



INTERNATIONAL EXPERIENCE IN APPLYING PROJECT-BASED LEARNING IN TEACHING FOREIGN LANGUAGES TO BIOENGINEERING STUDENTS

EXPERIÊNCIA INTERNACIONAL NA APLICAÇÃO DA APRENDIZAGEM BASEADA EM PROJETOS NO ENSINO DE LÍNGUAS ESTRANGEIRAS PARA ESTUDANTES DE BIOENGENHARIA

Antonina Glotkina

Moscow Aviation Institute (National Research University), Russia
<https://orcid.org/0009-0002-1471-0559>
glotkina@gmail.com

Elena Volkova

Moscow Aviation Institute (National Research University), Russia
<https://orcid.org/0000-0003-2267-0438>
lenka@mail.mipt.ru

Elena Vecherinina

Moscow Aviation Institute (National Research University), Russia
<https://orcid.org/0000-0002-9767-8613>
vealek@mail.ru

ABSTRACT

Objective: The study aims to test the efficiency of project-based learning (PBL) and reflective journal writing in bioengineering students as a means of increasing the effectiveness of foreign language teaching. **Methods:** The paper analyzes the experience of using PBL in combination with reflective journal writing in first-year bioengineering students. The authors review studies covering the historical development and experience in using the method, as well as its evolution in the education systems of European and Asian countries. **Results:** The application of PBL is noted to be of a practice-oriented nature, while the introduction of reflective journal writing contributes to the motivated progression of students along their educational routes. The efficiency of PBL is proven by the experience of several countries, and the introduction of reflective journal writing has a positive effect on students' mastery of a foreign language. Redefined application of project activities requires serious preparation from the teacher to avoid common mistakes in organizing the learning process using this methodology.

Keywords: Project-oriented learning; PBL, Professional language; International educational groups; Multilanguage environment.





RESUMO

Objetivo: O estudo visa testar a eficácia da aprendizagem baseada em projetos (PBL) e da escrita reflexiva de diários em estudantes de bioengenharia como forma de aumentar a eficácia do ensino de línguas estrangeiras. **Métodos:** O artigo analisa a experiência do uso do PBL em combinação com a escrita reflexiva de diários em estudantes do primeiro ano de bioengenharia. Os autores revisam estudos que abrangem o desenvolvimento histórico e a experiência na utilização do método, bem como a sua evolução nos sistemas educativos de países europeus e asiáticos. **Resultados:** Nota-se que a aplicação do PBL é de natureza orientada para a prática, enquanto a introdução da escrita reflexiva de diários contribui para a progressão motivada dos alunos ao longo dos seus percursos educativos. A eficácia do PBL é comprovada pela experiência de vários países, e a introdução da escrita reflexiva em diários tem um efeito positivo no domínio de uma língua estrangeira pelos alunos. A aplicação redefinida das atividades do projeto requer uma preparação séria do professor para evitar erros comuns na organização do processo de aprendizagem usando esta metodologia.

Palavras-chave: Aprendizagem orientada a projetos; PBL, Linguagem Profissional; Grupos educacionais internacionais; Ambiente multilíngue.

1 INTRODUCTION

In the 18th century, John Amos Comenius formulated the fundamental principle of didactics: "Teachers may teach less, but learners learn more" (Sorina, 2012, p. 25). In other words, the growth of students was viewed as a natural process to be supported but not forced. Thus, back in the 18th century, there was a question about the expediency of dualism in learning between prescribed learning content and the need for freedom and flexibility in choosing activities according to circumstances and situational needs (Klarin, 2018). Jean Jacques Rousseau (1762/2010), a representative of the Age of Enlightenment, spoke in favor of independent, heartfelt, and direct comprehension of the world. Largely due to his philosophical views, the ground for the "new education", i.e., the pedocentric approach, emerged when the world philosophy of education reevaluated the priorities, interests, and needs of the student. In this connection, it became necessary for teachers to create conditions for students' self-discovery and the development of their interests, initiative, and autonomy.

The official point of origin of project-based learning (PBL) is believed to be the late 19th to early 20th century. At this stage, the efforts to find new methodological approaches in teaching in Russian and foreign practice are similar in their innovative nature. The creator of PBL, John Dewey, after his trip to the USSR in 1928, describes





his cutting-edge approach to teaching, in which the key principle was that any work with students must begin with an investigation of the social and natural environment around them, and the criterion for the value of a project was its contribution to socially useful work (Dewey, 1938). However, the search for new forms and methods, which characterizes the atmosphere at the turn of the 20th century, was long anticipated by suggestions of the need to create an unorthodox approach with better results for engineering and architecture in the workshops of Italy in the 16th century. The craft needed to acquire the status of science, and the best results of work were established through a contest. The spirit of competition was upheld by students' work on projects (Latin for "before an action"). The innovation of the approach itself and its implementation had value in itself, and despite the non-compulsory implementation of projects in practice, students were engaged in a great deal of research activity, gaining practical knowledge that would have direct application in their future professional work. Such traditions of the Roman Higher School of Art were adopted by the Royal Academy of Architecture in Paris in the 17th century, and then the practice spread to such countries as Germany, Austria, and Switzerland (Morozova, 2007).

In many respects, the 20th century was a turning point for pedagogical practice due to the rising interest in pragmatism. In that period, Dewey emphasized that cognition doesn't deal with the transcendent (Dewey, 1938). Teaching can only occur through immersion in an uncertain situation and its resolution. The objects referred to them (the fields of politics, art, mathematics) are not learned unless they are inferred through a process of experimental thinking (Zotov, Mironov, and Razin, 2016). William Heard Kilpatrick, a follower of Dewey's ideas, denied the need to adhere to programs and did not consider lesson activities a mandatory element in the learning process. A similar view of learning was cultivated in the Soviet Union until 1932. However, this approach did not stand up to criticism due to the declining level of knowledge, which was noted by Soviet researchers. Thus, in August 1932, the Central Committee of the Communist Party of the Soviet Union made the decision to fully abandon the brigade-laboratory method and return to traditional programs, teaching manuals, and the class-lesson system.

At present, the popularity of the person-centered pedagogical paradigm forces pedagogical staff to once again revise the utilized teaching methods to properly provide for the social demand for initiative, creative, critically thinking, and easily adapting specialists capable of acting in the face of high uncertainty. There is a vital need to





achieve the relevance of teaching courses and demand in the labor market.

The purpose of the present study is to adapt and test the efficiency of PBL in combination with reflective journal writing in student groups as part of a professional English language course.

2 METHODS

The research was conducted at the Department of Foreign Languages at Moscow Aviation Institute. The department has a special focus on English for special purposes. Every year, survey statistics confirm that newly enrolled first-year students know little about their future specialty and have only superficial knowledge of their subject area. Their small life experience does not help them engage in discussions of professional topics in foreign language classes.

To be specific, in 2022, the department surveyed 18 first-year students specializing in biotechnical systems and technologies. The study tested their residual knowledge of the studied foreign language and assessed knowledge about their future profession. The surveyed group was made up of students at different proficiency levels: six students at the A2 level, four students at B1-, seven students at B1+, and one student at B2 on the CERF scale. In personal interviews about the chosen specialty, 16 respondents reported that they simply passed the threshold score and had no clear knowledge about the profession, and only two students stressed their interest in the special subject. This survey enables the teacher to formulate tasks for further work with the student group. First, the teacher needs to select useful materials in two directions – language learning and the use of background knowledge in discussing professional topics. Second, it is necessary to raise students' motivation to work on a foreign language and use it in a professional environment.

Based on the draft professional standard "Prosthetic Engineer", which currently awaits approval by the Ministry of Labor and Social Protection of the Russian Federation, the department identified topics for study in the foreign language course that allow the students to enrich their background knowledge on the subject. Furthermore, this contributes to their engagement in the discussions of technical issues in their specialty in the foreign language. Generalized labor functions of a prosthetic engineer include the following: "technical support of the design and construction of the prosthesis and its components; design and construction of the prosthesis; technical,





economic, and legal support of prosthesis design work; management of prosthesis design works". Based on these provisions, first-year students were provided with authentic video and text materials on the topics of biomimicry, mechanism design, 3D printing of bionic prostheses, creating prostheses for animals, the concept of the best prosthesis, prosthesis lifespan, and manufacturing of bionic prostheses from recycled materials.

During the semester, the students were offered a topic for a project to be prepared and defended at the end of the semester. The topic was formulated as "Creating an efficient prosthesis". The students were free to choose the target audience of the created prosthesis and offer solutions for efficient manufacturing regarding the parameter of preservation of the environment, i.e., opportunities for manufacturing prostheses from recycled materials. The topic was presented in December 2022, so the students had 6 weeks to study the issue and write reflective journals. Throughout this period, students attended practical English classes, recorded their achievements in reflective journals, and studied articles and video materials in their specialty. Practical classes involved intensive work on improving background knowledge of the subject in the foreign language. The students worked with texts and videos on their special topic to enrich their vocabulary. In other words, the classes utilized the practice of narrow reading/watching. This approach, described by Stephen Krashen, is similar to the work of a specialist researcher when it is necessary to thoroughly investigate a problem to identify its elements and propose a practical solution (Krashen, 2004).

3 RESULTS AND DISCUSSION

In the course of the study, the students used reflective journals to work on and analyze the materials studied in class, took notes in the foreign language, and conversed on professional topics. Their reflections concerned the customization of prostheses to the customer's needs, considering the unique characteristics of the human body. Their practical experience was also considered and became food for thought on their project. By writing the reflective journal, the students consciously recorded their successes and failures and demonstrated confident use of bioengineering terminology. The students split into three teams with three separate projects, specifically, developing hearing aids, developing customized limb prostheses





for musicians, and developing prostheses using recycled plastic for patients in categories K1 to 3. At the beginning of work on the projects, the students used common words to designate human limbs and organs and did not know the names of the stages of making prostheses at all (in other words, students made do with long-familiar vocabulary in English – "head", "arm", "leg", "foot", "ear", "production of prostheses", etc.). As they worked on their reflective journals, the students demonstrated deeper immersion in terminology (using such English words as "limb", "frontal, parietal, temporal lobe of the brain", "ear lobe", "ear canal", "auditory ossicles", "tympanic membrane", "nervous system", "neurons", "EEG procedure", "3D printing of samples", "production of prosthetic limbs with restored sensitivity", etc.). Furthermore, the students showed interest in unique engineering solutions, which is indicated by their recording of this information in their journals. In working on their projects, the students were recommended to pay attention to periodicals with chapters on science and bioengineering, such as *New Scientist*, *Science*, *BBC Focus Science*, *The Guardian – Section Science*, and *The Wall Street Journal – Section Science*. In these sources, the students could find illustrations of examples of prosthetic manufacturing and reports on patients' lives, which fostered their scientific interest and immersion in case studies in the foreign language.

The final stage of work with the students was the defense of their projects. In their projects, the students substantiated the choice of the category of people for whom they would be ready to create their prostheses and resource-saving materials and technologies. The projects also highlighted the economic component and stressed the importance of creating affordable models for patients. The presented projects dealt with creating prostheses for patient categories K1-3. In particular, one project dealt with creating hearing aids and another focused on prostheses with unique characteristics for musicians. In a conversation reviewing the work during the semester, 16 students expressed their approval of the reflective journaling approach. Two A2 students noted having difficulties but did not speak negatively about the approach.

At present, we are witnessing an avalanche-like growth in the popularity of PBL in teaching technical and humanities disciplines in several countries, such as Finland, France, Australia, the USA, and China (Zhao, Zhang, and Du, 2017; Condliffe, et al., 2017; Grossman, et al., 2019; Bui, et al., 2020; Kangas, Salo, and Korhonen, 2022; Martinez, 2022). The method finds both supporters and opponents in these countries.





In Finland, the emphasis in the application of the method is placed on the development of meta-subject competencies, while in France, the method is considered successful only if the results of educational projects can be commercialized. Australia aims to use innovative educational technology, which includes PBL. In the USA, the long history of the method has allowed for the establishment of collaborative relationships between the education system and the marketplace. China aims to use the method to develop original solutions to multidimensional problems mainly in the social and environmental sectors (Kazun and Pastukhova, 2018).

PBL is gaining popularity owing to its distinctive feature – training in a multidisciplinary format. However, teachers can make several methodical, didactic, or organizational mistakes when implementing project activities in teaching. Polat (2000; 2010) and Musikhin (2021) point to the fact that specialists tend to confuse different concepts and a simple presentation or report on a topic becomes a project. Another mistake is the incorrect distribution of project topics when the student is not interested in making a decision about what to work on and what topic to develop. PBL also does not assume a constant change of topics or accumulation of projects. The chase for the number of realized projects leads to superficial knowledge, unprocessed topics, unlearned material, and a lack of residual knowledge on the topic. Project activities can take the form of participation in conferences and exhibitions as an additional activity, which is a positive experience, but creates an additional burden for the student.

The selection of educational content must be guided by several rules. First, it is unacceptable for the project topic to lack a creative and problem-based component, as this clearly affects the student's interest in getting involved in the project work. Low motivation is also provoked by the lack of a practice-oriented element in the project when the study is conducted for the sake of study without a definite result. Projects can be individual or group in format, but in both cases, the work should be performed in the most comfortable conditions. If the group is created improperly or students' engagement is unbalanced, the result of the project cannot be satisfactory. The same result comes from the individual work of a student without proper support and guidance from the teacher. Project work involves a large amount of independent work, but by no means work without a qualified mentoring approach from the teacher, who should familiarize the student with research methods and appropriately, through properly posed questions, help the student in the direction of the study and the preparation and implementation of their project.





Over the decades of application, the general didactic plan of project work has been established as follows. With the teacher assuming mentoring and the student having a direct interest in the process, the student formulates the goal of their work and criteria for success. Next, of importance is step-by-step planning of the course of project work. The next stage is performing research itself, with all its accompanying components (collection of data and visual aids for its presentation, critical and creative revision of the facts at hand, work on the presentation and systematization of information, creation of graphs, drawings, and schemes and comments to them). The concluding, resulting stage of the work is the defense of the project, participation in its presentation, summary of the results of one's own and others' projects, their assessment, and final discussion of the results with the teacher. An important point here is that the teacher needs to take a serious approach to giving emotional support to students throughout their work on projects on an equal footing with professional consultations. This aspect is determined by the student's creative search during their research, in which they can face unpredictable challenges and obstacles. The very process of research is directly linked to creativity. As noted by the renowned biochemist Szent-Györgyi, "Discovery consists of seeing what everybody has seen and thinking what nobody has thought". Pondering the right questions and learning to pose them in an original way is largely the task of the teacher-mentor, who can help the student escape the loop of predictable solutions and traditional methods, find alternative ideas, and think creatively. A teacher-mentor is careful in their critical remarks not to compromise the student's motivation to continue working on the project.

The student demonstrates their own maturity in the creative process if at the very initial stage of work, they already begin to search for initial solutions to their task and if at the stage of stagnation and procrastination, they do not leave attempts to work on the difficult project, seeking a breakthrough solution and its further realization and testing.

An essential characteristic of PBL is the reflective activity of students in intellectual, emotional, and personal terms. Through immersion in PBL, students participate in the formation of a culture of reflective thinking. In the constant flow of information from a multitude of sources, it becomes an important skill to critically evaluate this data and to creatively revise and present it for subsequent participation in professional discussion, which cannot be achieved without reflection and keeping a reflective diary. Among the positive aspects of applying reflection tactics are the





following: students learn and process the material better, as they establish a connection between the received and acquired knowledge; students engage in analyzing their own actions and consciously review their progress and failures; in the process of keeping a reflective journal, students generalize and systematize the educational material and learn to plan their learning activities; another recorded result is a rise in student interest in the learning process. The problem of effective foreign language teaching in non-linguistic universities is urgent. The subject being not a core one in the specialty directly affects students' interest in the studied language. Furthermore, students' lack of motivation in overcoming difficulties in the learning process is largely rooted in the negative experience of learning at the stage of secondary education. A foreign language teacher at a university faces the task of organizing the learning process in the most useful way and motivating students to go deeper into learning a foreign language, overcome their negative experiences, and construct the process in such a way that it gives positive results.

4 CONCLUSION

The students' responsible attitude to the methodology allowed them to successfully follow the planned educational route and achieve their educational goals. The students confidently defended projects in the foreign language, gained positive experience in overcoming difficulties in the process of mastering the Foreign Language for Special Purposes course, and discovered efficient learning strategies allowing them to achieve positive results and maintain their motivation to study the foreign language. The employed approaches and their proven efficiency enables the department to expand the practice of applying the methods of reflective journal writing and PBL with other students.

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