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Research Article

Pedagogical Strategy In Teaching Autocad: Designing Board Games On Road Safety And Water Conservation By University Students For Kids In Rural Areas

Estrategia Pedagógica En La Enseñanza De Autocad: Diseño De Juegos De Mesa Sobre Seguridad Vial Y Conservación Del Agua Por Estudiantes Universitarios Para Niños En Áreas Rurales

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Abstract
Introduction: This study investigates an innovative pedagogical methodology for teaching AutoCAD where engineering students design board games on road safety and water

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conservation for children in rural areas. **Methodology:** Project-Based Learning (PBL) was applied to students in the "Engineering Drawing" course over two different academic periods. The experimental group (2023) designed board games using AutoCAD, while the control group (2022) followed a traditional methodology. **Results:** Statistical analyses showed that the grades of the experimental group were lower than those of the control group, but the perception and satisfaction of the experimental group students towards the activity were significantly positive. **Discussion:** Although grades did not improve, the PBL methodology fostered creativity, collaboration, and social responsibility, highlighting the impact of class schedules on performance. **Conclusions:** Integrating AutoCAD with PBL in engineering education not only teaches technical skills but also promotes values of social responsibility and ecological awareness, better preparing students for their professional and social futures.

Keywords: Project-Based Learning (PBL); AutoCAD; Board games; Road safety; Water conservation; Engineering education; Social responsibility; Pedagogical methodology.

Resumen
Introducción: Este estudio investiga una metodología pedagógica innovadora para la enseñanza de AutoCAD, donde los estudiantes de ingeniería diseñan juegos de mesa sobre seguridad vial y conservación del agua para niños en áreas rurales. **Metodología:** Se aplicó el Aprendizaje Basado en Proyectos (ABP) a estudiantes de "Dibujo para Ingeniería" en dos periodos académicos distintos. El grupo experimental (2023) diseñó juegos de mesa usando AutoCAD, mientras que el grupo control (2022) siguió una metodología tradicional. **Resultados:** Los análisis estadísticos mostraron que las calificaciones del grupo experimental fueron inferiores a las del grupo control, pero la percepción y satisfacción de los estudiantes del grupo experimental hacia la actividad fue significativamente positiva. **Discusión:** Aunque no se mejoraron las calificaciones, la metodología ABP fomentó la creatividad, la colaboración y la responsabilidad social, destacando el impacto de los horarios de clase en el rendimiento. **Conclusiones:** La integración de AutoCAD con ABP en la educación de ingeniería no solo enseña habilidades técnicas, sino que también promueve valores de responsabilidad social y conciencia ecológica, preparando mejor a los estudiantes para su futuro profesional y social.

Palabras clave: Aprendizaje Basado en Proyectos (ABP); AutoCAD; Juegos de mesa; Seguridad vial; Conservación del agua; Educación en ingeniería; Responsabilidad social; Metodología pedagógica.

1. Introduction

In contemporary university education, the challenge is not only to transmit technical knowledge but also to instill values and social awareness in students (Coston, 2017; Sánchez, 2018). Integrating advanced technological tools like AutoCAD software into the university curriculum offers a unique opportunity to achieve both objectives. In this context, the professor in charge of the "Engineering Drawing" course proposed an innovative pedagogical methodology: teaching AutoCAD to university students through a practical project with social impact.

The project involved designing board games using AutoCAD, focusing on two crucial themes: road safety and water conservation. These games were conceived not only as an academic exercise but with the specific purpose of serving as educational tools for schoolchildren in rural areas, which often lack adequate educational resources. Orienting the project towards these areas aims to benefit the school communities and cultivate social awareness among university students by showing them the direct impact of their technical skills on society.

This innovative approach represents a fusion of technology, pedagogy, and social responsibility. This research seeks to understand and evaluate how this methodology impacts the learning of AutoCAD among university students and how it can simultaneously generate a multiplier effect in rural communities and in the ethical and social training of future engineers.

The proposed didactic strategy is based on Project-Based Learning (PBL). PBL is not just a method but a systematic teaching approach that allows students to acquire essential knowledge and skills within a rigorous research framework centered on authentic problems (Moss & Beatty, 2010; Pujol-Cunill, 2017). This approach redefines the traditional classroom dynamics, transforming students from passive listeners into active agents in high-level cognitive processes and the teacher from a content transmitter into a facilitator and guide (Rohmah et al., 2020; Simbolon, 2016).

PBL offers a promising pedagogical methodology that fosters students' autonomy and active participation in contextual learning. According to Kokotsaki et al. (2016), PBL allows students to explore and apply complex concepts through real-world practices using technology as a catalyst for collaborative learning. The creation of board games with AutoCAD not only provides an opportunity to acquire technical skills but also promotes awareness and responsibility on crucial issues such as road safety and water conservation.

In engineering education, it is essential for students to acquire skills in technical drawing. Incorporating specialized software like AutoCAD facilitates this learning. According to De Salles Tiburcio & Monnerat (2012), AutoCAD is an optimal tool for teaching technical drawing in engineering, highlighting the need to adapt teaching methodologies to the digital age.

The creation of board games as part of the project aims not only to develop technical skills but also to serve as input for future work with rural schools. The game theory developed by Karl Groos in the late 19th century and other contemporary studies demonstrate that play is one of the best pedagogical strategies for developing skills and competencies (Gallucci, 2024).

Universities have the mandate to train individuals who are aware and willing to contribute to collective well-being. This perspective, supported by research such as Ali et al. (2021) and Ting et al. (2012), highlights the importance of social responsibility in academic training. The proposal to teach AutoCAD by creating board games for rural communities aims not only at the technical mastery of the software but also aspires to transfer learning from the classroom to real and meaningful situations, encouraging collaboration, autonomy, and social commitment.

The objective of this research is to investigate and evaluate the impact of an innovative methodology in teaching AutoCAD through the creation of board games focused on road safety and water conservation, in contrast to traditional teaching.

2. Methodology

2.1 Selection of Participants

The methodology was applied to students in the "Engineering Drawing" course of the Civil Engineering program at the Technical University of Loja. This course, taught in the second year, is a requirement for obtaining the civil engineering degree. Participants were selected from two different academic periods. The experimental group consisted of students who took the course between April and August 2023, divided into three sections (A1, A2, and A3). These students followed the Project-Based Learning (PBL) methodology to develop board games addressing road safety and water conservation for children in rural areas.

The control group consisted of students who took the course from April to August 2022, following a traditional methodology centered on theory, exercises, and homework. This group is referred to as group B. The groups were defined as follows: Experimental group: A1, A2, and A3; Control group: B.

All students who took the course in the specified periods were included, with no exclusion criteria applied. The inclusion of all students ensured that the sample was representative of the student population in the course. This selection allowed for a direct comparison between the traditional methodology and the proposed experimental methodology, facilitating the evaluation of the project's impact on teaching and learning. Including a control group was essential for assessing the effectiveness of the experimental methodology, as it provided a basis for comparison.

2.2 Description of the Courses

The "Engineering Drawing" course occupies a place in the Civil Engineering curriculum, with a total of 3 credits. It is structured with two hours of theoretical class, two hours of practical class, and one hour of weekly tutoring, extending over 16 weeks.

Course Objective: The primary objective of the course is to develop in students the ability to understand and apply the representation of elements necessary for civil engineering projects using AutoCAD software, an essential tool in the field of engineering.

Structure and Schedule: During the period from April to August 2023, the course was taught to the experimental groups A1, A2, and A3, while the control group B took the course from April to August 2022. The distribution and schedules of the sections were as follows:

- Section A1: 31 students, Tuesday from 7:00 to 13:00 with a one-hour break from 11:00 to 12:00.
- Section A2: 24 students, Monday from 13:00 to 15:00 and Wednesday from 7:00 to 10:00.
- Section A3: 29 students, Wednesday from 19:00 to 21:00 and Friday from 7:00 to 10:00.
- Section B (Control Group): 36 students, Friday from 7:00 to 13:00 with a one-hour break from 11:00 to 12:00.

Resources and Learning Environment: All sections/groups (A1, A2, A3, and B) received classes in person in the university's computer lab. Each student had an individual computer equipped with AutoCAD 2023 software from Autodesk. This setup allowed for a practical and direct learning experience with the tools used in the industry.

Instructor: The same instructor taught all the groups, ensuring consistency in teaching and evaluation across the different sections.

2.3. Description of the Proposed Learning Procedure

The proposed teaching methodology focused on directing students' actions toward creating meaningful content, aiming to activate a learning process that promotes the acquisition of higher-order and critical thinking skills. This approach aligns with the observations of (Amaya Cocunubo et al. (2024), Gonzales Giraldo (2023), and Tovar (2014), who emphasize the importance of educational methodologies that foster the development of critical thinking. The procedure was divided into several stages, detailed below:

Formation of Work Groups: Students were grouped by affinity into work teams with a maximum of 4 students per group. This formation encouraged collaboration and allowed students to leverage their individual skills and knowledge.

Research and Development Phase (Weeks 01-07): During the first seven weeks, students focused on:

- Learning basic drawing concepts and using AutoCAD with the help of the instructor week by week.
- Acquiring fundamental knowledge about road safety and water conservation.
- Receiving guidance on how to develop a board game.

This training was conducted with the help of subject matter experts. For example, a road safety expert prepared a video on topics and possible games they could develop, while a hydrology expert created a 5-minute video presenting topics they could develop. The training was basic since the board games were intended for school-age children up to 15 years old, so a highly specialized approach was not required.

Presentation of Sketches (Week 08): In week 08, students presented and explained the sketch of the board game to be developed. Each group explained the game, its rules, objectives, how it would be played, and the target age group. This stage allowed for an initial review and feedback on the proposed ideas.

Development of Plans and Instructions (Weeks 09-15): From week 09 to week 15, students worked on:

- Designing and developing the board game plans using AutoCAD.
- Creating clear instructions and necessary game components.
- Improving the design based on comments and feedback received.

Exhibition and Awards (Week 16): In week 16, the board games were presented to a jury that evaluated and awarded the best board games. The winners received extra points in the bimonthly grade, encouraging excellence and innovation in design.

2.4. Creation, Tools Used, and Analysis of the Developed Board Games

Creation of the Board Games: The creation of the board games was carried out following a detailed roadmap described below:

- *Idea and Concept*: Students began by identifying the idea and concept of their game, selecting a theme they were familiar with, such as road safety, water conservation, or both, and defining a clear objective for the players.
- *Research*: This phase was crucial, where students studied existing games to understand effective mechanics and define their target audience, ensuring their game was suitable for the intended age and interests.
- *Rules and Mechanics*: Students developed clear and concise rules, designing challenging and engaging game mechanics that encouraged strategy and decision-making.
- *Game Design*: This is where creativity truly shone; students worked on designing the board, pieces, and any graphic elements, ensuring everything was visually appealing and functional.
- *Prototype*: Creating a prototype was essential for testing the game in a practical setting.

Students played and tested their prototype, adjusting and refining the game as necessary.

This process fostered creativity, critical thinking, problem-solving, collaboration, and communication, in addition to generating a spirit of solidarity by focusing the games on rural schools, promoting social and community awareness among students.

Tools Used: Students were provided with a checklist of the components they needed to present and the tools to use. The main components that the board game might include were:

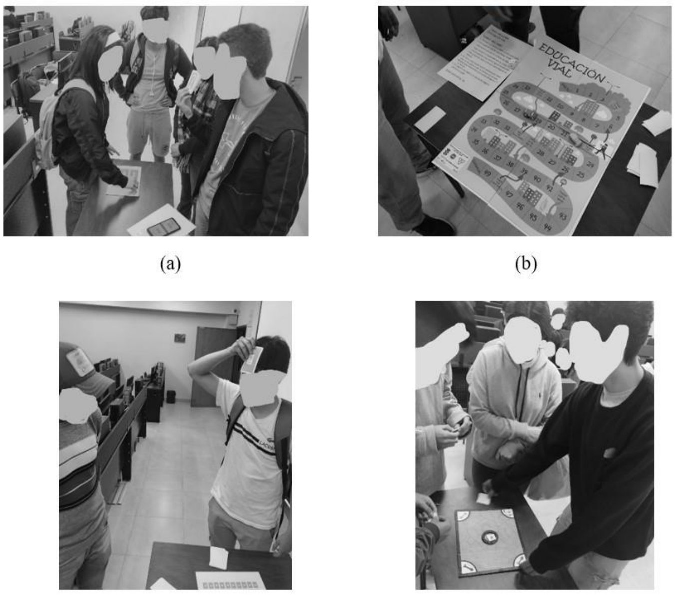
- *Board*: A flat surface where the game takes place. Developed in AutoCAD.
- *Pieces or Tokens*: Physical elements used by players. Developed with AutoCAD.
- *Cards*: Cards with specific information or actions. Developed in AutoCAD.
- *Game Rules*: Instructions on how to play. With the help of ChatGPT.
- *Assembly Instructions, Recommended Age, Theme or Story*: Additional details to enrich the game experience.

2.5. *Analysis of the Developed Games*

The results of the games were mixed, with some being very creative and others not as much. For example, one of the road safety games was designed for two players, including questions about traffic law and a clock that deducted time (Figure 01(a)), intended for children over 12 years old. Another road safety game, a path type, presented challenges such as recognizing traffic signs and was aimed at children aged 10 (Figure 01(b)). Additionally, there was a charades-type game (Heads Up Game) also focused on road safety, suitable for children over 8 years old (Figure 01(c)). Finally, a water conservation game involved contestants in a competition for squares on the board, intended for children over 12 years old (Figure 01(d)).

Figure 01.

Students exposing the developed board games.



(c) (d)

Source: Own elaboration (2024).

2.6. Data Collection and Processing

To evaluate the effect of the method used, two measurement instruments were employed: student learning and their perception or satisfaction.

Evaluation of Student Learning: Student learning was evaluated through final grades obtained. The analysis of grades consisted of comparing the statistical indicators of the experimental courses with those of the control group, determining whether they were superior, equal, or inferior. The grade analysis was conducted using Microsoft Excel and JASP software, applying the ANOVA test in particular to identify significant differences.

Evaluation of Perception or Satisfaction: To analyze student satisfaction with the methodology used, an anonymous and voluntary survey was conducted consisting of two questions:

- "Give a final rating to the Engineering Drawing course. Rate how you found the course from 01 to 10. (10 very good – 01 bad)."
- "Rate the project of making board games for students in rural schools with the help of AutoCAD software. Rate how you found this activity from 01 to 10. (10 very good - 01 bad)."

The responses provided by students to the questions were classified into ranges. Subsequently, statistical analyses were conducted to compare the results obtained with those of other authors, allowing for inference and conclusion regarding the effectiveness of the study methodology. This analysis helped identify significant differences and propose recommendations for future research based on a rigorous evaluation of the collected data.

3. Results

At the end of the academic term, final grades and satisfaction surveys were collected from both the experimental groups (A1, A2, A3) and the control group (B). The comparative results are presented below.

3.1 Final Grades

The final grades of the experimental groups (A1, A2, A3) were generally lower compared to those of the control group (B). These differences are evident in Table 1 and Figure 2, which detail the descriptive statistics of the grades for each group.

Table 1.

Grades of the experimental group students (A1, A2, A3) and control group (B)

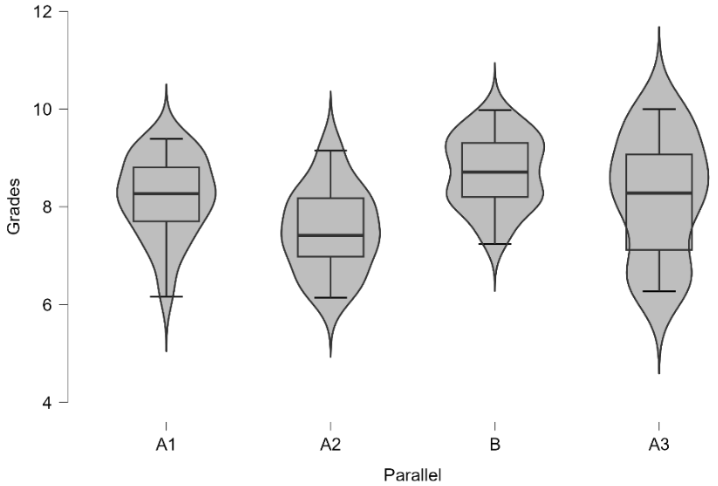
Descriptive statistics	A1	A2	A3	B
Valid (number)	31	24	29	36
Median	8,27	7,42	8,28	8,71
Mean	8,19	7,52	8,22	8,72
Std. Deviation	0,82	0,85	1,22	0,73
Coefficient of variation	0,10	0,11	0,15	0,08
Variance	0,68	0,72	1,49	0,53

Skewness	-0,60	0,20	-0,22	-0,17
Std. Error of Skewness	0,42	0,47	0,43	0,39
Kurtosis	-0,06	-0,63	-1,16	-0,91
Std. Error of Kurtosis	0,82	0,92	0,85	0,77
Shapiro-Wilk	0,96	0,97	0,93	0,97
P-value of Shapiro-Wilk	0,24	0,58	0,048	0,37
Minimum	6,16	6,14	6,27	7,24
Maximum	9,39	9,15	10,00	9,98

Source: Own elaboration (2024).

Figure 2.

Violin plot of the experimental group students (A1, A2, A3) and control group (B)



Source: Own elaboration (2024

According to the descriptive statistics, the control group (B) has a higher average grade compared to the experimental groups. However, to determine if these differences are statistically significant, a hypothesis test was conducted.

Analysis of Variance (ANOVA):

Given that we have three experimental groups and one control group, it is appropriate to compare their means using analysis of variance (ANOVA) or the Kruskal-Wallis test. The choice between these two tests depends on the fulfillment of certain assumptions inherent to each method. To decide which method is the most appropriate, the normality assumptions of the samples were first verified. In Table 1, the p-value of the Shapiro-Wilk test is a key indicator: values above 0,05 suggest that the samples follow a normal distribution. Except for group A3, all samples meet this criterion. Since group A3 does not follow a normal distribution, it was decided to exclude it from the comparative analysis of means. Next, the homogeneity of variances test was applied, obtaining a p-value of 0,681718 for the Bartlett test, which can be seen in Table 2. This figure indicates that with a 95% confidence level, there are no statistically significant differences between the standard deviations of the groups.

Table 2.

Equality of Variances (Variance Check)

	Test	P-value
Bartlett Test	1,00888	0,681718

Comparison	Sigma1	Sigma2	F-Ratio	P-Value
A1 / A2	0,824164	0,846877	0,94708	0,8769
A1 / B	0,824164	0,728319	1,28051	0,4791
A2 / B	0,846877	0,728319	1,35206	0,4118

Source: Own elaboration (2024).

Based on these preliminary findings, it is possible to proceed with the comparative analysis using ANOVA, as the basic assumptions for conducting this test are met, in table 3 a summary of the test:

Tabla 3.

ANOVA Table

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	20,55	2	10,275	16,31	0,0000
Within groups	55,4387	88	0,629985		
Total (Corr.)	75,9886	90			

Source: Own elaboration (2024).

The ANOVA table breaks down the variances into two essential components: between-group variance and within-group variance. The F-ratio value, which in this case is 16,31, is obtained from the quotient between the estimated variance between groups and the estimated variance within groups. Since the p-value associated with the F-test is less than 0,05, it can be concluded that there is a statistically significant difference between at least two of the means with a 95,0% confidence level. To identify which means specifically differ from each other, a post-hoc test was conducted using Tukey's Honest Significant Difference (HSD) test, the results of which are detailed in Table 4.

Table 4.

Results from the post-hoc test using Tukey's HSD Test

Contrast	Sig.	Difference	+/- Límits	Level	Count	Mean	Homogeneous Groups		
A1 - A2	*	0,672433	0,514494	A2	24	7,52208	X		
A1 - B	*	-0,521039	0,46365	A1	31	8,19452		X	
A2 - B	*	-1,19347	0,498659	B	36	8,71556			X

Source: Own elaboration (2024).

In Table 4, a multiple comparison is presented, allowing us to determine which means are significantly different from the others. The pairs accompanied by an asterisk indicate that the differences between those groups are statistically significant with a 95,0% confidence level; in this case, all means are different. On the other hand, in the same Table 4, the homogeneous groups column uses "X" marks to indicate similarity. If the "X" marks of different groups align, it means there are no statistically significant differences between those groups. However, in this case, the three groups showed statistical differences from each other. It is important to note that the Tukey HSD method used has a 5,0% risk of indicating that there are significant differences between one or more pairs when in fact there are none.

3.2 Student Perception

To evaluate the students' perception of the course and the methodology applied, two key questions were asked. The first question aimed to gauge the overall rating of the "Engineering Drawing" course by all students, both in the experimental and control groups. The second question, directed exclusively at the experimental group, sought feedback on the specific activity of creating board games using AutoCAD. The results of these surveys are presented below.
Regarding question 01 of perception: The survey described in the methodology had minimal participation since it was not mandatory to complete it. Table 5 summarizes the results for question 01 posed to the experimental group (A1, A2, A3) and the control group (B1) after the course was completed. Question 01: "Give a final rating to the Engineering Drawing course. Rate how you found the course from 01 to 10. (10 very good – 01 bad)."

Table 5.

Statistical measures of the assessment for question 01

Descriptive statistics	A1 (Q1)	A2 (Q1)	A3 (Q1)	B (Q1)
Valid (number)	10,00	11	10	12
Median	9,727	10,00	10,00	10,00
Mean	10,00	9,364	9,600	9,667
95% CI Mean Upper	9,451	9,910	10,03	9,945
95% CI Mean Lower	0,4671	8,817	9,167	9,388
Std. Deviation	9,000	0,9244	0,6992	0,4924
Minimum	10,00	7,000	8,000	9,000
Maximum	10,00	10,00	10,00	10,00

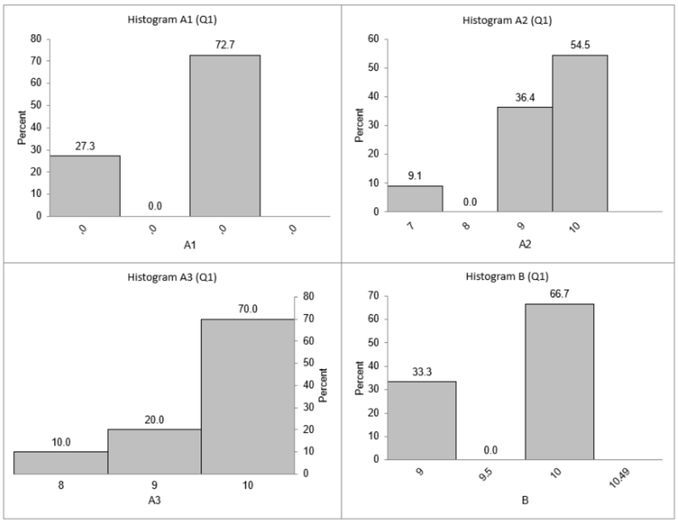
Source: Own elaboration (2024).

Based on the statistics, it can be observed that the students' perception of the "Engineering Drawing" course is crucial for evaluating not only the effectiveness of the content and pedagogy but also the level of student engagement and satisfaction. It is encouraging to observe that all groups, both experimental and control, gave high ratings with medians of 10,00. This uniformity in medians suggests that, in general, students found value and relevance in the course regardless of the teaching methodology employed. However, it is worth noting that this survey was not mandatory, so it may have some bias as it was not obtained randomly. It is also observed that group A2 has a slightly lower mean, which may be due to the class schedule, which will be analyzed later.

Based on the distribution of ratings in Figure 3, we can see how the ratings were distributed. In group A1, 72,7% of students give a rating higher than 10 points; in group A2, 90,9% of students rate the course with more than 9 points; in group A3, 90% of students give a rating of more than 9 points, and finally, in group B, 66,6% of students rate with more than 10 points, making the control group the one with the lowest percentage of students rating with the highest score. This suggests that despite the difficulties associated with the schedule, the project-based methodology may have had a positive impact on the overall perception of the students in this group.

Figure 3.

Histogram - Distribution of grades given by students for the subject Engineering Drawing.



Source: Own elaboration (2024)

Data for question 02 of perception: Question 02 was only posed to the experimental group since this group was subjected to the new teaching practice. Question 02 was: "Rate the project of making board games for students in rural schools with the help of AutoCAD software. Rate how you found this activity from 01 to 10. (10 very good - 01 bad)." The statistical values for question 02 are presented in Table 6.

Table 6.

Statistical measures of the assessment for question 02

Descriptive statistics	A1 (Q2)	A2 (Q2)	A3 (Q2)
Valid (number)	9,000	11	10
Median	8,455	10,00	9,000
Mean	1,809	9,182	8,700
95% CI Mean Upper	6,000	1,401	1,567
95% CI Mean Lower	4,000	4,000	5,000
Std. Deviation	10,00	6,000	5,000

Minimum	9,000	10,00	10,00
Maximum	8,455	11	10

Fuente: Own elaboration (2024).

The students in the experimental groups A1, A2, and A3 provided feedback on their experience in the board game project activity using AutoCAD. The satisfaction medians for groups A1 and A3 were 9,00, while group A2 recorded a median of 10,00, indicating a highly positive perception of the activity. The satisfaction means were 8,455; 9,182; and 8,700 for groups A1, A2, and A3, respectively, with group A2 showing the most favorable perception on average. However, the variability in responses, reflected in the standard deviations and ranges, suggests differences in the individual experiences of students within each group.

4. Discussion

This study focused on implementing an innovative teaching method, specifically Project-Based Learning (PBL), where students used AutoCAD software to create board games for children in rural areas. The goal of this methodology was not only to improve students' grades but also to foster skills such as creativity, critical thinking, problem-solving, collaboration, and communication. Additionally, by designing board games addressing topics like road safety and water conservation, the project aimed to promote a spirit of solidarity and social and community awareness among university students.

4.1 ABP Academic Performance and PBL Effectiveness

The results did not show an improvement in grades, as the ANOVA analysis concluded that the average grades of the experimental group were statistically lower than those of the control group. However, it is important to highlight that the lower average in the experimental groups could be due to the additional time students dedicated to the projects, which might have limited their ability to focus on other aspects of the course.

Despite this, the PBL methodology showed educational potential comparable to traditional techniques. Some previous studies have shown mixed results regarding the effectiveness of PBL. For example, Kizkapan & Bektas (2017) examined the effects of project-based learning and traditional learning methods on students' academic performance, and the results did not show significant differences between the experimental and control groups in post-test scores.

On the other hand, Zhang & Ma (2023) highlights that the effectiveness of PBL is influenced by moderating variables such as the region of the country, the subject area, the type of course, the academic period, the group size, the class size, and the experimental period. According to Zhang, PBL is more effective in Asia, especially Southeast Asia, than in Western Europe and North America. Additionally, PBL more significantly promotes students' learning effects in engineering and technology subjects and is better applied in laboratory classes than theoretical classes. For optimal results, PBL is more suitable for teaching in small groups of 4-5 people, and an experimental period of 9-18 weeks is more appropriate.

Although no improvements in grades were observed in our study, the positive perception of students towards PBL suggests that this methodology could have other educational benefits not directly reflected in numerical grades. These benefits include increased motivation, active participation in learning, and the development of practical and problem-solving skills.

4.2 Student Perception and Satisfaction

The response of the experimental group students in terms of perception and satisfaction was more positive than that of the group that received the course traditionally if we analyze the frequency of ratings given regarding perception. This finding is consistent with previous research, such as (Cleary (2020), suggesting that active learning methodologies can empower students and increase their participation in the educational process.

The implementation of PBL has been shown to significantly improve students' perceptions in various educational contexts. Thi Van Pham & Huu Tran (2021) found that PBL in technical courses not only improves students' perceptions but also enhances their critical thinking and problem-solving skills. Similarly, Pradanti & Muqtada (2023) showed that PBL positively impacts learning, motivation, and performance of university students.

In writing classes, PBL has been effective in improving students' perception of the subject and their writing skills (Fadhillah et al., 2023). Valentina M. & Inna O. (2023) also found that PBL positively impacts university students' perception of the subject and their satisfaction with the learning process.

PBL promotes the development of leadership and social skills, leading to cognitive, social, and self-empowerment development among students, according to Mullai (2017). In a different context, Sulong et al., (2023) demonstrated that PBL in a General Psychology class for undergraduate students had significant positive impacts on both learning achievement and student satisfaction.

In a study conducted on an international campus in Qatar, Abdalla et al. (2019) found that PBL significantly improved engineering students' perceptions, highlighting the importance of team dynamics in enhancing their satisfaction. Paľová & Vejačka (2022) also showed that implementing PBL in business informatics courses improved the effectiveness of the educational process by increasing learning and developing practical experiences.

The experimental group students particularly valued the practical relevance of the projects and the opportunity to apply their knowledge in real contexts. This not only improves their theoretical understanding but also their preparation for facing professional problems in the future, which is reflected in a more positive perception and satisfaction with the course.

4.3 Collaboration and Creativity

PBL proved effective in fostering collaboration and creativity among students. Creating board games allowed students to use their imagination and think innovatively, which is essential for developing creative skills in engineering. Creativity is an essential skill in today's world, and its promotion in education is increasingly recognized. McCrum (2017) examines creative problem-solving skills in structural engineers through interdisciplinary problem-based learning. The current research highlights how creating board games can be an effective strategy for fostering creativity in the specific context of teaching technical drawing. By creating board games, students have the opportunity to use their imagination and think innovatively to create products that serve schoolchildren in rural areas. This develops their ability to address problems creatively in other contexts.

4.4 Impact of Class Schedule on Performance

In our research, group A2, which took the course at a less optimal time, with classes at noon (Monday from 13:00 to 15:00) and very early in the morning (Wednesday from 7:00 to 10:00), showed a slightly lower mean perception and academic performance compared to the other groups. The expressions of dissatisfaction from the students in this group suggest that these schedules negatively affected their perception of the course and academic performance.

The literature supports our observations. Ray (2009) found that classes scheduled at noon and in the afternoon can negatively affect academic performance, especially when combined with non-attendance. Additionally, studies by Yeo et al. (2023, 2021) and Diette & Raghav (2017) demonstrated that very early morning classes are associated with lower attendance, fewer hours of sleep, and poorer academic performance. Wenze & Charles (2022) also showed that students in 8 a.m. classes reported lower GPAs and more sleepiness compared to those in later schedules. These studies agree that class schedules at noon and very early in the morning can significantly impact academic performance due to the effect on sleep, attendance, and concentration.

4.5 Social and Community Awareness

A crucial aspect of this project was its focus on social and community awareness. By designing board games for schoolchildren in rural areas, students not only developed technical skills but also a sense of social responsibility. This dimension of the project is consistent with the observations of Ali et al. (2021), who argues that universities should play an active role in training responsible and socially engaged citizens. This approach not only promotes more inclusive and effective education but also prepares students to be active and responsible citizens in society.

The literature widely supports the benefits of socially and community-focused projects in higher education. (Buckley et al., 2004) found that such projects not only increase student engagement but also foster philanthropy and target group participation. Chaves (2015) notes that social justice projects can increase interest in researching social problems and improve social and linguistic skills. (Perić, 2012) highlights that academic service-learning programs develop entrepreneurial behavior and social responsibility, enabling students to be more socially aware and active in their communities. Stone & Madigan (2011) observed that community projects help students develop essential soft skills and gain meaningful experiences through teamwork. Espinoza Hernández et al. (2023) and Morton (2011) point out that community projects increase student engagement and awareness of course and community issues, offering opportunities for citizenship. Goggins (2012) and Kagotho et al. (2017) emphasize that these initiatives strengthen university-community partnerships and enhance student learning and engagement through practical experiences. Aaslund & Woll (2021) highlight the positive learning outcomes and real-life impact on residents in participatory action learning projects.

These literature findings are consistent with the results of our study. Participation in creating board games for rural schools allowed students not only to apply their technical knowledge but also to develop a deep sense of social responsibility and community engagement. This practical and socially relevant learning approach has proven effective in preparing students to face real-world problems and become active and committed citizens, aligning with the observations of multiple studies highlighting the educational and community benefits of socially focused projects.

4. 6 Study Limitations

Despite the significant findings, some limitations should be considered. The PBL methodology, although enriching, may require significantly more time from students compared to more traditional methodologies, which could have influenced the grades obtained. Additionally, using software like AutoCAD requires a learning process that might not be accessible or intuitive for all students, and its effectiveness in learning can greatly depend on the instructor's quality and experience, as suggested by Safiee et al. (2019). Variations in class schedules, especially for group A2, could have impacted students' perception and performance.

4.7 Recommendations and Future Research

It is recommended to encourage role rotation within teams to develop diverse skills and present the games in rural schools to obtain direct feedback. Additionally, it is important to investigate how class schedules affect students' creativity and productivity. Finally, organizing workshops with professionals to delve into specific topics and enrich students' learning is suggested.

Through discussing the results obtained in this study, the transformative potential of combining innovative teaching with modern technological tools is demonstrated. Creating board games assisted by graphic software not only offers an innovative educational solution for university students but also highlights how technology can be used to create accessible and attractive educational resources for children in rural areas. This effort to combine the traditional play of board games with the power of graphic software not only opens the door to new pedagogical methods but also invites us to reflect on how we can continue to adapt and evolve in favor of more inclusive and effective education

5. Conclusions

This study has demonstrated the potential of combining technological tools like AutoCAD with innovative pedagogies to impact learning and social awareness. The creation of board games not only taught AutoCAD to university students but also instilled values and social awareness. Although the Project-Based Learning (PBL) methodology did not significantly improve grades, a more active learning environment and a positive perception from students were observed.

The students' response was notably positive, valuing the practical relevance of the projects and the opportunity to apply knowledge in real contexts. PBL fostered collaboration, creativity, and critical thinking, essential skills in today's world.

The project's focus on rural communities anticipates a positive impact on these communities and highlights the added value of instilling a deep social awareness in university students. This approach promotes more inclusive and effective education, preparing students to be responsible citizens.

Finally, the combination of AutoCAD and PBL in engineering education facilitates technical learning and promotes values of social responsibility and ecological awareness. This approach is highly beneficial for training competent and conscientious engineers in the 21st century. It is crucial that university education continues to adapt and evolve to integrate these approaches and train professionals committed to social change and civic responsibility.

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