O‘ZBEKISTON MILLIY UNIVERSITETI XABARLARI, 2024, [1/7/1]
ISSN 2181-7324

FALSAFA
http://journals.nuu.uz
Social sciences

UDK 5(075.3)

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TABIIY FANLAR DARSLARIDA LOYIHA ASOSIDA O‘QITISH METODIKASI

Annotatsiya

Tabiiy fanlarda o‘qitish metodikasining asosiy istiqboli samarali tushunish va esda saqlash maqsadida talabalar bilan amaliy mashg‘ulotlarga asoslangan. Shu sababli, loyiha barqarorlik va elektrotexnika tamoyillarini birlashtiradi, talabalarni elektr energiyasi bo‘yicha darslarni qo‘llashda ekologik toza shaharsozlik amaliyotlarini tadqiq qilish, loyihalash va amalga oshirishga undaydi.

Kalit so‘zlar: barqaror shahar rivojlanishi, elektr zanjirlari, qayta tiklanadigan energiya, seriyali sxemalar, parallel sxemalar, amaliy o‘rganish, hamkorlik.

МЕТОДОЛОГИЯ ОБУЧЕНИЯ НА ОСНОВЕ ПРОЕКТНОГО ОБУЧЕНИЯ НА НАУЧНЫХ КЛАССАХ

Аннотация

Основная перспектива методики преподавания естественных наук основана на практической работе со студентами с целью эффективного понимания и запоминания. Таким образом, проект объединяет принципы устойчивого развития и электротехники, побуждая студентов исследовать, проектировать и внедрять экологически чистые методы городского развития, одновременно применяя уроки, связанные с электричеством.

Ключевые слова: устойчивое городское развитие, электрические цепи, возобновляемая энергия, последовательные цепи, параллельные цепи, практическое обучение, сотрудничество.

METHODOLOGY OF TEACHING BASED ON THE PROJECT BASED LEARNING IN SCIENCE CLASSES

Annotation

The main perspective of teaching methodology in science based on hand-on activities with students in order to understand and remember effectively. Therefore, the project integrates principles of sustainability and electrical engineering, challenging students to research, design, and implement eco-friendly urban development practices while applying lessons on electricity.

Keywords: Sustainable urban development, Electrical circuits, Renewable energy, Series circuits, Parallel circuits, Hands-on learning, Collaboration

Introduction. Project-based learning (PBL) involves students designing, developing, and constructing hands-on solutions to a problem. The educational value of PBL is that it aims to build students’ creative capacity to work through difficult or ill-structured problems, commonly in small teams. Typically, PBL takes students through the following phases or steps:

Identifying a problem

Agreeing on or devising a solution and potential solution path to the problem (i.e., how to achieve the solution)

Designing and developing a prototype of the solution

Refining the solution based on feedback from experts, instructors, and/or peers.

Depending on the goals of the instructor, the size and scope of the project can vary greatly. Students may complete the four phases listed above over the course of many weeks, or even several times within a single class period. Because of its focus on creativity and collaboration, PBL is enhanced when students experience opportunities to work across disciplines, employ technologies to make communication and product realization more efficient, or to design solutions to real-world problems posed by outside organizations or corporations. Projects do not need to be highly complex for students to benefit from PBL techniques. Often times, quick and simple projects are enough to provide students with valuable opportunities to make connections across content and practice.

Literature review. Solving problems is an essential skill for the future workforce in many science, technology, engineering, and math (STEM) careers. In the context of higher education, the development of problem solving skills includes a variety of teaching strategies to prepare students for solving new kinds of problems and provide opportunities for theoretical concepts to become more concrete [1]. It was noticed that students who falter in introductory STEM courses are more likely to develop learning gaps that grow as they tackle more difficult material [2]. The goal of this study is to close such gaps and build a solid foundation for more advanced work in upper level courses. This can be achieved by using PBL strategies in which instruction is delivered through small groups and students are encouraged to collaborate to master concepts. In working with undergraduate students over many years, the authors have experienced countless occasions where students are asked to work in groups to solve a problem, yet, they wait for the instructor or classmates to give them a hint to solve the problem for them. Perhaps, they have never been taught how to find the information required to problem solve. This issue is certainly not unique to the authors' experience; as other educators have noticed that many students are completely dependent on the help of a tutor for the majority of their class projects [3]. Biazus and Mahtari conducted a quasi-experiment using project-based learning and direct instructional learning models and found that the PBL model had a significant impact on the enhancement of creative thinking skills of secondary school students [4]. Over the past few decades, project-based learning has received a lot of attention in the field of education. Many studies have shown that project-based learning can improve students’ learning motivation, problem-solving skills, teamwork, and communication skills. However, due to the complexity and diversity of project-based learning, as well as differences in research methods, research findings on its effectiveness and influencing factors vary. By combining the results of multiple independent studies, more accurate and reliable conclusions can

be obtained to further understand the effects of project-based learning. In addition, project-based learning meta-analysis studies can help reveal the factors and mechanisms influencing project-based learning. This can help guide the design and implementation of project-based learning and promote effective student learning. Based on this, this study compensates for the limitations of individual studies by integrating and synthesizing multiple independent studies in order to systematically assess the effects of project-based learning, provide more accurate and reliable evidence, and reduce the chance of research findings. At the same time, project based learning meta-analysis can provide a broader perspective to help researchers and educational policy makers gain a comprehensive understanding of the effects and influencing factors of project-based learning, so that they can develop more effective teaching strategies and policies to promote the improvement and development of project based learning [5]. It is recommended to enhance students' problem-solving particularly in introductory classes where students need to master the basics before moving on to an advanced course[8]. A number of scaffolding strategies have been presented in the literature. Examples of common scaffolds in PBL include but not limited to: using real-case projects grounded in the personal interests[10], projects can be broken into parts to better facilitate collaboration in small groups, hands-on activities can be used to link theory to practice[11], and graphic organizers can be used to visually depict an idea either through writings or charts[9].

Research methodology. The class that is involved in this study is a required science or biology course in Presidential school in Jizzakh, Uzbekistan. The class selected for this study is Science containing 12 students with 3 females and 9 males. The class is a tutorial/practical course with 4-hours tutorial and 1- hour practical per week. However, the hours could change according to students' scientific potential and level of understanding of the topic. Figure 1 shows the science room that allows exposure to the equipment and hands-on practices typically found in ordinary classroom.

The section selected for this study was offered in Spring 2024. As a response to spring season, this season is usually the start of fourth term classes in schools and students are in a bit of a tired mood. Therefore, students are motivated and interested to lessons by making project as an exciting activity with tutorial lessons in a week. The class is divided into four sections; all meet once a week with quarter of the students enrolled in the class. To kick off the project, we designed a series of thought-provoking questions that served as an entry event. These questions aimed to give students a sense of purpose and a clear challenge to address. The questions were designed to stimulate critical thinking and problem-solving skills, focusing on real-world issues such as:

How does urbanization impact the well-being of city residents?

What are the environmental consequences of urban sprawl?

How can sustainable practices improve the quality of life in urban areas?

The project aims to provide students with a hands-on learning experience that integrates principles of sustainability and electrical engineering. Students will design and build a scale model of a sustainable town, incorporating functioning electrical circuits to demonstrate their understanding of electricity and its applications in powering homes and businesses. Students will start by researching sustainable urban development practices. This will include studying renewable energy sources, energy-efficient building designs, waste management systems, and green infrastructure. They will look into case studies of existing sustainable towns and cities to gather ideas and inspiration. Parallel to their sustainability research, students will delve into the principles of electricity. They will learn about series and parallel circuits, the properties of conductors and insulators, and how electricity is generated, distributed, and used in everyday life. Based on their research, students will brainstorm ideas for their sustainable town. They will sketch preliminary designs, identifying where and how electrical circuits will be integrated into their model. Each group will decide on the layout of their town, the types of buildings to include, and the renewable energy sources they will use. Students will create detailed blueprints of their town models. These blueprints will include the layout of streets, buildings, and green spaces, as well as the placement of electrical circuits. They will also specify the materials they will use for construction and the types of electrical components needed (e.g., wires, switches, batteries, LED lights). Students will develop electrical schematics for their town models. These schematics will illustrate the design of series and parallel circuits, showing how electricity will flow to power different parts of the town. They will plan the integration of renewable energy sources like solar panels or wind turbines into their electrical systems.

Using eco-friendly materials such as recycled cardboard, balsa wood, and non-toxic paints, students will construct the physical structures of their town. They will build scale models of homes, businesses, and public buildings, ensuring that each structure aligns with sustainable building practices. Students will install the electrical circuits within their town models. They will connect wires, switches, and power sources to create functioning series and parallel circuits. LED lights will be used to illuminate buildings, and small motors may be included to demonstrate mechanical functions powered by electricity. Renewable energy components, such as miniature solar panels or wind turbines, will be integrated into the model. These components will be connected to the electrical circuits to demonstrate how renewable energy can be harnessed to power the town. Students will test their electrical circuits to ensure they function correctly. They will troubleshoot any issues, such as faulty connections or insufficient power supply, and make necessary adjustments. This phase will help them understand practical challenges in electrical engineering and develop problem-solving skills. Based on the testing phase, students will refine their models. They may need to reinforce structures, improve circuit layouts, or enhance aesthetic elements to make their towns more realistic and functional. Students will present their completed models to their peers, teachers, and possibly external judges. Each group will explain the design and construction process, highlighting the sustainability features and electrical systems of their town. They will demonstrate how the circuits work and how renewable energy sources power the town.

Assessment of Student Projects Using Rubric Criteria

To ensure a fair and comprehensive evaluation of the students' projects, we developed a detailed rubric with specific criteria. This rubric helps to provide clear expectations for students and a consistent framework for assessing their work. The projects will be marked based on the following criteria:

Criteria	Exceeds Expectations (5)	Meets Expectations (4)	Approaching Expectations (3)	Needs Improvement (2)
Understanding of Electrical Concepts	Student demonstrates advanced understanding and application of electrical concepts in their project.	Student demonstrates adequate understanding and correct application of electrical concepts.	Student shows basic understanding with minor errors in application.	Student demonstrates little understanding and the application of electrical concepts is incorrect or missing.
Application and Functionality	All circuits and renewable energy sources function flawlessly and demonstrate high efficiency.	Most circuits and renewable energy sources function well with good efficiency	Some circuits and renewable energy sources function with occasional issues; efficiency could be improved.	Many circuits or renewable energy sources do not function properly; efficiency is lacking.
Use of Indigenous/Scrap Materials	Student creatively uses a variety of indigenous or scrap materials, enhancing the project's sustainability significantly.	Student makes good use of indigenous or scrap materials, contributing to the project's sustainability.	Student uses indigenous or scrap materials, but the contribution to sustainability is minimal.	Student makes little to no use of indigenous or scrap materials, with no clear sustainability focus.
Design and Aesthetics	The model town is exceptionally designed with superior attention to detail and aesthetic appeal.	The model town is well designed with good attention to detail and aesthetic appeal.	The model town's design shows effort but lacks some detail and coherence.	The model town's design is poorly executed with little attention to detail or aesthetics.
Collaboration and Teamwork	The group shows outstanding teamwork, with seamless collaboration and equitable contribution from all members.	The group works well together with a clear division of labor and good collaboration.	The group collaborates but could improve the division of labor and effective contribution by all members.	The group shows poor collaboration, with uneven contribution and lack of teamwork.
Presentation and Explanation	Presentation is exceptionally delivered with clear, concise explanations, and all questions are answered expertly.	Presentation is well delivered with good explanations, and most questions are answered well.	Presentation is adequate, but explanations could be clearer; struggles with some questions.	Presentation is unclear or incomplete, with poor explanations and inability to answer questions satisfactorily.
Innovation in Problem Solving	Student displays exceptional problem solving skills with innovative solutions throughout the project.	Student shows good problem-solving skills with effective solutions.	Student shows some problem-solving ability but often resorts to conventional solutions.	Student struggles with problem-solving and fails to find effective solutions.
Reflection and Self Assessment	Reflection is insightful, identifying clear strengths and areas for improvement, with deep understanding of learning.	Reflection is adequate, identifying some strengths and weaknesses, with a good understanding of learning.	Reflection shows some thought but lacks depth in identifying personal and project learning insights	Reflection is superficial, with little to no understanding of personal learning or project outcomes.

Analysis and results. As we mentioned before, the project significantly enhanced student engagement and learning outcomes in our science classes besides other subjects as well. Despite initial fatigue in the spring term, the hands-on approach and real-world relevance of sustainability and electrical engineering rekindled students' interest. The forming small group promoted active participation and collaboration, fostering both technical and interpersonal skills. Additionally, their understanding of electrical engineering principles, including the design and implementation of series and parallel circuits, showed marked improvement. Overall, the project effectively bridged theoretical knowledge and practical application, resulting in a meaningful and engaging learning experience[6].

Conclusion. One of the key benefits of PBL is that students construct their understanding by actively engaging in the learning process. In this project, students built their knowledge by designing and creating models of sustainable buildings. This hands-on approach allowed them to see the direct application of theoretical concepts in real-world scenarios.

Students displayed their learning continuously throughout the project. Each phase of the project, from research and planning to design and construction, provided opportunities for students to showcase their progress. This continuous display of learning mirrored real-world practices, where projects evolve and develop over time.

The final presentations were a crucial component of the project. By presenting their work to an audience and responding to questions, students enhanced their problem-solving skills. They learned to articulate their ideas clearly, defend their choices, and think on their feet. These skills are essential for success in both academic and professional settings.

PBL allowed students to apply their learning in a context that closely resembles real-world challenges. By working on a project related to urban sustainability, students gained a deeper appreciation of the complexities and interdependencies of environmental issues. They also developed practical skills that will be valuable in their future careers.

REFERENCES

1. Netwong, T. (2018). "Development of Problem Solving Skills by Integration Learning Following STEM Education for Higher Education." International Journal of Information Education Technology, 8(9), 639-643.
2. Alzen, J. L., Langdon, L. S., & Otero, V. K. (2018). "A logistic regression investigation of the relationship between the Learning Assistant model and failure rates in introductory STEM courses."J International journal of STEM education, 5(56), 1- 12.
3. Khouyibaba, S. (2015). "Teaching remedial courses: Challenges and teaching philosophy." J Procedia-Social Behavioral Sciences, 186, 927-931.
4. Biazus, M., and Mahtari, S. (2022). The impact of project-based learning (PjBL) model on secondary students’ creative thinking skills. Int. J. Essential Competencies Educ. 1, 38–48. doi: 10.36312/ijece.v1i1.752
5. Zhang L and Ma Y (2023) A study of the impact of project-based learning on student learning effects: a meta-analysis study. Front. Psychol. 14:1202728. doi: 10.3389/fpsyg.2023.1202728.
6. J.O. Tolipova “Biologiyani o‘qitishda Pedagogik Texnologiyalar” Cho’lpon nomidagi nashriyot-matbaa ijodiy uyi Tashkent — 2011, 9-11
7. E Shamurodov, S Sharipov, X Juraev, J Bazorova - “Methodological Bases of Formation of Chemical Concepts in Pupils in School from Chemistry Course” Journal of Pedagogical Inventions and Practices, 2022, 1-5 pages

8. Stanger-Hall, K. F. (2012). "Multiple-choice exams: an obstacle for higher-level thinking in introductory science classes." J CBE—Life Sciences Education, 11(3), 294-306.
9. Chasanatun, T. W., & Lestari, S. "The Development of Learning Material in Teaching Writing used Project Based Learning with Graphic Organizer Concept." Proc., International Conference on English Language Teaching (ICONELT 2017), Atlantis Press, 92-96.
10. Grant, M. (2009). "Understanding projects in project-based learning: A student’s perspective." Proc., Annual Meeting of the American Educational Research Association.
11. Joyce, T., Evans, I., Pallan, W., & Hopkins, C. J. E. E. (2013). "A hands-on project based mechanical engineering design module focusing on sustainability." J Engineering Education, 8(1), 65-80.