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The impact of technological innovation and educational methodologies on academic performance in a Huancayo university

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***Abstract* – In this study, the impact of technological innovation and innovative educational methodologies on students' academic performance was evaluated over several semesters. A steady increase in the mean and mode of final grades was observed, indicating an overall improvement in academic performance. Swarm and violin plots highlighted changes in the density of grades, especially during the implementation of innovative methodologies. Statistical tests confirmed significant differences between semesters, supporting the main hypothesis. In summary, the integration of technology and innovative pedagogical approaches demonstrated a positive impact on student learning, supporting the continuity of these practices to enhance future educational programs. These results have important implications for designing effective pedagogical strategies that harness technological innovation to enrich the learning experience and enhance academic performance.**

***Keywords--* Academic innovation, pedagogical methodologies, academic performance, technology impact, educational assessment.**

I. Introduction

Higher education in Peru faces a challenging context, prompting the need to study and implement various issues within the sector, namely: adaptation to the educational system with diverse methodologies and technological innovation. This is of great relevance because they influence student learning and the creation of educational materials to achieve meaningful learning. Technological innovations are immersed in methodologies that complement and strengthen educational practices in university education. Universities have rapidly adapted to them in recent times due to the context they are facing. Therefore, the following question arises: Can technological innovation and methodologies in education lead to an improvement in learning?

In this context, Information and Communication Technologies (ICT) in higher education have introduced new teaching dynamics, adopting various technological tools that enhance the practice of the subject in which the student is participating. Currently, numerous universities have begun integrating technologies into their teaching methods, marking an evolutionary phase in the application of technology in education. Contemporary education not only aims at knowledge transmission but also at the autonomous training of individuals to adapt to changing demands. In this sense, ICT has become an essential element for both professional growth and education [1].

An important change has been the introduction of various educational modalities offered by universities, and this integration is thanks to technologies. Virtual learning has emerged as the most popular modality in recent years, driving the expansion of online education. This transformation has broadened educational scope in various fields, including science, technology, arts, and soft skills that contribute to individual and collective development [2].

The implementation of technological tools in universities has proven to be a fundamental aspect, as ICTs play a crucial role in the educational environment for both students and teachers. These technologies have contributed to the development of online education programs, offering flexibility to students, and facilitating access to course content. Various teaching methodologies have been implemented as a result, such as PBL (Problem-Based Learning), project-based learning, design thinking, game-based learning, flipped classroom, cooperative learning, and collaborative work. These methodologies foster communication between teachers and students by incorporating tools such as email, online chats, video conferences, and others, thus expanding access to education and improving learning management. Platforms like YouTube, online journals, virtual libraries, and websites have been proposed as tools to facilitate and manage access to knowledge [3].

In the context of research on educational innovation, statistics serve as a vital tool for assessing the impact of new technologies and methodologies on student learning. Statistical methods provide a quantitative framework that enables objective interpretation of the effects of tools such as ICT and flipped classrooms, which are central to enhancing educational outcomes. By summarizing, describing, and validating observed patterns in academic performance, statistical analysis supports the evidence-based integration of innovative practices in higher education. This rigorous approach strengthens the reliability of findings, contributing to the scientific foundation of research and encouraging further adoption of technology-driven educational strategies [4][5].

It is imperative to validate whether technological innovation and methodologies in education truly lead to an improvement in learning. Numerous studies support this claim, highlighting the transformative capacity of ICT in education.

A. ICT

Currently, the use of ICT has rapidly spread worldwide, especially among young people, who use them for the learning process [6]. ICT encompasses a set of elements, from video games and smartphones to telecommunications tools. These means facilitate learning by promoting interaction and knowledge exchange, in addition to adapting

to various situations and needs [7]. ICT plays a fundamental role in the field of learning and innovation to achieve sustainable growth [8]. ICT offers many possibilities to improve teaching and learning processes, providing access to information, promoting interaction, and facilitating the development of digital skills.

ICT, including MOOCs and their various forms, the use of LMS for e-learning, as well as tools such as video conferencing, blogs, wikis, social networks, and digital games, have a significant effect on student engagement [9]. Technological tools play a crucial role in transforming education. Their integration into educational institutions has a beneficial impact on facilitating knowledge acquisition [10].

B. Technological Innovation

Technological innovation has brought about significant changes among young university students, bringing them closer and initiating the exchange of experiences, both positive and negative [11]. Technological innovation in higher education is guided by three foundational elements: technological tools, educational resources, and student motivation.

Technological tools are integral to modern educational practices, allowing interactive and adaptive learning experiences. Tools such as Learning Management Systems (LMS) like Moodle and Canvas not only deliver content but also foster student engagement through various interactive components [12]. These platforms also integrate analytics for tracking student progress, which enables personalized feedback and enhances learning outcomes [13].

Educational resources have also evolved through technological innovation, expanding beyond traditional materials to include digital resources such as open educational resources (OERs), digital libraries, and multimedia content. These resources democratize access to information, making high-quality educational materials accessible to diverse student populations [14]. Furthermore, the shift to digital resources supports the development of digital literacy, which is increasingly recognized as an essential skill in modern education [15].

Student motivation is greatly influenced by the use of technology, which can engage students through gamified learning environments, virtual simulations, and real-time feedback systems. The intrinsic motivation of students can increase when educational tasks align with their interests, and technology enables this by adapting to diverse learning styles and preferences [12]. Moreover, studies show that virtual environments facilitate active learning and self-regulation, which are crucial for maintaining motivation in digital learning contexts [16].

Access to various technological tools, such as computers, laptops, tablets, or mobile phones, has become an integral part of the educational system in an era of rapid technological development and adoption [17].

Key technological tools for innovation in higher education:

1) Learning Management Systems (LMS): Platforms such as Moodle, Canvas, and Blackboard offer a virtual environment for various activities, including course management, delivery of educational materials, communication between students and teachers, and assessment.

2) Video Conferencing Tools: Platforms such as Zoom, Microsoft Teams, and Google Meet allow for virtual meetings, online classes, and conferences, facilitating interaction between teachers and students.

3) Online Collaboration Platforms: Google Docs, Microsoft Office 365, and Trello enable collaborative work between students and teachers for communication and idea exchange.

The implementation of technological tools has significantly transformed teaching in higher education, challenging educators to adapt to new pedagogical models that leverage technology for enhanced teaching effectiveness. The use of Learning Management Systems (LMS) such as Canvas and Blackboard has enabled more efficient course management by centralizing materials, assessments, and communications [18]. Video conferencing tools, such as Zoom and Microsoft Teams, have facilitated real-time interaction, helping educators and students overcome physical limitations and engage in synchronous learning [19]. Moreover, online collaboration platforms like Google Workspace have promoted active participation in knowledge creation and sharing among students and teachers, fostering a collaborative learning environment [20]. These tools have not only improved access to resources but also enabled a more interactive and supportive learning experience.

Technological innovation in higher education, represented by these tools, has not only facilitated access to information but has also transformed educational dynamics, promoting collaboration and interactivity. It is essential for teachers to adapt and receive training in the effective use of these tools to maximize their potential and improve the quality of education.

C. The Innovation of ICT in Education

The integration of Information and Communication Technology (ICT) in higher education offers various benefits, yet it also poses challenges that require careful consideration.

Teacher Training: Training educators is essential for effective ICT implementation, as it equips them with the skills to navigate digital tools and resources. Research indicates that professional development in ICT fosters teacher confidence and pedagogical adaptability, allowing them to incorporate technology in ways that enhance learning [21]. However, limited training resources and support can result in inconsistent adoption and usage across institutions, impacting educational quality [22].

Digital Educational Resources: ICT broadens access to resources like digital libraries, academic databases, and multimedia learning materials. These resources provide diverse, interactive content that can improve knowledge retention and accommodate various learning styles [23]. Despite their benefits, reliance on digital resources may exacerbate digital divides among students with differing levels of access to technology, creating inequities in learning experiences [24].

Collaborative Learning and Communication: ICT platforms facilitate collaborative learning, allowing students to engage in group activities and communication beyond

physical boundaries. Tools such as Google Workspace and Microsoft Teams enable real-time collaboration, which is shown to improve learning outcomes by fostering active engagement and peer learning [25]. Nonetheless, effective collaboration requires digital literacy, and students lacking these skills may struggle to benefit fully from collaborative ICT tools [26].

Assessment and Feedback: ICT enables immediate feedback, which is critical for learning reinforcement. Formative assessments through digital platforms allow students to identify areas for improvement and track their progress over time [27]. However, over-reliance on automated feedback systems may reduce opportunities for personalized feedback, which can be essential for addressing individual learning needs [28].

D. Flipped Classroom

The flipped classroom model represents an innovative pedagogical strategy that redefines the traditional teaching dynamic. In this approach, students acquire theoretical content outside the classroom, typically through multimedia resources, videos, or readings, allowing them to explore the material at their own pace. Class time is reserved for practical activities, discussions, and problem-solving, providing students with a more interactive and collaborative experience. The importance of the flipped classroom lies in its ability to foster more active and personalized learning, adapting to various learning styles [29]. By allowing students to engage in practical activities under the guidance of the instructor, a deeper understanding of concepts is promoted, and critical and analytical skills are developed. Ultimately, the flipped classroom seeks to maximize interaction time in class to drive more meaningful and student-centered learning.

E. Objectives of the Study

The primary objective of this study is to assess the impact of technological innovation and modern educational methodologies on the academic performance of students over multiple semesters in a university setting in Huancayo. The study aims to analyze how the integration of technology and innovative teaching approaches influences student learning outcomes and to identify any significant improvements in academic achievement.

The motivation behind this study stems from the growing importance of incorporating technology into education and the need to understand its effectiveness in improving student learning outcomes. Additionally, the desire to explore how innovative teaching methods can enhance academic performance in the context of a university in Huancayo serves as a driving force. This study seeks to address these gaps in knowledge and contribute valuable insights to educational practices.

F. Research Problem/Novel Contribution

The research problem addressed in this study revolves around the need to evaluate the effectiveness of technological innovation and modern teaching methodologies on student academic performance in a university setting. By exploring this problem, the study contributes to the existing body of knowledge by providing empirical evidence on the impact of these factors on student learning outcomes. Additionally, the findings offer a framework that can inform future studies in diverse educational contexts, broadening the understanding of how technology-driven educational practices can optimize learning experiences and adapt to the specific needs of various regions, including Huancayo.

II. METHODOLOGY

Throughout history, educational resources have evolved in line with technological advancements, and in recent decades, technological progress has provided a wide range of resources applicable to online educational environments [30]. Education progresses in parallel with human evolution, with constant adaptation being crucial to enable students to effectively train for their careers. Education should not only be a receiver of information but also empower students to apply that knowledge in practice. It is essential for education, as a cornerstone of national growth, to adopt advanced and effective learning methods.

The fundamental principles of universities, including the pursuit of truth, academic quality, research, tolerance, commitment to development, creativity, and innovation, are essential to their function [4][12]. In the Peruvian context, education has undergone transformations with the implementation of Information and Communication Technologies (ICT), such as Learning Management Systems (LMS), which offer virtual environments for course management, delivery of educational materials, and communication between students and teachers. Additionally, video conferencing tools, online collaboration platforms, and social networks are employed, facilitating interaction and knowledge exchange, crucial aspects in higher education as they provide flexibility, access to resources, and foster interaction and collaboration among students.

According to Nguyen [32], education must adapt to new contexts and technologies to maintain its relevance, aligning with the previous idea that higher education must constantly evolve to efficiently train students in their careers. Furthermore, White and Black [33] highlights that emerging technologies have the potential to transform education, in line with the previous notion that ICT can improve the quality of higher education by providing access to educational resources, promoting collaboration, and personalizing learning. Doe [34] points out that the use of ICT in education is increasing globally, which connects with the previous observation that the use of ICT in higher education has experienced significant growth in recent years, although there are also challenges for its effective use.

For the study, the flipped classroom methodology has been implemented in classes as a tool to apply new learnings to students. This has been carried out in a higher education institution with students of systems engineering during cycles 20-I, 20-II, 21-I, 21-II, 22-I, 22-II. This means that the tool for learning improvement has been implemented from the first semester of the year 2020 until the second semester of 2022. The purpose of this tool is for the student to learn through the development of cases, which is the practical part of the class topic, providing solutions demonstrating expertise in solving the proposed cases. The flipped classroom demonstrates that practical work allows students to develop the competencies established in the course.

To analyze the data, the final course averages have been used, comparing means using the total course averages as an indicator, which were compared to demonstrate the significant evolution of learning. These data are discrete due to being established within a range since they are grades from 0 to 20. The population consists of 350 students in the systems engineering program, and the sample consists of 36 students enrolled during the study period when the improvement tool was implemented. Due to the characteristics of the data, they do not follow a normal distribution.

The data were obtained by evaluating, in each class, through a quantifiable instrument, which are rubrics to determine the level of student knowledge regarding the topics covered during the classes. To validate this research, the Kruskal-Wallis test was used as a fundamental statistical tool to assess possible variations among multiple independent groups in relation to the variable of interest. The Kruskal-Wallis test was meticulously chosen due to its ability to analyze non-parametric samples, that is, data sets that do not meet the normality assumptions required by traditional parametric tests [29][35]. This method is particularly relevant in research contexts where the nature of the data does not allow valid inferences to be made using parametric methods. The choice of the test is based on its robustness against non-normal distributions and its applicability to identify potential statistically significant differences among multiple groups, thus allowing a comprehensive and reliable evaluation of the variables analyzed in the present study.

The process of integrating student evaluation records, which demonstrate the level of achievement attained through the teaching-learning process, involved running SQL queries to select the data as presented in Fig. 1, which were then exported to a text format. The information collected was categorized by semester and course evaluated to develop a summary based on a descriptive analysis. Because the data did not meet the assumptions of normality, the Kruskal-Wallis statistical test was developed to evaluate the equality of population medians.

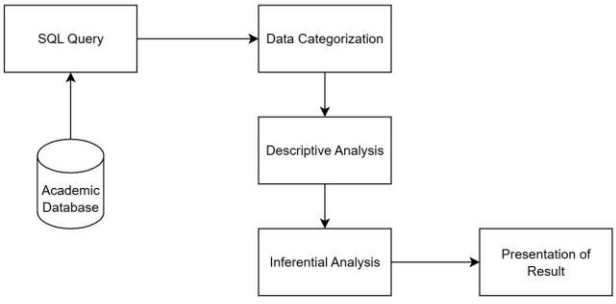

Fig. 1 Data Integration for Statistical Processing.
Note: Data integration organizes activities aimed at processing information recorded in academic databases using statistical techniques.

III. Results

Table 1 presents data collected over several semesters that allow us to identify significant trends that reflect the impact of pedagogical strategies and the use of technological tools on academic results. By observing the key statistical measures, it can be seen how changes in educational methodologies contribute to improving student performance, marking a positive evolution in their grades and in their learning process.

TABLE I
Descriptive Summary

Statistical measures	Semester					
	2022 II	2022 I	2021 II	2021 I	2020 II	2020 I
Mean	16.48	15.00	14.55	12.64	11.06	10.62
Mode	17.00	16.00	14.00	10.00	9.00	8.00
Minimum	14.00	13.00	12.00	10.00	9.00	8.00
Q1	15.00	14.00	13.75	12.00	9.50	8.00
Median	17.00	15.00	14.00	12.00	11.00	11.00
Q3	17.00	16.00	16.00	15.00	12.00	12.00
Maximum	19.00	17.00	17.00	16.00	14.00	14.00

The data show an ascending behavior in the academic performance of students throughout the semesters evaluated, highlighting significant improvements in the main statistical measures. The arithmetic mean reflects a continuous increase from 10.62 in semester 2020 I to 16.48 in 2022 II, which evidences an increase in grade point averages and suggests a positive impact on the educational strategies employed, such as the use of technological tools. Consistently, the mode also presents increasing values, starting at 8.00 in 2020 I and reaching 17.00 in 2022 II, indicating a higher frequency of higher grades. Measures of central tendency, such as median and quartiles, confirm this pattern, with the median increasing from 11.00 to 17.00 and the third quartile (Q3) increasing from 12.00 to 17.00. Likewise, the maximum and minimum values adjust upward, consolidating the trend of generalized improvement in students' academic performance.

On the other hand, Fig. 2 provides a detailed visual analysis of the evolution of the final averages obtained by the students in each semester evaluated, highlighting a clear upward trend in the values as the integration of computer tools in the learning process increases. This behavior suggests that educational technologies not only enhance access to didactic resources, but also favor a more dynamic and efficient learning environment, facilitating the understanding of complex contents and the development of key competencies.

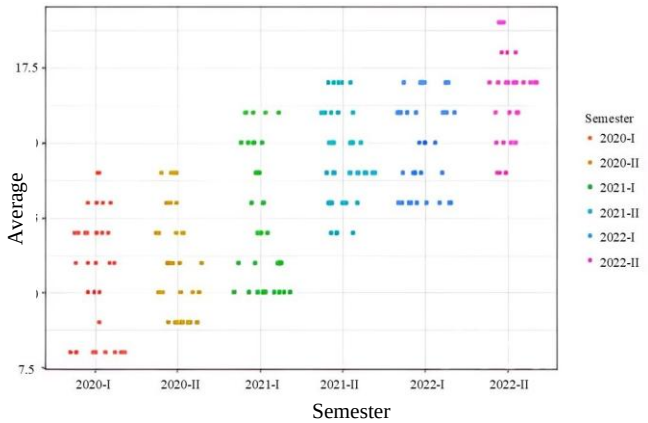

Fig. 2: Swarm plot of evaluation
Note: The graph depicts the dispersion of grades achieved by students in each evaluated semester.

In the Fig. 3, through the violin graph, provides a detailed analysis of the distribution and density of the

averages achieved by students in different semesters, allowing us to identify key patterns in academic performance. During the 2020-I semester, a higher concentration of grades is observed around the score of 11, which coincides with the median of the values. Although the median remains constant in semester 2020-II, there is evidence of an increase in the minimum values and a more pronounced concentration of averages close to 11, with a general upward trend. This subtle change in the distribution can be attributed to the incorporation of technological tools in the teaching process. This initial period was marked by a learning and adaptation process for both students and teachers, which influenced the variability of the results. Despite this, the data suggest that technology is beginning to have a positive impact on academic performance, paving the way for more significant improvements in subsequent semesters.

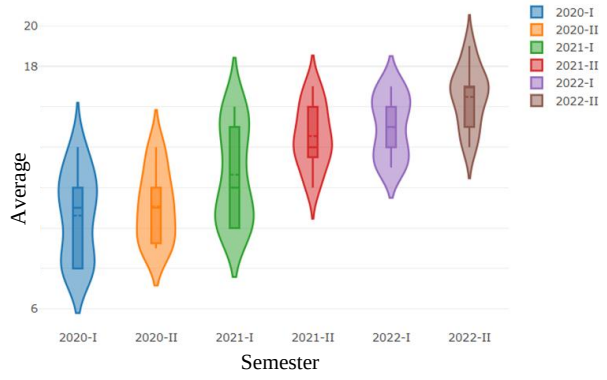

Fig. 3: Violin plot of final averages per semester
Note: The graph depicts the dispersion of grades achieved by students in each evaluated semester.

The 2021-II and 2022-I semesters present very similar values under a discrete statistical appreciation. However, it is observed that during the 2022-I semester, there is a higher density of grades of 16, while in the 2021-II semester, the highest density is observed in the grade of 14. This change was due to an increased interaction with teaching methods such as flipped classroom, problem-based learning, and case study development, which allowed students to engage in teamwork and collaborative work, resulting in a higher density of the grade 17 during the 2022-II semester, indicating better achievement of the competencies and goals established in the course.

Due to the lack of normality and homogeneity of variances assumptions in the datasets, the equality of the medians of the final averages for each semester was evaluated through the Kruskal-Wallis statistical test. The result of this statistical test yielded a p-value of 2.2 e16, which ensures that at least one of the medians is different. Given this result, the Dunn test was applied to determine which data groups are different. The result of the statistical test indicated that under a significance level of 5%, there is equality between the datasets corresponding to the semesters (2020-I, 2020-II) and the semesters (2021-II, 2022-I), thus indicating a significant difference between the remaining semesters.

IV. Results

A. In-depth Interpretation of Results in the Context of Educational Innovation

The findings of this study underscore the transformative impact of technological innovation and modern pedagogical methodologies on student academic performance. The study's analysis reveals that using methodologies like flipped classrooms and problem-based learning (PBL) in conjunction with technological tools significantly enhances students' engagement and learning outcomes over time. These findings contribute meaningfully to our understanding of how innovation in educational approaches influences the learning environment, echoing current trends in education research.

In particular, the flipped classroom model allows students to prepare theoretical content before class, freeing class time for active learning activities. This approach optimizes teacher-student interactions, promoting higher cognitive engagement and retention of material [36]. According to Al-Atabi [37], flipped classrooms offer students a greater sense of autonomy and responsibility over their learning, which aligns with self-determination theory. The current study's findings confirm that students achieve higher academic performance when this methodology is implemented, with statistical analyses (Kruskal-Wallis and Dunn tests) showing significant performance increases across semesters. These improvements suggest that flipped classrooms can enhance students' ability to assimilate and apply knowledge—a conclusion supported by Bond et al. [38], who found similar increases in engagement and retention in flipped classroom environments.

Furthermore, the implementation of problem-based learning (PBL) encourages critical thinking and collaborative skills, which are essential in both academic and professional settings. PBL activities require students to work together on complex, real-world problems, which in turn fosters deeper understanding and application of knowledge. Hmelo-Silver et al. [39] suggest that PBL promotes metacognitive skills as students actively engage in problem-solving and reflection. In this study, students exposed to PBL showed marked improvements in collaborative and cognitive skills, supporting the premise that PBL not only enhances knowledge acquisition but also strengthens students' ability to work in teams. The findings are consistent with those of Borrego et al. [40], who observed similar enhancements in engineering students who participated in PBL activities.

Moreover, the study highlights the role of student motivation as a mediating factor in the success of innovative methodologies. Motivation is crucial for academic achievement, as it drives students to engage with the content actively and persevere through challenges. In the context of technology-mediated learning, research by Ryan and Deci [41] emphasizes that students who feel autonomous and competent are more likely to show sustained engagement. This study's results align with this theory, demonstrating that students tend to perform better when engaging with interactive, technology-enhanced methodologies that foster a sense of ownership over their learning process.

B. Implications for Educational Practice and Policy

The study's findings carry substantial implications for the design of curriculum and educational policies. By demonstrating the positive effects of flipped classrooms and PBL on academic performance, this study provides evidence that can guide educational institutions toward the adoption of more active, student-centered learning methodologies. Specifically, the study supports the notion that integrating technology in a way that actively involves students in their learning can have a lasting impact on their academic success.

In terms of curriculum design, these results suggest that institutions of higher education should consider systematically incorporating flipped classrooms and PBL into their courses. The benefits of these approaches, as shown by the improved performance and engagement of students, underscore the importance of designing curriculums that move beyond traditional lecture-based models. Alqahtani and Rajkhan [18] argue that the transition to such models requires not only changes in teaching methods but also in assessment practices, as students in active learning environments benefit from formative, continuous assessments that capture their learning progress over time.

From a policy perspective, the adoption of innovative methodologies like flipped classrooms and PBL requires investments in both technology infrastructure and faculty training. Recent studies, such as those by Tondeur et al. [22], emphasize that effective integration of technology in education depends on teachers' comfort and proficiency with these tools. Therefore, educational institutions must prioritize professional development initiatives that equip faculty with the skills necessary to implement and sustain these methodologies. Additionally, policymakers should support initiatives that fund digital resources and learning platforms to make these innovations more accessible to a broader range of students.

The context-specific findings of this study, which was conducted in Huancayo, Peru, also have implications for other regions with similar educational landscapes. In many parts of Latin America, challenges related to access to technology and internet connectivity can limit the effectiveness of technology-based innovations [19]. This study provides insights into how active learning models like flipped classrooms and PBL can be adapted to local contexts, suggesting that even in areas with limited resources, these methodologies can still yield positive outcomes when adapted appropriately. For example, low-cost, easily accessible digital resources can be incorporated, allowing students to engage with content at their own pace and interact with peers in collaborative environments.

C. Comparative Analysis with Existing Literature

The results of this study align with, but also extend, current literature on educational innovation and the efficacy of technology in teaching and learning. While numerous studies have validated the benefits of flipped classrooms and PBL, this study provides unique insights by highlighting these methodologies' specific impacts on student performance over multiple semesters, with statistical rigor confirming the significance of the observed differences.

Alignment with Active Learning Theories: The findings resonate strongly with theories of active learning and self-determination. Self-determination theory [41] posits that students are more likely to engage deeply with content when they feel autonomous and competent. In this study, students reported feeling more in control of their learning process when engaging with flipped classrooms and PBL activities. This aligns with Al-Atabi's [37] findings that flipped classrooms enhance student autonomy, thereby fostering intrinsic motivation.

Differences in Learning Environments: Unlike conventional learning models, which often place students in passive roles, the methodologies explored here position students as active participants. A meta-analysis by Bond et al. [38] corroborates this view, showing that technology-enhanced learning environments like flipped classrooms can significantly increase students' engagement and satisfaction. However, Bond et al. [38] also emphasize that these benefits depend on the thoughtful integration of technology, as poorly implemented technology can lead to disengagement. This study supports Bond's assertion, as students in Huancayo experienced meaningful gains in performance and engagement when technology was carefully integrated into their learning environment.

Motivational Factors in Technology Integration: Another key aspect that distinguishes this study is its focus on the motivational role of technology in student success. The motivational impact of active learning approaches like flipped classrooms has been discussed by Chen et al. [36], who found that students who feel empowered to control their learning environment are more likely to engage with the content. Our study contributes to this body of knowledge by showing that technology, when used to support autonomy and engagement, can significantly boost academic performance. Ryan and Deci's [41] work on intrinsic motivation also supports this idea, suggesting that students' sense of competence and autonomy in technology-mediated environments can have a lasting impact on their academic success.

Contextual Comparisons with Latin American Educational Settings: Martin et al. [19] discuss challenges related to the implementation of technology in Latin America, particularly issues related to infrastructure and access. In comparing their findings with this study, we observe that while technology access remains a limitation in some regions, institutions that strategically implement active learning models—such as Huancayo's university—can still benefit substantially from innovation. This study underscores the importance of contextually adapted strategies for technology integration, suggesting that even in resource-limited settings, flipped classrooms and PBL can be effectively implemented with the right support structures.

Empirical Support for PBL and Skill Development: PBL's impact on skill development, as observed in this study, aligns with research by Borrego et al. [40], who found that engineering students gained practical skills through PBL that improved their problem-solving capabilities. Similarly, our study's results indicate that PBL helps students develop cognitive and collaborative skills, confirming its effectiveness in fostering competencies that are critical in the professional world. This outcome highlights that PBL is not only beneficial for theoretical

knowledge but also plays an essential role in preparing students for real-world challenges.

Potential for Scaling Technology-Enhanced Learning: Lastly, the study's findings suggest that technology-enhanced learning can be scaled in diverse educational settings. However, as Selwyn [24] points out, the scalability of educational technology depends on institutional commitment and sufficient funding for infrastructure. This study supports Selwyn's findings, showing that while technological innovation in education is beneficial, scaling it effectively requires addressing logistical and economic barriers. This research thus emphasizes the role of policy support in facilitating the broader adoption of these methodologies

V. Conclusion

The present study analysed the impact of technological innovation and the implementation of new educational methodologies on students' academic performance over several semesters. The results obtained provide a detailed insight into the evolution of final averages and the density of grades, supporting the assertion that the introduction of technology and innovative pedagogical methods can lead to significant improvements in learning.

The arithmetic means of the final averages exhibited a positive trend over the studied semesters, suggesting a favourable impact of technological innovation on academic performance. The presence of ascending values in the mode reinforces the idea that the use of technological tools is correlated with more successful academic outcomes.

The subtle variation in the density of grades during the 2020-I semester indicates a period of learning and adaptation for students to new technologies, highlighting the importance of facilitating the transition. Figure 3 revealed notable changes in the distribution of grades, especially with the introduction of new methodologies such as flipped classroom, problem-based learning, and case study development.

The application of statistical tests, such as Kruskal-Wallis and Dunn's test, supports the presence of significant differences between the semesters, validating the hypothesis that at least one of the medians is different. The equality between the datasets corresponding to the semesters (2020-I, 2020-II) and the semesters (2021-II, 2022-I) indicates a significant difference compared to the rest of the evaluated semesters.

Based on the results obtained, it is suggested to continue and expand the implementation of innovative technologies and methodologies in teaching. Specific adjustments in pedagogical strategies are recommended to further optimize students' academic performance. Overall, this study supports the notion that technological innovation and new methodologies in education lead to significant improvement in learning. These conclusions provide a solid foundation for decision-making in the design of future educational programs and highlight the ongoing importance of effectively integrating technology into teaching and learning processes.

VI. Limitations and Study Forward

It is important to emphasize that, although the study provides significant data on the impact of innovative methodologies in a specific university context, it also presents certain margins for methodological improvement that open opportunities for future research. The analysis was developed from the comparison of academic results obtained during several consecutive semesters, in which technological resources and active pedagogical strategies were progressively implemented. This longitudinal perspective offers valuable insight into the process of educational transformation in real contexts. However, since there was no control group, the findings should be interpreted as part of an institutional monitoring process, rather than as a comparative evaluation between differentiated interventions. Future research could complement these results by incorporating parallel groups or experimental designs that allow contrasting different pedagogical conditions within similar populations. It is also recognized that academic achievement may be influenced by multiple contextual or personal factors not explored in this study, such as individual access to resources, student motivation, or teacher dynamics. Considering these variables would enrich the overall understanding of the phenomenon studied. On the other hand, by focusing on quantitative data, the study does not collect qualitative information related to student perception or experience. Future research could integrate mixed approaches, including interviews or focus groups, to capture a more comprehensive view of technology-mediated learning processes. Finally, extending this type of analysis to other institutions or academic contexts will allow us to identify common or differentiated patterns in the implementation of innovative methodologies, thus strengthening the evidence available for the design of more effective pedagogical policies and strategies.

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