



Project-Based Learning



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Abstract

In the degree in Pedagogy in Experimental Sciences at ULEAM Chone extension, the effectiveness of the project-based learning methodology has not been evaluated, so it is necessary to determine its uses and advantages at the university level. The objective of the study is to analyze project-based learning among students of the Pedagogy in Experimental Sciences career. It is developed through a mixed approach that integrates qualitative and quantitative data, the inductive method is used, and the study population is made up of students of the degree. The survey technique is used. The results demonstrate that PBL contributes to the development of research and problem-solving skills, collaboration and teamwork, the application of theoretical knowledge to practical situations, and the motivation and commitment of students, with a positive experience in its use. It is concluded that PBL is an active methodology with significant benefits in the teaching-learning process of students, of the Pedagogy in Experimental Sciences career, among which it stands out in promoting the understanding of scientific concepts, the development of research skills and problem-solving, the capacity for collaboration and teamwork, which highlights the application of theoretical knowledge to practical situations and that there is a positive perception and experience of the methodology on the part of the students.

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1 Introduction

Although today's society constantly evolves and transforms, the educational system maintains teacher-centered methodologies that barely respond to the needs and demands of current higher education, a situation that requires a change in the methodological perspective that gives the student prominence in the construction of their knowledge, skills, values and strengthens the teacher's role as guide and advisor of the educational process (Zambrano Briones et al., 2022), that is capable of integrating methodologies that enhance the educational process.

At the Latin American level, the application of methodologies based on conventional teaching prevails, traditional pedagogy still dominates and there is a lack of real innovation in pedagogical practice, there are important efforts in countries of the region to move towards models and methodologies that adapt to the contemporary demands of education (Gamarra et al., 2023), there is an urgent need to apply innovative methods that allow moving towards a school that responds to the needs of the demands of today's society.

In higher education, methodological changes are being consolidated in the teaching-learning processes that are oriented towards more active methodologies (García et al., 2020), there is a transition from a traditional model focused on the figure of the teacher and on methodologies that barely motivate student interest towards active methodologies with an innovative approach (Moreno, 2023).

In Ecuador, the Ministry of Education (2019) encourages the use of innovative methodologies in teaching-learning processes. According to Rojas-Avilés et al. (2020), innovation in the educational system is related to the specific capacities of teachers that allow them to propose strategies that improve teaching practice” (p. 85), in this sense, the Organic Law of Education Intercultural Ecuador promotes student-centered, innovative, inclusive, participatory and life-relevant education. The Project Based Learning (PBL) aligns with innovative methodologies because it seeks for students to become protagonists of their learning, build their knowledge through experimentation and exploration, and connect with the real world.

The Ministry of Education defines PBL as a methodology that invites students to become protagonists of their learning through the creation of spaces where creativity is put into practice, which allows the implementation of knowledge acquired in the classroom in specific actions for the service of the educational community and its environment. The study is important because PBL applied in the university context is an ideal methodology to address problems or projects applied to the real world, it involves the application of practical knowledge, encourages collaboration, teamwork and effective communication, favors creativity and applies to a wide variety of topics and areas of learning (Baş et al., 2016; Nithyanandam, 2020).

Its development is relevant because it allows the evaluation of the effectiveness of PBL at the level of higher education specifically applied to the context of the Pedagogy degree in Experimental Sciences at ULEAM Chone extension, determining improvements in learning, knowledge retention, and skills in students, in comparison with other methodologies used at the university. Research is useful because its results can contribute to the implementation of a continuous methodology and promote more effective teaching along with more enriching learning experiences, in addition to guiding towards innovation in curricular design, leading to the incorporation of interdisciplinary projects and enriching in the academic programs of the ULEAM Chone extension, in addition to the fact that its results can be replicated in other university contexts.

Although there is a broad consensus on the usefulness of PBL, the bibliography related to its functionality and real experiences is limited, mainly due to the pedagogical and technical difficulties of its application, the use of traditional methodologies as well and the pressure to comply with the prescribed curriculum, which makes further implementation of this methodology at the university level difficult (Ayerbe Lopez & Perales Palacios, 2020). There are notable investigations that have documented the relevance of PBL as a learning methodology, with benefits at basic education levels (González et al., 2021; Izagirre et al., 2020) secondary (Pascagaza & Bohorquez, 2019) and university (Burgos-Leiva et al., 2021), where its special usefulness has been documented for evaluation (García et al., 2020), development of soft skills (Zepeda Hurtado et al., 2022), learning and motivation (Botella & Ramos, 2019b) among others.

As a problem of the study, a scarce application of the PBL methodology at the higher level is identified, this is a consequence of the lack of knowledge of the advantages that this methodology offers, in the case of the Pedagogy in Experimental Sciences degree at the ULEAM Chone extension is not has evaluated the effectiveness of the methodology, so it is necessary to determine its uses and advantages, in this specific context, consequently, it is appropriate to consider the principles and resources of an active methodology where learning is considered a more constructive than the receptive process with support. in pedagogical theories that postulate learning by doing based on the theoretical contributions of John Dewey (Salido López, 2020). Pedagogy is identified as the object of study.

The objective of the study is to analyze project-based learning among Pedagogy students in Experimental Sciences at the ULEAM Chone extension, in its development specific objectives are met aimed at analyzing the benefits of PBL in the teaching-learning process, assessing the students' perception of the PBL, evaluate the application of the PBL methodology among students (Ergül & Kargin, 2014; Guo et al., 2020).

Project-Based Learning. PBL originated in Kilpatrick's proposal in 1918 as an active learning methodology that consists of developing a project through an event that provokes curiosity or interest in the student. This methodology has a constructivist approach that seeks answers to the problems raised at the beginning of a project, with a special focus on its development (Guerrero et al., 2021). Intrinsically, the student is motivated to develop the project and the methodology relieves the content as part of another aspect of the educational process, along with aspects such as reflection, collaboration and evaluation among peers (Solís-Pinilla, 2021).

This entire process is carried out through dialogue and positive spaces, through a process of design, planning, and execution where it is discussed constructively and the respective suggestions for the development of the project are made. PBL is an active methodology based on constructivist principles, whose objective is that students, using research strategies, participate in the structuring of the project to obtain a final product (Andrade et al., 2020). It is executed through a process of negotiation between the participants, it is creative and didactic, and its function is to grant a sense of authenticity to students, for them to discover the basic principles of a discipline (Bottle & Ramos, 2019).

The objective of PBL is to enable a significant modification of the roles of teachers and students, as well as the development of competencies. Aguirregabiria Barturen & García Olalla (2020), represent an alternative to apply a dynamic, integrative teaching-learning process that favors collaborative learning. This methodology allows working on central aspects of the curriculum, students focus on activities that lead to the essential contents of the subject, the project must be a challenge for students, who by solving the project must acquire new knowledge and progress in terms of their autonomy with work and responsibility with the task (Lowyck & Pöysä, 2001; Laal & Ghodsi, 2012).

The PBL is developed as a comprehensive proposal where the subjects involved coordinate their objectives and evaluate their contents based on the development of a single project that the students execute through work teams (Llorens-Largo et al., 2021). PBL is a methodology that allows students to develop projects through which answers are given to problems of war. The advantages that this methodology offers with the construction of one's own identity, development of creativity, problem-solving, development of critical thinking, and decision-making, among others (Vargas & De la Barrera, 2021). This methodology is based on an active and coordinated process that has the necessary flexibility to adapt to the characteristics of the students and the sociocultural context for conflict resolution (Obando-Arias, 2021). It includes a different form of work that encourages inquiry, and the individual and autonomous work of students, in which a greater commitment to learning is favored.

PBL is a different way of working ideal for communication and cooperation between the different actors involved in the educational process, being relevant for its versatility to apply it to any educational context, both at the levels of early childhood education and in education. superior (Domènech et al., 2019). However, its application is recommended in primary education, where it contributes to the activation of students and facilitates the connection between classroom learning and real-life (Llorens-Largo et al., 2021).

PBL provides students with a real learning context, which allows them to participate directly in the teaching process, and which is reflected in the ability to make decisions aimed at solving a task of a certain level of complexity (García et al., 2020), in creativity, teamwork and innovation (Paz & Moquillaza, 2023) and that in general offers a high level of satisfaction with the teaching and learning experience (Sánchez et al., 2023) and towards practice (Espejo-García et al., 2022).

Various aspects of PBL enrich the educational environment, among those linked to student training, among which those linked to student training stand out: Focused on the mobilization of knowledge, construction of competence, and visibility of social practices that increase the sense of knowledge and learning (Evans, 2008; Mishra et al., 2020). Discovery of new knowledge, worlds in a perspective of awareness. Generation of new learning within the framework of the project. Identification of acquisitions and shortages from a self-assessment and evaluation perspective. Gaining self-confidence, strengthening personal and collective identity through empowerment, development of autonomy, and ability to choose and negotiate (Solís-Pinilla, 2021).

Through PBL, students define the creation of a final product, plan for project management, and design and develop a final product, this begins with possible solutions until reaching the final product (Rodríguez-Sandoval et al., 2010). PBL must meet five basic characteristics: develop a central focus on the curriculum, not be a secondary activity, organize around key questions related to aspects of a specific area, generate constructive research that leads to the creation of knowledge, achieve the active participation of the student in the design and implementation of the project and raising problems that occur in real life (Botella & Ramos, 2020).

2 Materials and Methods

The study is based on a mixed approach through which qualitative and quantitative data are collected, analyzed, and integrated. This methodology facilitates approaching a problem from different points of view (Caro-González et al., 2014). It is descriptive and field research because it focuses on describing how the PBL methodology is implemented in the specific context of the Pedagogy in Experimental Sciences career at ULEAM Chone extension and what the results observed in terms of student learning. Therefore, it is also a field investigation because the data is collected directly from the selected environment.

The inductive method is used for the analysis of PBL based on data collection, identification of patterns, generation of concepts, comparison and drawing of conclusions. The analytical method is also used by carrying out a detailed analysis of the individual components of the PBL methodology to understand it in its entirety.

The study population is made up of 30 students randomly selected from the Fifth, Sixth, Seventh and Eighth Semesters of the Pedagogy in Experimental Sciences degree at ULEAM Chone extension. The survey technique is used to prepare and obtain data effectively (Bardales, 2021), on the application of PBL, from which the analysis and discussion that supports the research is developed. The instrument used is the questionnaire. All the data collected are processed in the Microsoft Office Excel program and are represented through percentage statistical bars, from which the analysis and discussion of the results that support this research are built.

3 Results and Discussions

The results are obtained from the application of the survey to the students of the Pedagogy in Experimental Sciences career, six closed questions are applied using two Likert-type scales, Figure 1 shows the surveys applied to the students.

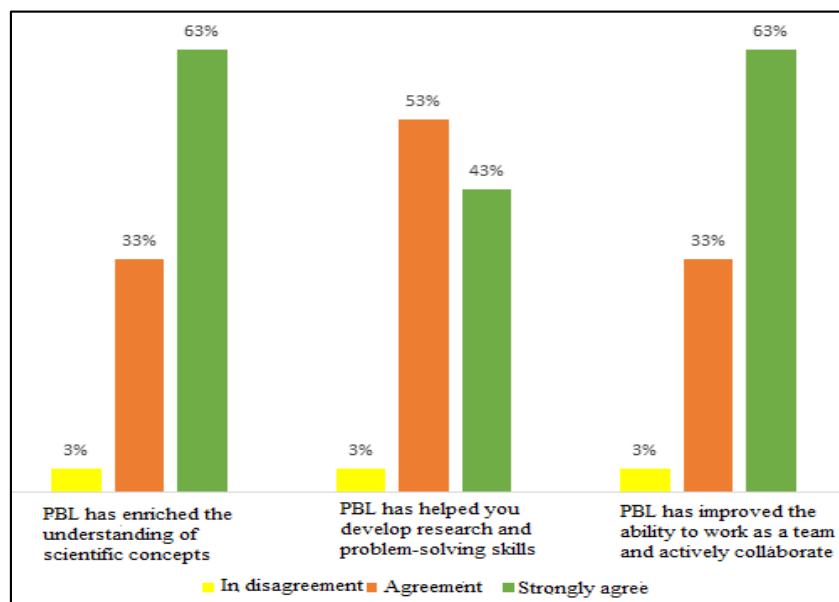


Figure 1. The surveys applied to the students

When asking students in question number one if PBL has enriched their understanding of scientific concepts, 63% of students say they strongly agree and 33% agree. Likewise, to question two, 53% of students agree that PBL has helped them develop research and problem-solving skills, while 43% strongly agree. Furthermore, in question three it is determined that 63% of the students state that they strongly agree that PBL has improved the ability to work as a team and collaboratively and 33% of the students agree with this statement. Figure 2 shows the results of the queries made to the students.

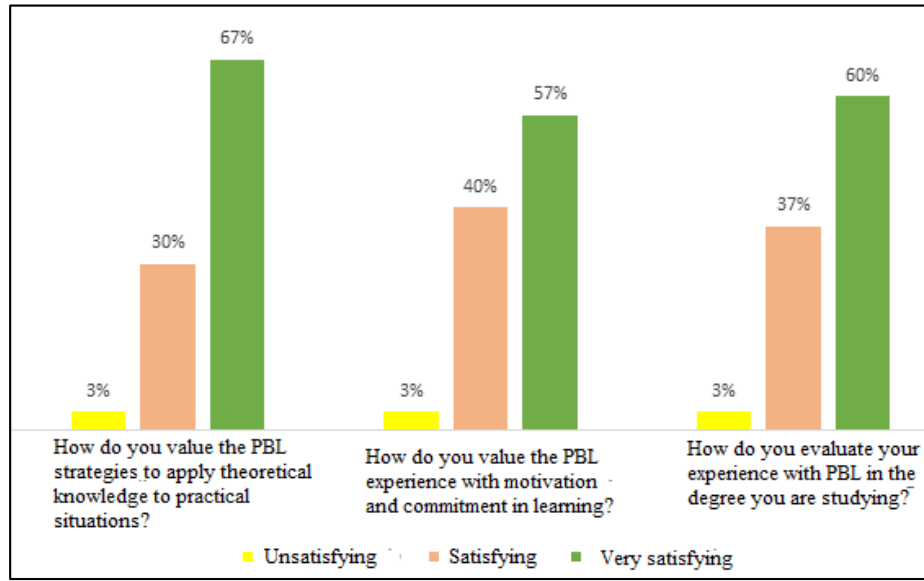


Figure 2. Student survey

In question four about the assessment of PBL strategies to apply theoretical knowledge to practical situations, 67% of the students surveyed rated it as very satisfactory, 30% as satisfactory, and 3% as unsatisfactory. In question five, 57% of respondents rated the PBL experience as very satisfactory and 40% as satisfactory for motivation and commitment to learning. Regarding the evaluation of their own experience in question six, 60% of respondents say that it is very satisfactory and 37% that their experience with PBL in the degree they are studying is satisfactory.

The results show a positive perception of students towards PBL, findings that are similar to multiple studies that present a positive assessment of this methodology that allows students to think, and act based on the design of a project, developing a plan with defined strategies, to provide a solution to a question (Pascagaza & Bohorquez, 2019), with benefits for the understanding of scientific concepts. In this regard, it has been found that thanks to the fact that students actively participate in the learning sequence, selection and generation of content, it is facilitated. theoretical assimilation and practical application (Zambrano Briones et al., 2022).

The results also show that PBL contributes to research and problem-solving skills; its structure as a teaching strategy allows for autonomous involvement in research processes, minimizing the limitations of traditional teaching (Zambrano Briones et al., 2022). which helps the student make decisions, and allows them to define their path and overcome situations and problems posed by responding to the curriculum (Izagirre et al., 2020). It privileges research based on various questions raised, which must seek to be resolved by searching for information from different sources (González et al., 2021). It also allows achievements to be achieved jointly so that both individual and group growth is favored, as well as cognitive, attitudinal and social skills (Pascagaza & Bohorquez, 2019). In addition, benefits have been identified in the development of soft skills, especially in interpersonal, self-control and coping (Zepeda Hurtado et al., 2022).

The results show that PBL favors teamwork and collaboration, which coincides with studies that indicate improvements associated with the development of skills for collaborative work (Pascagaza & Bohorquez, 2019), the active participation of students and supervision and teacher feedback (Burgos-Leiva et al., 2021), to greater intervention by the teacher and student who assumes responsibility for learning, works in groups managing possible conflicts, have a receptive attitude to the exchange of ideas, shares information and learns from others (Zambrano Briones et al., 2022).

Its usefulness is highlighted for the application of theoretical knowledge to practical situations. In this regard, it has been found that PBL favors the investigation of reality by mobilizing concepts when confronting information (González et al., 2021), that the integration of knowledge and its application Reality situations occur from the assignment of activity with specific objectives and its relationship with a topic, real problem or question that derives from some experience (Pascagaza & Bohorquez, 2019).

The benefits of PBL are also identified in motivation and commitment to learning. In this sense, the literature reports that PBL reduces demotivation problems (Zambrano Briones et al., 2022) and contributes to self-determination since PBL is an active methodology and Student-centered helps address basic needs through the development of an

environment of autonomy, adequate structuring, and a receptive context, especially appropriate to enable positive feedback strategies and teamwork (Botella & Ramos, 2019b).

Finally, students show a positive perception of the experience with the PBL methodology, and a wide variety of related experiences are reported from the literature, highlighting the improvements concerning the conventional methodology (Burgos-Leiva et al., 2021), an option for transforming traditional teaching strategies (Zambrano Briones et al., 2022), of relevance in the educational experience for the integration of subjects, reinforcing the overall vision of knowledge (Pascagaza & Bohorquez, 2019), which allows responding to the current curriculum (de los Ríos & Navío, 2020).

There are some limitations such as the time allocated for the development of the study, and its applicability to the group corresponding to the Pedagogy in Experimental Sciences career recommendations are: Evaluate the experience of the APB in other careers of the ULEAM Chone extension, to compare the results regarding students' motivation and commitment to learning; develop research on PBL to research, problem-solving and collaborative work skills to evaluate its benefits in the Pedagogy in Experimental Sciences career; socialize the results of the research with the teachers of ULEAM Chone extension to expose the benefits of the PBL methodology in the teaching-learning process (Lewalter, 2003; Pedaste et al., 2015).

4 Conclusion

PBL is an active methodology with significant benefits in the teaching-learning process of students of the Pedagogy in Experimental Sciences career, among which it stands out to promote the understanding of scientific concepts, the development of research and problem-solving skills, the collaboration and teamwork skills. There is a high appreciation of the PBL methodology for the application of theoretical knowledge to practical situations by students of the Pedagogy in Experimental Sciences career. A positive perception and experience of the project-based learning methodology is demonstrated by the students of the Pedagogy in Experimental Sciences career, with the predisposition expressed in the motivation and commitment of the students towards its use in the classroom.

Conflict of interest statement

The authors declared that they have no competing interests.

Statement of authorship

The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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