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Impact of Project-Based Learning on the Motivation of Students at a Productive Technical Education Center in Ayacucho –CETPRO

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ABSTRACT

Purpose: Evaluate the Impact of project-based learning on the motivation of students at a Productive Technical Education Center –CETPRO. Methodology: Design: quasi-experimental experimental study. Participants: the sample consisted of a probabilistic sampling, which was represented by students of the Computer Operation specialty of a CETPRO in Ayacucho, Peru, of which 15 students formed an experimental group and 15 students for the control group. Instrument: The Academic Motivation Scale (EMA) instrument was used, which consists of 28 items, the intrinsic motivation dimension includes items 1-13, the extrinsic motivation dimension items 13-20 and the demotivation dimension items 21-28. Statistical analysis: means comparison analysis was used with the Student t test. Results: The students in the experimental group achieved more satisfactory results in their Motivation scores (Average = 80.73) after the application of the project-based learning intervention, compared to the students in the control group (Average = 67.53). Conclusion: The research concludes that the project-based learning method is essential for the development of skills in students and also for problem solving. To achieve this, it is essential that teachers incorporate this method into their teaching methodology, so that students acquire the necessary knowledge and gain practical experiences, being creative and dynamic in classes is emphasized, so that students feel motivated and acquire the skills.

Keywords: Project-based learning, demotivation, motivation, intrinsic motivation, method, knowledge.

1. Introduction

It is essential to establish a connection between the learning process and the student's life trajectory, with the purpose that such learning acquires meaning and acts as an intrinsic motivator for the student, allowing knowledge to be based on the student's previous experiences, perceptions and emotions (Sepúlveda et al., 2021). This approach should be complemented with educational methodologies that incorporate specific activities designed to foster the development of fundamental skills, which are critical thinking, teamwork and emotion management, as emphasized by Moran, et al., (2020). Consequently, educational institutions are devoting their efforts to the incorporation of more active and collaborative pedagogical approaches within the classroom. The project-based learning method, in particular, is emerging as one of the most popular and valued approaches in this regard (Aguirregabiria and Garcia, 2020). According to Rahman et al., (2023), project-based learning (PBL) is one of the learning models that can empower students to think critically.

Translated with DeepL.com (free version)It is important to emphasize that the educational system is not limited only to granting individuals a certain accumulation of knowledge, but also seeks to instruct the individual on how to apply such knowledge in practice and play an effective role in contemporary society, whether in theoretical, practical, professional or physical contexts (Politsinskaya et al., 2019). The underlying philosophy of the project-based learning approach lies in the continuous and active cooperation of students on behalf of their educational experience by conducting investigations that include challenging questions and carefully structured tasks (Solis, 2021). According to Cheng & Yang (2019), project-based learning has a

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medium to large positive effect on students' academic performance compared to traditional instruction. Moreover, the medium effect size is affected by subject area, school location, instructional hours, and information technology support, but not by educational stage and group size.
On the other hand, motivation has a significant impact on academic outcomes, as directing a student towards motivation during a specific stage of his or her life can influence how he or she approaches education in the future (Botella and Ramos, 2020). It is critical to note that keeping students motivated to complete their assignments is crucial, as this increases their chances of success. In addition, students need to be engaged in their learning process so that they can perform effectively in practice (Rueda et al., 2020).
By regularly using project-based learning tools, systematic retention of project experiences allows students to compare various projects more systematically and highlight problem solving effectively leading to reduced project risks in the future and better practical management skills (Vasiliene et al., 2020).

2. Conceptual references

Project-based learning (PBL) is understood to be a promising approach that enhances student learning in higher education. Empirical studies on project-based learning have been reviewed with a focus on student outcomes (Guo, et al., 2020). Project-Based Learning (PBL) is characterized by employing holistic thinking, critical evaluation, and competent learning. This approach is dynamic and is integrated both in a disciplinary environment and from a global perspective, and is closely related to other types of learning (Valeriano, 2021). In this method, it is emphasized that each participant must contribute to the realization of an outcome with the aim of learning in depth, which is known as a product (Botella and Ramos, 2020). Similarly, project-based learning (PBL) emphasizes the relationship between concepts acquired through projects and real experiences so that students can relate concepts acquired from experiences they already have with new knowledge (Nuraini et al., 2023).
Project Based Learning (PBL) is presented as a methodological proposal that allows students to approach a subject collaboratively, integrating multiple fields of knowledge as a teaching strategy (Cyrulies and Schamne, 2021). According to its perspective, it requires students to apply theoretical concepts to address practical problems, so that learning culminates in the development of the key concepts of the work assigned by the teacher (Ramos, 2020). The purpose of this method is to promote innovative educational practices that incorporate what students experience and learn, closely related to their context, fostering the fact of being able to plan, complete what is planned, and evaluate projects that are connected to the real world (Barquero, 2020). Project-based learning creates a space in which the student applies skills and previous knowledge to new situations, so that these allow him/her to build skills that are useful for his/her development, in addition, it promotes critical thinking (Zambrano et al, 2022).
Current Project Based Learning (PBL) practices focus on topics defined by the teacher and are used as a partial or total substitution for traditional assessments (Zhang, 2023). Through this experience, individual and autonomous learning is encouraged, framed in the planning of an activity with clearly defined purposes and processes (Salido, 2020). In the framework of project-based learning, teachers play a guiding role by facilitating the organization of information, rather than just transmitting basic information to students, since their main objective is for students to acquire knowledge and develop skills (Mustafa and Méric, 2019).
An essential component of the Project Based Learning (PBL) method is the authenticity of the problems addressed, which are designed to reflect situations in the real environment. This element contributes significantly to enhancing students' desire to learn (Villanueva et al., 2022). It is important to highlight the fact of observing a direct relationship between the implementation of PBL and academic performance, evidencing intellectual growth and students' motivation towards the tasks (Calderón and Loja, 2021).
Motivation plays a key role in the creative process because creative people who are immersed in the creative process tend to be fully engaged in creation. Therefore, high motivation can lead to obtaining an efficient product or result (Ting and Yu, 2020). It is elementary to mention that motivation represents a fundamental aspect in education and the learning process, since unmotivated students usually do not do their own to acquire new knowledge, on the other hand those highly motivated show a strong desire to attend school while having an active participation in the learning process (Mina and Caicedo, 2019).
Motivation encompasses moments of personal development and achievement that are manifested when a student carries out tasks, solves challenges and has an important influence on academic achievement (Castro and Vega, 2021). In this sense, motivation is perceived as the internal forces that drive an individual to focus on processes that lead to action (Cobo et al., 2022). Furthermore, students' motivation to reinforce the knowledge acquisition process is influenced by their desire to acquire new knowledge and their curiosity to experience a different learning approach (Gustiani, 2020).
Motivation plays a significant role in the educational process, since it is part of it as a crucial component of motivated learning and contributes to the generation of new experiences, both positive and negative, as indicated by Sánchez et al. (2022). In addition, motivation guides student activities and has an impact on their autonomy, which in turn influences their level of learning (Montes and Moreta, 2019). Motivation is deeply linked to the intellectual and formative aspect generated by the learning process, and its final result is the fact of acquiring new knowledge, skills and experiences that have a positive impact on the behavior related to the intellect and the attitude towards the search for new knowledge (Fabiana and Vega, 2022).

According to Seli (2019), processes involve goals, beliefs, perceptions, and expectations. For example, a task is often related to how competent a person believes he or she is at completing that task. Also, beliefs about the causes of current task successes and failures influence motivation and behavior on future tasks. For example, students who attribute failure to lack of ability behave differently than students who attribute failure to lack of effort.

When students learn by participating in real-world projects, almost every aspect of their experience changes. The role of the teacher changes. He or she is no longer the content expert doling out information in bite-sized chunks. Student behavior changes as well. Instead of following the teacher's lead, students pursue their own questions to create their own meaning (Boss & Krauss 2019).

On the other hand, motivation is an internal experience that is driven by biological, cultural and social aspects that stimulate the performance of behaviors through the use of cognitive resources for learning (Granillo et al., 2022). Assessing students' motivation in relation to a discipline, a particular content or a didactic tool is of fundamental importance, due to its influence on the teaching-learning environment and its effect on educational processes in general (Velázquez et al., 2020). One of the benefits of project-based learning is to show a greater capacity of students. Through it, student creativity can be observed through various school projects. Creativity is a process that produces novelty, which is useful, sustainable, or satisfying to people (Siti et al., 2019).

Creativity can be measured through several aspects, including fluency, flexibility, originality, and novelty Fluency can be measured through many responses. Flexibility can be measured by using many variations of ideas to answer the problem. Originality is measured by asking whether the response given is different from that of other students or whether the response produced is an unusual response (Susanti et al 2022).

Material and Methods

The study is quantitative in nature and adopts an experimental approach in which one or two independent variables are deliberately manipulated with the objective of analyzing the outcome of this manipulation related to one or more dependent variables in a control context (Hernández et al.,2018). In the quasi-experimental design used, the instruments can be measured and applied on more than three occasions, that is, at three different times, also allowing the regulation or graduated manipulation of the independent variable at different times to obtain more accurate results (Arias and Covinos, 2021).

It is important to note that this research was conducted in the city of Ayacucho, Peru, using that locality as the unit of analysis to identify the influence of project-based learning on the motivation of students studying the specialty of Computer Operation in a CETPRO (Technical-Productive Education Center).

3. Study variables

Project-based learning (PBL): PBL is presented as a methodology that offers students the opportunity to approach a topic collaboratively, integrating diverse fields of knowledge as a teaching strategy (Cyrulies and Schamne, 2021). This approach is characterized by constructively guiding students' knowledge development through structured, directed and formative interaction (Fajardo and Gil 2019).

Motivation: Motivation is the perceived force that helps drive a person to focus on the internal processes that lead to action, as stated by Cobo et al. (2022).

Table 1 below shows the variables, dimensions and the indicators used to measure them.

Table 1: Distribution of variables

Variables	**Dimensiones**	**Indicadores**
Project-based learning	Presentation of central ideas	Evidence of ability to synthesize the information found.
	Organization of information	Indicates in an organized manner the findings found.
	Syntax and spelling	Correct use of scientific vocabulary
Motivation	Intrinsic motivation	For stimulating experiences
	Extrinsic motivation	Regulation identified
	Demotivation	Absence of motivation

Note: Own elaboration

3.2 Population and sample

The population of this study was made up of the students of the Computer Operation specialty at a CETPRO located in Ayacucho, Peru. In order to obtain the sample, a probabilistic sampling was used, which finally consisted of 15 students in the experimental group and 15 students in the control group.

3.3. Techniques and instruments for data collection

To achieve the objective of the study, the survey was used as a technique and pre- and post-tests were also used as data collection tools. In addition, to evaluate the students' responses, a Likert-type scale was applied, which

contemplates the following values: “Strongly agree” (5 points), “Agree” (4 points), “Sometimes” (3 points), “Disagree” (2 points) and “Strongly disagree” (1 point).
On the other hand, in the measurement of student motivation, the Academic Motivation Scale (EMA) instrument was used, which was based on the Spanish validation of the Educational Motivation Scale developed by Núñez et al. in 2005. It consists of 28 items, where the intrinsic motivation dimension comprises items 1-13, the extrinsic motivation dimension includes items 13-20, and the demotivation dimension comprises items 21-28. The scoring scale is based on a Likert-type scale, in which values are assigned from 1 (never corresponds) to 5 (always corresponds), with an intermediate score of 3 (sometimes corresponds).

4. Results

Ho: The application of project-based learning does not allow the significant development of motivation in students of a CETPRO in Ayacucho.
Hi: The application of project-based learning allows the significant development of Motivation in students of a CETPRO in Ayacucho.
Significance level: alpha = 0.05.
Test statistic: Hypothesis testing with Student's t-test for independent samples will be applied at the pre-intervention and post-intervention time points.

Table 2: Motivation in students at a center in Ayacucho

	Group		
Statistician	**Control (n=15)**	**Experimental (n=15)**	**t de Student**
Formerly			
Media	66.53	64.40	t = 0.837
Desv. típ.	7.74	6.13	p = 0.410
Then			
Media	67.53	80.73	t = 5.475
Desv. típ.	5.66	7.43	p = 0.000*

Note: Database

Motivation in students of a center in Ayacucho is not different at 95% reliability according to Student's parametric t-test (p=0.410), both for the control and experimental teams prior to the application of project-based learning, and there is a slight advantage for the students in the control group compared to the students in the experimental group.
Likewise, Motivation in students of a Center of Ayacucho, is different at 95% reliability according to the parametric Student's t-test (p=0.000), for the control and experimental group after the application of the PBL intervention, so, the students of the experimental group obtained more satisfactory results in their Motivation scores (Mean = 80.73) after the project-based learning intervention, with respect to the students of the control group (Mean = 67.53).

Specific hypothesis 1

Ho: The application of project-based learning does not significantly develop Intrinsic Motivation in students of a CETPRO in Ayacucho.
Hi: The application of project-based learning allows the significant development of Intrinsic Motivation in students of a CETPRO in Ayacucho.
Significance level: alpha =0,05
Test statistic: Hypothesis testing will be applied with the Student's t-test for independent samples at the pre-intervention and post-intervention times.

Table 3: Intrinsic Motivation in students of an Ayacucho Center.

	Group		
Statistician	**Control (n=15)**	**Experimental (n=15)**	**t de Student**
Formerly			
Media	24.67	22.73	t = 1.403
Desv. típ.	3.18	3.33	p = 0.210
Then			
Media	25.67	42.27	t = 9.130
Desv. típ.	2.32	6.65	p = 0.000

Note: Database

Intrinsic Motivation in students of a center in Ayacucho is not different at 95% reliability according to Student's t-test (p=0.210), both for the control and experimental groups before the application of the PBA, with a slight advantage for students in the control group compared to students in the experimental group.
Likewise, Intrinsic Motivation in students of an Ayacucho Center, is different at 95% reliability according to Student's parametric t-test (p=0.000), both for the control and experimental group after the application of the Project Based Learning intervention, so, the students of the experimental group obtained more satisfactory results in their Intrinsic Motivation scores (Mean = 42.27) after the Project Based Learning intervention, in relation to the students of the control group (Mean = 25.67).

Specific hypothesis 2

Ho: The application of project-based learning does not significantly develop Extrinsic Motivation in students of a CETPRO in Ayacucho.
Hi: The application of project-based learning allows the significant development of Extrinsic Motivation in students of a CETPRO in Ayacucho.
Significance level: alpha =0,05
Test statistic: Hypothesis testing will be applied with the Student's t-test for independent samples at the pre-intervention and post-intervention times.

Table 4: Extrinsic Motivation in students of an Ayacucho Center.

	Group		
Statistician	**Control (n=15)**	**Experimental (n=15)**	**t de Student**
Formerly			
Media	21.93	23.33	t = 1.573
Desv. típ.	2.89	1.88	p = 0.127
Then			
Media	21.80	24.87	t = 2.067
Desv. típ.	3.03	3.36	p = 0.014

Note: Database

Extrinsic Motivation in students of a center in Ayacucho is not different at 95% reliability according to Student's parametric t-test (p=0.127), for the control and experimental groups before the application of the PBA, with a slight advantage of the students in the control group with respect to the students in the experimental group.
Likewise, Extrinsic Motivation in students of a Center of Ayacucho, is different at 95% reliability according to Student's parametric t-test (p=0.014), both for the control and experimental group according to after the application of the Project Based Learning intervention, so, the students of the experimental group obtained better results in their Extrinsic Motivation scores (Mean = 24.87) after the Project Based Learning intervention, with respect to the students of the control group (Mean = 21.80).

Specific hypothesis 3

Ho: The application of project-based learning does not significantly develop demotivation in students of a CETPRO in Ayacucho.
Hi: The application of project-based learning allows the significant development of demotivation in students of a CETPRO in Ayacucho.
Significance level: alpha =0,05
Test statistic: Hypothesis testing will be applied with the Student's t-test for independent samples at the pre-intervention and post-intervention times.

Table 5: Lack of motivation among students at a center in Ayacucho

	Group		
Statistician	**Control (n=15)**	**Experimental (n=15)**	**t de Student**
Formerly			
Media	19.93	19.33	t = 0.430
Desv. típ.	4.10	3.52	p = 0.670
Then			
Media	20.07	13.60	t = 7.849
Desv. típ.	2.94	1.24	p = 0.000*

Nota: Base de datos

Demotivation in students of a center in Ayacucho is not different at 95% reliability according to Student's parametric t-test (p=0.670), both for the control and experimental groups before the application of project-based learning, with a slight advantage for students in the control group with respect to students in the experimental group.

Likewise, the Demotivation in students of a Center of Ayacucho, is different at 95% reliability according to the parametric Student's t-test (p=0.000), both for the control and experimental group according to after the application of the PBL intervention, so, the students of the experimental group obtained better results in their Demotivation scores (Mean = 13.60) after the application of the project-based learning intervention with respect to the students of the control group (Mean = 20.07).

5. Discussion and conclusions

Within the research, the results indicated that students in the experimental group achieved better performance in terms of their motivation scores. After the project-based learning intervention, the average motivation score in this group was 80.73. In comparison, students in the control group obtained an average motivation score of 67.53. These findings indicate that the project-based learning method proved to be effective in increasing students' motivation.

Furthermore, in the study by Cobo et al. (2022), it was observed that students in the experimental group obtained an average of 70.01 compared to the control group, whose average was 50.02, after the implementation of PBA. These results indicate that the aforementioned method plays an essential role in increasing students' motivation.

Additionally, when examining the results obtained, it stands out that the students in the experimental group achieved outstanding results in the intrinsic motivation score, reaching an average of 42.27 after the implementation of project-based learning. In contrast, students in the control group obtained an average of 25.67. These findings suggest that students, having a clear purpose, experience a significant increase in intrinsic motivation. This fact is further supported by the research of Botella and Ramos (2020), in which it was observed that students in the experimental group achieved an average of 45.25 in their scores after the implementation of the PBA method, compared to the average of 36.20 obtained by students in the control group. This reinforces the claim that students can increase their levels of intrinsic motivation by practicing and strengthening their knowledge through this approach.

In addition, the results achieved reflect that students in the experimental group achieved better scores in extrinsic motivation, achieving an average of 24.87 after the implementation of project-based learning. In contrast, students in the control group obtained an average of 21.80 in this aspect. This suggests that the method is highly effective in fostering increased motivation in students. In agreement with these findings, the study conducted by Fabiana and Jisson (2022) evidenced that students in the experimental group achieved an average of 29.14 in their extrinsic motivation after the implementation of the PBL method, compared to the average of 20.45 obtained previously. This supports the idea that the use of this method can significantly contribute to students feeling more motivated to learn and increase their knowledge levels.

Similarly, the results of the study indicated that students in the experimental group achieved lower scores in demotivation, with an average of 13.60 after the implementation of the project-based learning intervention, compared to the average of 20.07 obtained by students in the control group. This supports the assertion that the method is effective in addressing and solving the problem of lack of motivation in students.

This is supported by the study of Montes and Moreta (2019), in which it was observed that students in the experimental group achieved an average of 10.60 in demotivation before the implementation of the PBL method. However, after the PBL intervention, their average decreased to 17.28. This indicates that the method is essential to prevent students from becoming unmotivated to learn and to foster their knowledge growth.

The research concludes that the project-based learning method is essential for developing students' skills and also for problem solving. To achieve this, it is essential that teachers incorporate this method into their teaching methodology, so that students acquire the necessary knowledge and gain practical experience. In addition, the importance of teachers being creative and dynamic in class is emphasized, so that students feel motivated and acquire the skills they need to approach solving problems effectively.

6. Bibliographic References:

1. Aguirregabiria, J., & García, A. (2020). Aprendizaje basado en proyectos y desarrollo sostenible en el Grado de Educación Primaria. *Enseñanza de las ciencias,* 38(2), 5-24. https://doi.org/10.5565/rev/ensciencias.2717
2. Arias, J. y Covinos, M. (2021). Diseño y metodología de la investigación. Enfoques Consulting E.I.R.L.
3. Barquero, A. (2020). Aprendizaje basado en proyectos: una experiencia en el área de formación ciudadana. *Perspectivas,* (21), 1-17. https://doi.org/10.15359/rp.21.2
4. Boss, S., & Krauss, J. (2019). Reinventing project based learning: your field guide to real world projects. (3rd. Edition). ISTE. https://shorturl.at/uoPpl
5. Botella, A., & Ramos, P. (2020). Motivación y Aprendizaje Basado en Proyectos: una Investigación-Acción en Educación Secundaria. *Multidisciplinary Journal of Educational Research,* 10(3), 295-320. http://dx.doi.org/10.447/remie.2020.4493
6. Botella, A., & Ramos, P. (2020). Relación y motivación en un aprendizaje basado en proyectos. *Estudios pedagógicos,* 46 (1), 145-160. https://dx.doi.org/10.4067/S0718-07052020000100145

7. Calderón, P., & Loja, H. (2021). El Aprendizaje Basado en Proyectos desde la perspectiva docente. *Mamakuna,* (17), 49–56. https://revistas.unae.edu.ec/index.php/mamakuna/article/view/517
8. Castro, V., & Vega, J. (2021). La motivación y su relación con el aprendizaje en la asignatura de física de tercero en bachillerato general unificado. *Revista EDUCARE,* 25(2), 322–348. https://doi.org/10.46498/reduipb.v25i2.1503
9. Cheng, H., & Yang, Y. (2019). Revisiting the effects of project based learning on students academic achievement: a meta analysis investigating moderators. *Educational Research Review*, 26, 71-81. https://doi.org/10.1016/j.edurev.2018.11.001
10. Cobo, R., López, Y., Sáez, F., & Mella, J. (2022). Compromiso, Motivación Académica y Adaptación de los Estudiantes Universitarios. *Revista Electrónica Educare*, 26 (3), 1-19. https://doi.org/10.15359/ree.26-3.15
11. Cyrulies, E., & Schamne, M. (2021). El aprendizaje basado en proyectos: una capacitación docente vinculante. Páginas de educación, 14(1), 01–25. https://doi.org/10.22235/pe.v14i1.2293
12. Fabiana, E., & Vega, J. (2022). La motivación en el aprendizaje de la lectura en los estudiantes. *Revista EDUCARE,* 26(1), 476–493. https://doi.org/10.46498/reduipb.v26iExtraordinario.1641
13. Granillo, L., Esquivel, M., Eguía, M., & Bosco, M. (2022). Motivación y Estrés en clases en línea por COVID-19: Un estudio en CCH Oriente. *Educación y Ciencia,* 11(58), 8-27. http://educacionyciencia.org/index.php/educacionyciencia/article/view/697/456621
14. Guo, P., Saab, N., & Post, L. (2020). A review of project based learning in higher education: student outcomes and measures. *International Journal of Educational Research*, 102, 101586. https://doi.org/10.1016/j.ijer.2020.101586
15. Gustiani, S. (2020). Student´s motivation in online learning during Cpovid-19 pandemic era. A case study. *Holistics*, 12(2) 23-40. https://www.jurnal.polsri.ac.id/index.php/holistic/article/download/3029/1235
16. Hernández, R., Fernández, C. & Baptista, P. (2018). Metodología de la investigación (6ª ed.). McGraw-Hill.
17. Mina, P., & Caicedo, H. (2019). La motivación y su uso en la resolución de problemas. *Revista Boletín Redipe*, 8(8), 95–100. https://doi.org/10.36260/rbr.v8i8.803
18. Montes, C., & Moreta, R. (2019). La función predictora de la Autoeficacia en la Motivación Escolar en estudiantes de medicina del Ecuador. *Revista De Ciencia, Tecnología e Innovación*, 6(4), 565–578. https://revista.uniandes.edu.ec/ojs/index.php/EPISTEME/article/view/1465
19. Morán, J., Ruiz, P., Ruiz, P., & Calvo, R. (2020). Metodologías complementarias de aprendizaje para la adquisición de competencias en la formación de especialistas y actividades profesionales confiables. *Educación Médica,* 21(5), 328-337. https://doi.org/10.1016/j.edumed.2020.02.001
20. Mustafa, F., & Meric, T. (2019). Integrating augmented reality into problem based learning: The effects on learning achievement and attitude in physics education. *Computers & Education,* 142(1),10-35. https://doi.org/10.1016/j.compedu.2019.103635
21. Núñez, J., Martín-Albo, J., & Navarro, J. (2005). Validación de la versión española de la Échelle de Motivation en Éducation. *Psicothema*, 17(2), 344-349.
22. Nuraini, O., Asri, I., & Fajri, N. (2023). Development of project based learning with steam approach model integrated science. *Journal of research in science education,* 9(4), 1632-1640. https://doi.org/10.29303/jppipa.v9i4.2987
23. Politsinskaya, E., Lizunkov, V. y Ergunova, O. (2019). Organization of student project-based activities through individual learning routes. International *Journal of Emerging Technologies in Learning (iJET),* 14(11), 186-193. https://doi.org/10.3991/ijet.v14i11.10312
24. Rahman, A., Santosa, T., Nurtamam, M., & Widoyo, H. (2023). Meta Analysis: the effect of ethnoscience based project based learning model on students critical thinking skills. *Journal of research in science education,* 9(9), 611-620. https://doi.org/10.29303/jppipa.v9i9.4871
25. Ramos, N. (2020). Pintando Sonrisas: una experiencia de Aprendizaje Basado en Proyectos. *Observar: Revista electrónica de didáctica de las artes*, (14), 46-62. https://www.observar.eu/index.php/Observar/article/view/112
26. Rueda, S., Panach, J., Gil, M., Casas, S., & Pérez, M. (2020). Cuando la clase invertida no es suficiente: estrategias para motivar al alumnado en ingeniería del software. *Actas de las XXVI Jornadas sobre la Enseñanza Universitaria de la Informática*, 5(1), 125-132. https://rua.ua.es/dspace/bitstream/10045/125035/1/JENUI_2020_018.pdf
27. Salido, P. (2020). Metodologías activas en la formación inicial de docentes: Aprendizaje Basado en Proyectos (ABP) y educación artística. *Revista de Currículum y Formación de Profesorado*, 24(2), 120-143. DOI: 10.30827/profesorado.v24i2.13565
28. Sánchez, Y., Alonso, M., Castillo, I., & Gálvez, F. (2022). Diagnóstico sobre la motivación escolar en estudiantes de ingeniería. *Ingenio y Conciencia Boletín Científico de la Escuela Superior Ciudad Sahagún*, 9(17), 18-22. https://doi.org/10.29057/escs.v9i17.7888
29. Sepúlveda, P., Cabezas, M., García, J., & Fonseca, F. (2021). Aprendizaje basado en problemas: percepción del proceso enseñanza aprendizaje de las ciencias preclínicas por estudiantes de Kinesiología. *Educación Médica*, 22(2), 60-66. https://doi.org/10.1016/j.edumed.2019.01.004

30. Seli, H. (2019). *Motivation and Learning Strategies for College Success: A Focus on Self-Regulated Learning* (6th ed.). Routledge. https://doi.org/10.4324/9780429400711
31. Siti, U., Akhsanul, I., & Rizal, A. (2019). Creating manipulatives: improving student's creativity through project based learning. *Journal on mathematics education*, 10(1), 93-102. https://files.eric.ed.gov/fulltext/EJ1204815.pdf
32. Solís, J. (2021). Aprendizaje basado en proyectos: una propuesta didáctica para el desarrollo socioemocional. *Revista Saberes Educativos*, (6), 76–94. https://doi.org/10.5354/2452-5014.2021.60710
33. Susanti, D., Sari, L., & Fitriani, V. (2022). Increasing student learning motivation through the use of interactive digital books based on project-based learning. *Journal of research in science education*, 8(4). https://doi.org/10.29303/jppipa.v8i4.1669
34. Ting, W., Yu, T. (2020). Applying project-based learning and SCAMPER teaching strategies in engineering education to explore the influence of creativity on cognition, personal motivation, and personality traits. *Thinking Skills and Creativity,* 35(1),100-631. https://doi.org/10.1016/j.tsc.2020.100631
35. Valeriano, G. (2021). Experiencias de aprendizaje basado en proyectos para resolver diversos desafíos de la vida. *Revista Latinoamericana Ogmios*, 1(2), 170–177. https://doi.org/10.53595/rlo.v1.i2.016
36. Vasiliene, V., Vasilis, A., Meidute, I., & Sabaityte, J. (2020). Peculiarities of educational challenges implementing Project based learning. World Journal on Educational Technology: current Issues, 12(2), 136-149. https://doi.org/10.18844/wjet.v12i2.4816
37. Velazquez, R., Maldonado, K., Del Valle, W., & Valdéz, P. (2020). Motivación de los estudiantes hacia el uso de la tecnología para el aprendizaje de las matemáticas. *Revista Científica Sinapsis,* 1(16), 1-9. https://doi.org/10.37117/s.v1i16.246
38. Villanueva, C., Ortega, G. & Díaz, L. (2022). Aprendizaje Basado en Proyectos: metodología para fortalecer tres habilidades transversales. *Revista de estudios y experiencias en educación*, 21(45), 433-445. https://dx.doi.org/10.21703/07185162.v21.n45.2022.022
39. Zambrano, M., Hernández, A. & Mendoza, K. (2022). El aprendizaje basado en proyectos como estrategia didáctica. *Conrado*, 18 (84), 1 – 20. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1990-86442022000100172
40. Zhang, D. (2023). Open-Topic Project-Based Learning and Its Gender-Related Effect on Students' Exam Performance in Engineering Mechanics. *Journal of Civil Engineering Education,* 149(3), 1-19. https://doi.org/10.1061/JCEECD.EIENG-1919