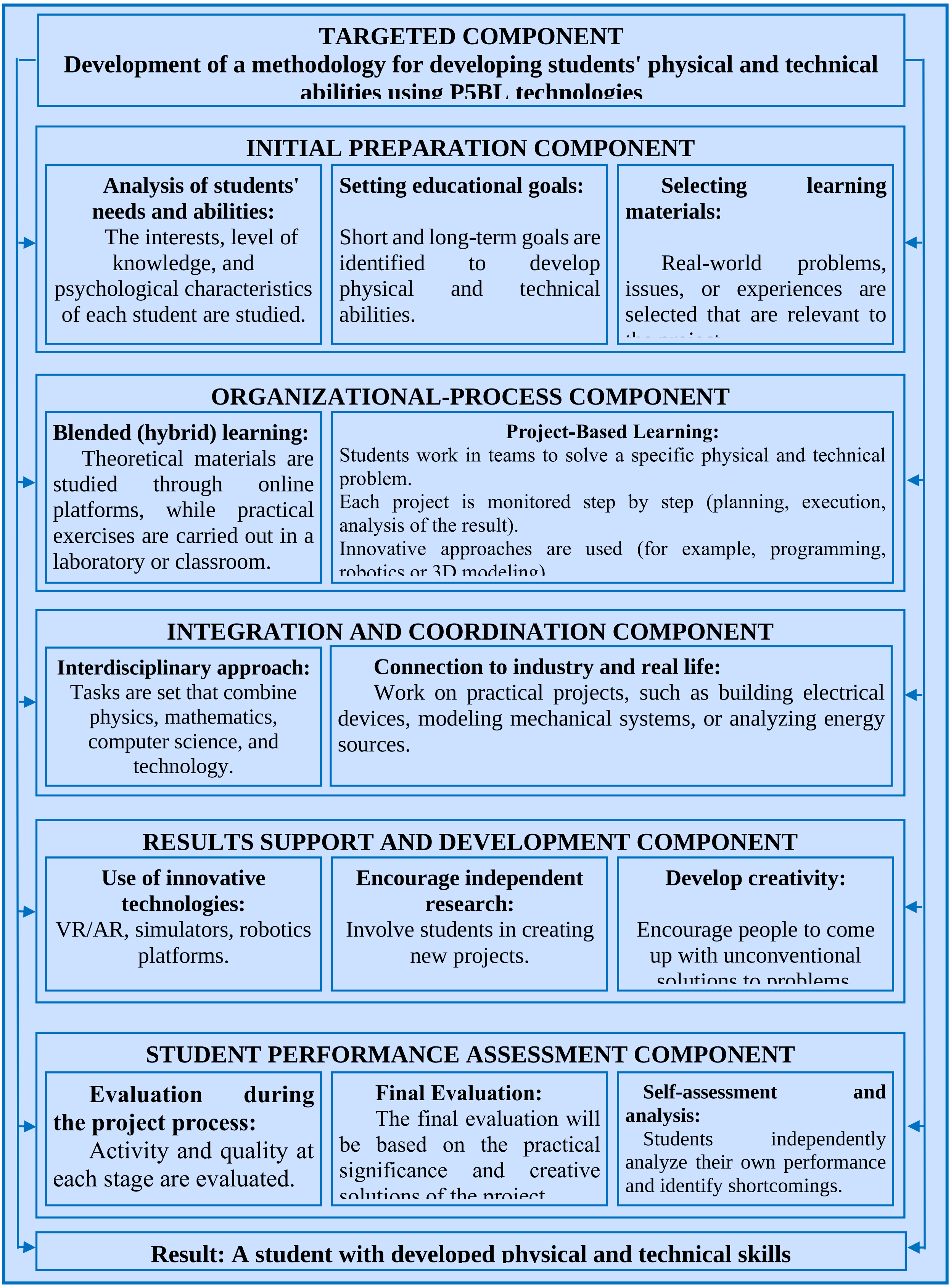

Figure 1. A model for developing students' physical and technical abilities using P5BL technologies

Approach to setting goals:

Goals should align with school curriculum and standards.

They should focus on developing students' individual capabilities.

The final product of the project (e.g., experiment, device, or report) should be clear and engaging for students.

2. Organization of the learning process

In this stage, a hybrid form of P5BL technology (Blended Learning) is implemented.

Online study of theoretical materials: Students independently acquire theoretical knowledge through virtual platforms. For example, interactive video lessons or simulations explaining the laws of physics.

Practical activities: Experiments are conducted in laboratory settings or classrooms to reinforce theoretical knowledge. For example, assembling a simple electrical circuit and testing its functionality.

To ensure the successful organization of the learning process, the following factors are considered when selecting materials:

Alignment with curriculum requirements: Project activities must align with the school curriculum in physics and technology subjects. Example: If topics like mechanical energy or electrical energy are studied in physics, projects should be based on these topics.

Practice-oriented materials: Materials and tools that allow students to work hands-on are selected. Example: Easily accessible materials for experiments such as wires, batteries, lamps, resistors, and basic mechanical components.

Opportunities for applying innovative technologies: Materials incorporating modern technologies are used. Example: Arduino platforms, modeling software for 3D printers, or robotics components.

Process organization: The teacher prepares specialized materials and equipment for project activities. The materials must be both easy to understand and conducive to developing practical knowledge. Projects linked to real-life problems are chosen to engage students.

Examples:

Mechanical motion project: Students work on simple mechanical systems (e.g., pulleys or levers).

Electric energy utilization project: Students assemble an electrical circuit and connect it to devices used in real life.

DISCUSSION

3. Project-Based Learning (PBL)

This stage ensures that students work independently or in groups to solve real-life problems.

Problem Selection: Students are presented with a specific physical or technical problem. Example: Improving the efficiency of solar panels.

Planning: The objectives, stages, and required resources for the project are defined. Example: The project team divides tasks—some collect materials, while others conduct experiments.

Practical Work: The project is implemented, and the results are documented and analyzed. Example: Assembling and testing a robotics device.

4. Interdisciplinary Integration

Various subjects are interconnected to enhance students' ability to apply knowledge in practice.

Mathematics and physics integration: Solving physics problems using mathematical formulas. Example: Using speed and distance formulas to study motion.

Informatics and technology integration: Programming electronic devices or creating 3D models. Example: Programming electronic projects using the Arduino platform.

5. Assessment stage

Students' work is evaluated through multiple assessment methods.

Project process assessment: Students' participation in planning, execution, and presentation of project results is evaluated. Example: Assessing teamwork and time management skills.

Final assessment: The overall results of the project and its practical significance are evaluated. Example: Evaluating the efficiency of a completed device.

Self-assessment: Students analyze their work and learning outcomes, providing independent evaluations. Example: "What knowledge did I acquire during the project process, and what can I improve?"

6. Support and development of results

This stage involves supporting students' further education and research activities.

Use of innovative technologies: Utilizing VR/AR technologies to study complex experiments in a virtual environment. Example: Simulating experiments using VR before conducting them in real life.

Opportunities for independent research: Encouraging students to work on new ideas. Example: Conducting research projects on topics like "Green Energy."

Overall effectiveness of the model

Through these stages, students develop the ability to connect theoretical knowledge with practice, work collaboratively, think creatively, and solve real-world problems.

CONCLUSION

In our view, the integration of P5BL technologies into the educational process offers significant opportunities for enhancing students' physical and technical abilities. This approach facilitates the development of practical skills, links theoretical knowledge with practice, and fosters creative thinking abilities. Additionally, it enhances teamwork, the ability to share responsibilities, and problem-solving skills. Students' technical reasoning, as well as their competencies in working with devices and technologies, are strengthened, leading to increased interest and motivation in learning.

Through P5BL technologies, the content of education becomes interactive and creative, encouraging students to deeply explore modern technologies. This, in turn, improves their readiness for future professional and practical activities. Consequently, students become not only knowledgeable in their respective subjects but also skilled in applying this knowledge and capable of solving problems as creative individuals. This approach plays a vital role in improving the quality of education and meeting the demands of modern society.

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