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# PLATAFORMAS TECNOLÓGICAS EN LA ENSEÑANZA DE BASES DE DATOS RELACIONALES: DISEÑO APLICADO EN ESCENARIOS REALES




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**Abstract—**This study analyzes the influence of a technological platform on the learning of relational databases and the development of technical skills among Computer Engineering students at the Instituto Tecnológico Superior de Zacapoaxtla (ITSZ). The research arises from the need to strengthen database instruction through strategies that promote students' active participation, motivation, and academic engagement, linking theoretical content to real-world situations. The methodology employed follows a mixed-methods paradigm applied to a sample of 30 students enrolled in the "Fundamentals of Databases" course. Data collection involved a diagnostic test and a final exam evaluated using a rubric, a 24-item Likert-scale questionnaire (Cronbach's alpha, $\alpha = 0.7069$), and semi-structured interviews. Quantitative analysis was performed using descriptive statistics and the McNemar test to assess the change in the pass rate, while qualitative data were processed using thematic coding in ATLAS.ti. The results demonstrated a statistically significant change in students' academic performance (McNemar's test, $\chi^2 = 5.14$, $p < 0.10$, exceeding the critical value of 2.7055), accompanied by a substantial increase in motivation (90%), active participation (90%), academic engagement (86.6%), and the development of applied technical skills (90%). It is concluded that the integration of the technological platform with contextualized projects fostered learning and the development of technical and professional competencies.

**Keywords**—Learning, professional competence, computer science, technology.

**Abstract--** This study analyzes the influence of a technological platform on the learning of relational databases and the development of technical competencies among Computer Engineering students at the Instituto Tecnológico Superior de Zacapoaxtla (ITSZ). The research stems from the need to strengthen the teaching of databases through strategies that foster students' active participation, motivation, and academic engagement by linking theoretical content with real-world situations. The methodology employed follows a mixed-methods approach applied to a sample of 30 students enrolled in the Database Fundamentals course.

Data collection involved a diagnostic test and a final test, both evaluated using a rubric; a 24-item Likert-type questionnaire (Cronbach's alpha, $\alpha = 0.7069$); and semi-structured interviews. Quantitative analysis was conducted using descriptive statistics and McNemar's test to evaluate the change in the pass rate, while qualitative data were processed using thematic coding in ATLAS.ti.

The results demonstrated a statistically significant change in students' academic performance (McNemar's test, $\chi^2 = 5.14$, $p < 0.10$, exceeding the critical value of 2.7055), accompanied by a substantial increase in motivation (90%), active participation (90%), academic engagement (86.6%), and the development of applied technical competencies (90%). It is concluded that the integration of the technological platform with contextualized projects fostered learning and the development of technical and professional competencies.

**Keywords**: computer science, learning, professional competence, technology.

## INTRODUCTION

This research focuses on analyzing the use of the Redgate Data Modeler technology platform—an online data modeling tool that helps teams collaboratively design, visualize, and manage databases (Redgate, 2025)—as a support strategy for teaching and learning relational databases among computer science students. Teaching this subject matter requires students not only to understand theoretical concepts but also to develop skills in designing, modeling, and managing databases and applying structured queries using SQL in practical situations.

As background to this problem, various studies have analyzed strategies and tools aimed at improving database instruction. De la Rosa et al. (2022) developed a web application for database learning that incorporated SQL content, self-assessments, exams, and entity-relationship diagram simulations, receiving favorable feedback from students, instructors, and experts. For their part, Elalouf et al. (2022) analyzed the teaching of SQL in both face-to-face and online settings, highlighting the importance of consistent practice and instructor guidance. Likewise, Barra et al. (2024) addressed innovative strategies aimed at fostering motivation and academic engagement. Martínez et al. (2025) studied active database learning geared toward developing competencies in Computer Engineering and found improvements in technical skills, collaborative work, and student engagement. Taken together, this literature highlights the importance of moving beyond an approach focused exclusively on theory and instead promoting practical, active experiences linked to real-world situations.

Currently, universities face the challenge of incorporating technological tools that promote not only the acquisition of technical knowledge but also the development of professional competencies. In particular, database instruction represents a complex area within computer science education, due to the need to understand abstract concepts, perform modeling processes, and apply structured queries using SQL in practical scenarios. In this context, technological platforms offer a supportive alternative to foster more active, collaborative, and practice-oriented teaching and learning processes.

The research problem arises from the difficulties students face in relating theoretical content to real-world applications, as well as from the need to strengthen their active participation, motivation, and academic engagement through the use of technological platforms. Although traditional methodologies continue to be used, several recent studies indicate that active learning and the use of technological platforms can foster a more meaningful understanding. In this regard, the research aims to analyze how a technology platform can contribute to strengthening technical competencies related to the design and administration of relational databases.

In this regard, the overall objective of the research is to implement a technology platform for teaching relational databases in real-world contexts, with the aim of enhancing the development of technical skills, academic achievement, and student engagement, as well as analyzing its impact on the teaching and learning process. To achieve this purpose, the specific objectives are to assess the level of integration of a technological platform in the teaching of relational databases; to design and implement a teaching strategy that links theory with practice through contextualized projects; to evaluate its effect on the development of technical skills, active participation, and academic engagement; to analyze its influence on the acquisition of professional competencies related to database design and management; and to identify the advantages, limitations, and conditions that favor its integration.

**Rationale**

This research is justified by the need to strengthen the teaching of relational databases through strategies that link theoretical knowledge to its application in contextualized situations and projects. In university-level computer science education, learning about databases requires students to develop not only

conceptual knowledge but also practical skills that they can apply in situations related to their future professional performance.

According to Rico (2018), the teaching of relational databases is a fundamental pillar in the training of future computer science professionals, since information management and proper structuring are highly sought-after skills in the workplace. However, a gap persists between the theory taught in the classroom and its practical application in real-world contexts, which limits students' ability to transfer the knowledge they have acquired to authentic problem-solving situations.

Given this situation, the implementation of a technological platform emerges as an effective alternative for transforming teaching–learning processes, promoting not only theoretical understanding but also the development of applied skills, motivation, and student engagement; this approach addresses the need to bridge the gap between theoretical knowledge and its practical application—an aspect identified as part of the research problem.

The research is also relevant because it seeks to provide insights that allow for an assessment of the influence of a technological platform not only on database learning but also on aspects related to students' active participation and academic engagement. In accordance with the study's methodological approach, the combination of quantitative and qualitative data allows for an analysis of both the observable results of the implementation and the students' perceptions and experiences during the educational process.

The primary beneficiaries are the students, who can acquire more solid and applicable skills in their professional field, as well as the instructors, who gain innovative methodological strategies to invigorate their teaching practice. At the institutional level, the research helps strengthen ties with society by addressing the needs of various sectors. Society also benefits by having graduates who are better prepared to meet the technological demands of a constantly changing workforce.

Finally, the study aims to contribute to strengthening teaching strategies for relational databases through the integration of technology, practical activities, and context-based projects.

## METHODOLOGY

The research conducted employed a mixed-methods approach; the choice of this paradigm was justified by the nature of the research problem, which required analyzing both the

of the implementation of a technological platform and the experiences of the students while using it. This approach made it possible to evaluate the platform's effect on the development of technical skills, the application of theoretical knowledge in real-world contexts, active participation, and academic engagement, as well as to understand the students' perceptions and experiences during the learning process.

The study was conducted at the Instituto Tecnológico Superior de Zacapoaxtla in the city of Zacapoaxtla, Puebla. The instruments were administered to 30 students enrolled in the "Fundamentals of Databases" course, who provided the information necessary for the study; their ages ranged from 18 to 20 years.

The students participated in various academic activities supported by a data modeling technology platform. During the process, quantitative and qualitative data were collected using different instruments: a diagnostic test, a Likert-scale questionnaire, a semi-structured interview, and a final exam.

Data collection was conducted using Google Forms, which facilitated access to, organization of, and storage of the information. Responses were automatically saved on the Google platform, facilitating their subsequent download and organization for data analysis. The instruments consisted of items with open-ended, closed-ended, and Likert-scale responses, designed to gather information on the use of the technology platform, participation, interaction, collaboration, skill development, and academic engagement. All instruments were administered in person in the computer lab; each student had a computer available with internet access and access to the Google Forms during the scheduled time for the "Database Fundamentals" course. During the administration, the instructor was present to provide general guidance and answer questions related to accessing the forms, without interfering with the participants' responses.

**Administration of the Assessment Tools**

The process began with the diagnostic test, consisting of five practical exercises evaluated using a rubric on a scale from 1 (poor) to 5 (excellent). The purpose of this test was to identify students' prior knowledge and skills regarding the management of relational databases, particularly in areas such as table design, the use of primary and foreign keys, and the formulation of basic queries. The estimated duration of this test was 60 minutes.

The diagnostic test and the final test were structured with exercises similar in terms of organization and level of difficulty, allowing for a comparison of the results obtained before and after the intervention.

Subsequently, a Likert-scale questionnaire was administered, consisting of 24 items and completed individually in approximately 30 minutes. The scale consisted of five response levels: strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. The instrument provided quantitative information regarding motivation, participation, collaboration, interest in the content, and academic engagement.

In the third phase, a semi-structured interview was conducted to gather qualitative information regarding students' participation, interaction, and collaboration while using the technology platform. The interview was conducted individually and lasted approximately 15 minutes. The instrument allowed for a deeper exploration of the participants' experiences and perceptions regarding the learning process.

Finally, the final exam was administered, consisting of five practical exercises and lasting 60 minutes. The exercises were evaluated using the same rubric scale as in the diagnostic test, ranging from 1 (poor) to 5 (excellent). This evaluation made it possible to identify the progress achieved following the implementation of the technology platform. Comparing the two evaluations allowed us to determine the changes observed in the students' learning.

**Analysis**

In the quantitative approach, the data obtained through the Likert-scale questionnaire and the diagnostic and final tests were coded and organized into data matrices to facilitate their processing. The quantitative analysis was conducted using descriptive statistics, such as mean, median, and mode, to identify general trends and describe the behavior of the variables studied.

The questionnaire allowed for the analysis of variables related to motivation, active participation, academic engagement, perceptions regarding the use of the platform, and the development of technical skills. The information obtained made it possible to draw comparisons and describe the trends observed in the students' responses.

SPSS was used to process the quantitative data; this IBM software provides advanced statistical analysis, a comprehensive library of machine learning algorithms, text analysis capabilities

text analysis, open-source extensibility, integration with big data, and seamless deployment in applications (IBM, 2026). Meanwhile, ATLAS.ti was used to analyze the interviews and open-ended responses; this qualitative research tool can be used to code and analyze transcripts and field notes, conduct literature reviews, create network diagrams, and visualize data. It is a qualitative data analysis platform that allows for the analysis of content such as text, graphics, audio, and video files (Software-Shop, 2026).

From a qualitative perspective, the responses obtained through the semi-structured interviews were reviewed and organized into categories related to perceptions of the platform's use, its influence on participation and interaction, activities that fostered learning, the application of knowledge to real-world projects, the development of technical skills, and academic engagement.

The analysis identified recurring patterns and themes in the experiences expressed by the students. Among the findings were favorable perceptions of the platform, references to an increased ease in understanding the content, the application of knowledge to real-world projects, improved database design skills, and greater participation during activities.

**Reliability of the instrument**

To determine the reliability of the questionnaire, Cronbach's alpha was applied, one of the most commonly used statistical measures for evaluating the internal consistency of the items that make up a measurement instrument (Roco, 2024). The result obtained was $\alpha = 0.7069$ for the 24 items in the questionnaire. This value indicates an acceptable level of reliability and demonstrates adequate internal consistency among the items used to measure variables related to the implementation of the technology platform, learning, participation, and academic engagement. **McNemar's Test**

To determine whether there was a significant change in the results obtained before and after the intervention, the McNemar test was applied; this test is used to determine differences between groups with dichotomous response variables and is suitable for small samples (Lorenzo, 2025). The scores recorded on the diagnostic and final assessments were used in this test. Considering a 90% confidence level and one degree of freedom, the data yielded a calculated value of $\chi^2 = 5.14$, which is greater than the critical value $\chi^2\_(\text{critical}) = 2.7055$. Since the calculated value is greater than the critical value, Figure 1 shows that there is a statistically significant change in the results after the intervention, as well as an improvement, since the number of students who went from failing to

pass is greater than the number of students who showed the opposite change. This provides quantitative evidence of an improvement in student performance following the implementation of the technology platform.

| | | despues | |
|---|---|---|---|
| | | no aprobado | aprobado |
| antes | aprobado | 1 | 18 |
| | no aprobado | 5 | 6 |

$$X^2 = \Sigma \frac{(A-D-1)^2}{A+D}$$

| | |
|---|---|
| Chi crítico | 2.7055 |
| x2= | 5.142857143 |

| | |
|---|---|
| renglones | 2 |
| columnas | 2 |
| grados de libertad | 1 |
| Nivel de confianza | 90 % |

**Figure 1.** *McNemar's test***.**

**Source**: Author's *own work* (2026).

## ANALYSIS OF RESULTS

The questionnaire results show a predominantly favorable perception of the implementation of the technology platform. Regarding motivation to learn relational databases, 50% of the students scored at the highest level on the scale and 40% at the next-highest level, representing 90% favorable responses, as shown in Table 1 and Figure 2.

**Table 1**. *Motivation to learn relational databases with Vertabelo.*

| | | Frequency | Percentage | Valid Percentage | Cumulative Cumulative |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 6.7 | 6.7 | 6.7 |
| | 3 | 1 | 3.3 | 3.3 | 10.0 |
| | 4 | 12 | 40.0 | 40.0 | 50.0 |

| | | | | |
|---|---|---|---|---|
| 5 | 15 | 50.0 | 50.0 | 100.0 |
| Total | 30 | 100.0 | 100.0 | |

**Source**: Author's *own work* (2026).

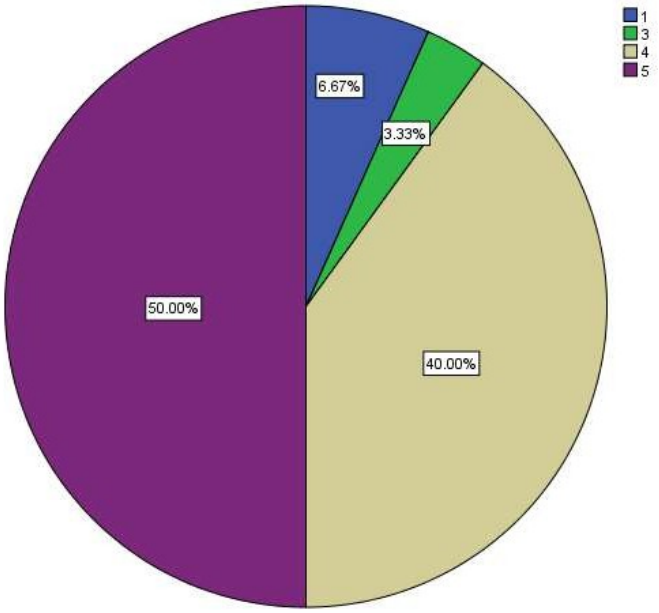


**Figure 2.** *Motivation for learning relational databases with Vertabelo*.

**Source**: Author's *own work* (2026).

Regarding the perception that the platform made learning more engaging, 50% of participants rated it at level 4 and 33.3% at level 5, resulting in 83.3% of responses in the higher levels, as shown in Table 2 and Figure 3.

**Table 2**. *Vertabelo makes learning more engaging*.

| | | Frequency | Percentage | Valid Percentage | Cumulative Cumulative |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 3.3 | 3.3 | 3.3 |
| | 3 | 4 | 13.3 | 13.3 | 16.7 |
| | 4 | 15 | 50.0 | 50.0 | 66.7 |
| | 5 | 10 | 33.3 | 33.3 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

**Source**: *Compiled by the author* (2026).

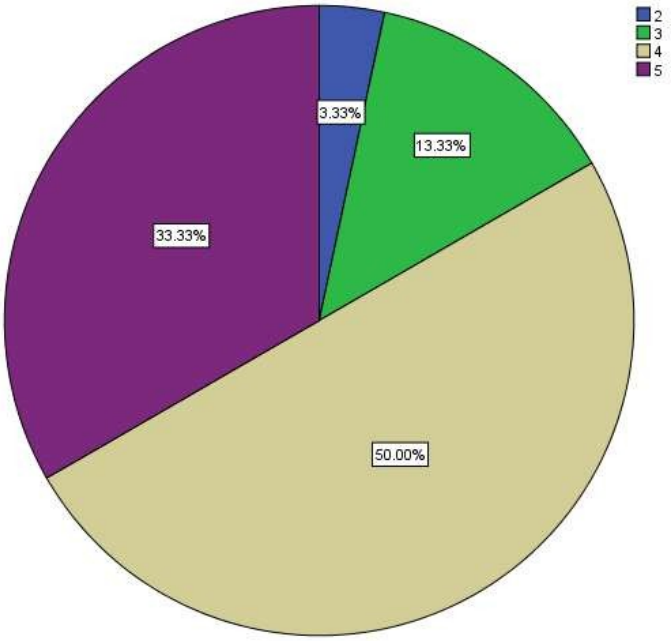


**Figure 3.** *Vertabelo makes learning more engaging***.**

**Source**: Author's *own work* (2026).

Regarding active participation, 60% of students were at level 4 and 30% at level 5, representing 90% favorable responses. This result indicates a positive perception of student engagement in the activities carried out through the platform, as shown in Table 3 and Figure 4.

**Table 3**. *Active Participation with Vertabelo.*

| | | Frequency | Percentage | Valid Percentage | Cumulative Cumulative |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 10.0 | 10.0 | 10.0 |
| | 4 | 18 | 60.0 | 60.0 | 70.0 |
| | 5 | 9 | 30.0 | 30.0 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

**Source**: Author's *own work* (2026).

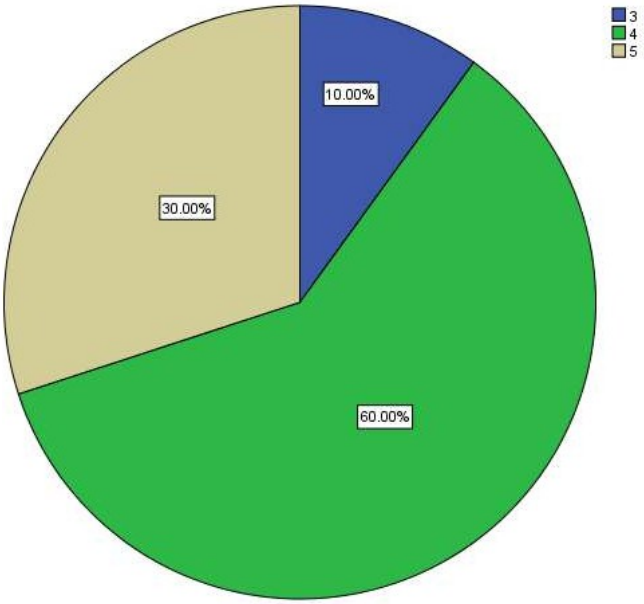


**Figure 4.** *Active participation with Vertabelo***.**

**Source**: Author's *own work* (2026).

Regarding academic engagement, the results show that 63.3% of participants were at level 4 and 23.3% at level 5, totaling 86.6% at the higher levels of the scale.

Regarding the application of theoretical knowledge in real-world situations, 53.3% were at level 4 and 26.7% at level 5, representing 80% of favorable responses. Additionally, 90% of the students expressed a favorable perception regarding their understanding of the topics through the development of authentic projects.

Regarding the development of technical and professional competencies, 50% of the participants were at level 4 and 40% at level 5, resulting in 90% favorable responses. These results indicate a positive perception regarding the strengthening of skills related to the design and management of relational databases.

Finally, regarding collaboration among peers, 40% of the students were rated at level 4 and 46.7% at level 5, representing 86.7% favorable responses.

Overall, the quantitative results show favorable trends in the variables analyzed, particularly in motivation, active participation, academic engagement, application of knowledge in real-world situations, development of technical skills, and collaboration. These results are complemented by the qualitative information obtained through interviews, in which the

students noted that the platform facilitated understanding, enabled them to develop projects, and fostered greater interaction during academic activities. Figure 5 shows the identified categories.




**Figure 5.** *Implementation of Vertabelo***.**

**Source**: Author's *own work* (2026).

Integrating the quantitative and qualitative results provided a broader view of the phenomenon under study. While the quantitative data allowed for the identification of trends and changes in the analyzed variables, the qualitative information provided insight into the students' experiences and perceptions during the intervention. In this regard, the results suggest that integrating the technological platform with practical activities and contextualized projects fostered the connection between theoretical knowledge and its application in real-world situations.

## DISCUSSION OF RESULTS

Analysis of the results obtained reveals the main effects associated with the implementation of a technology platform for teaching relational databases. The quantitative results show that students had a favorable perception of the use of the technology platform and its incorporation into the teaching-learning process for relational databases. In terms of motivation, 90% of the students scored at the highest levels, indicating a positive perception of the activities carried out through the platform. Similarly, 83.3% of the students felt that the use of the

platform made learning about databases more engaging. This result is significant because one of the challenges identified in teaching this subject relates to the difficulty of understanding abstract concepts and establishing a direct connection between theoretical content and its practical application. Regarding active participation, 90% of the students expressed a favorable rating. This result demonstrates that the platform-supported activities fostered greater student interaction with the content and learning activities. Likewise, 86.6% gave a favorable rating regarding their academic engagement, indicating a positive perception of their participation and responsibility during the activities. Regarding the application of theoretical knowledge to real-world situations, 80% of the students gave a favorable rating. This result is particularly significant because one of the central objectives of the research was to bridge the gap between theoretical knowledge and its application in practical contexts. Work through authentic projects also received a positive evaluation, as 90% of the students strongly agreed that this type of activity enhanced their understanding. This suggests that the use of contextualized situations helped students relate database content to problems that require the application of knowledge to develop solutions. Regarding the development of technical and professional competencies, 90% of the students gave a favorable evaluation. This result is consistent with the goal of strengthening skills related to the design and management of relational databases, particularly through the practical application of acquired knowledge. Finally, 86.7% of the students expressed a favorable assessment regarding collaboration. This result indicates that the activities carried out not only promoted individual learning but also fostered interaction and teamwork in resolving database-related situations.

Overall, the quantitative results show a positive trend in areas related to motivation, the appeal of learning, active participation, academic engagement, the application of knowledge in real-world situations, understanding through authentic projects, the development of professional technical skills, and collaboration among peers. The percentages obtained indicate that the learning experience supported by the platform was viewed positively by the majority of students.

To complement the analysis of the results, the McNemar test was applied to determine whether there was a statistically significant change in student performance before and after the implementation of the technology platform. This test is appropriate because it allows for the analysis of changes in paired data when two possible response categories are considered. In this case, it was used to compare students' performance before and after the intervention, considering the categories of "pass" and "fail." The null hypothesis stated that there was no statistically significant change in student performance before and after the implementation of the technology platform, while the alternative hypothesis stated that there was a statistically significant change. The statistic obtained using the McNemar test was 5.14, while the critical value was 2.7055, with one degree of freedom and a 90% confidence level. Because the calculated value was greater than the critical value, sufficient evidence was found to reject the null hypothesis and accept that there was a statistically significant change in student performance following the implementation of the platform. In addition to the statistical result, the direction of the change was favorable, as a greater number of students moved from failing to passing than those who made the opposite transition. Therefore, the results support the conclusion that, following the intervention, there was an improvement in student performance.

The qualitative results obtained through the interviews complemented the quantitative data and provided deeper insight into students' perceptions of the learning experience. Qualitative analysis is a continuous process of examining available information by synthesizing, orienting, verifying, comparing, and classifying it (Diaz, 2003), and enabled the identification of categories related to the implementation of the platform, its impact on learning, the activities that facilitated knowledge acquisition, work on real-world projects, the development of technical skills, participation and interaction, and the overall perception of the platform's use,

Students reported the following: the use of the technology platform fosters interest in learning relational databases; specifically, 50% selected the highest option, and 40% rated their interest as high. They confirmed that the use of the technology tool helps improve their attitude toward the course, with more than 80% of students rating their attitude as high or very high. The use of technological tools promotes more active learning, in which students engage

in constructing their own knowledge through practical and collaborative activities, as 60% of the students felt that the platform encourages their participation and 30% rated it at the highest level on the scale. Most participants perceived that using the platform increases their sense of responsibility and dedication toward the course, as more than 60% rated themselves at the "high" level and more than 20% at the "very high" level. More than 70% of students believe that the platform facilitates their understanding of theoretical concepts by allowing them to apply these concepts in practical activities related to database design. Working on projects enhances understanding of the course content; consequently, 50% of the students selected the highest level and 40% the high level. The use of the technology platform helps strengthen skills related to data modeling, diagram design, and understanding relationships between entities; 90% of students rated these skills at the high or very high levels. Most students believe that using the platform promotes collaboration with their peers, as more than 80% rated this aspect at the high or very high levels.

The results obtained align with the research objectives and are consistent with previous studies on the incorporation of technological tools and active strategies in database instruction.

De la Rosa et al. (2022) developed a web application designed for database learning that incorporated elements such as SQL, self-assessments, exams, and entity-relationship diagram simulations. Their results showed a favorable evaluation of the proposal. This research aligns with the present study regarding the importance of providing students with tools that allow them to interact practically with database content.

Furthermore, Elalouf et al. (2022) analyzed the teaching of SQL in both face-to-face and online settings, highlighting the importance of practice and faculty guidance. The results of the present study align with this perspective, as the use of the platform was accompanied by practical activities and faculty guidance—elements that contributed to learning outcomes.

Barra et al. (2024) analyzed innovative strategies to increase student motivation and engagement. Their results support the importance of using methodologies that promote more active participation. In the present study, the favorable assessment of motivation, active participation, and academic engagement reveals a trend consistent with these approaches.

In particular, the results align with those of Martínez et al. (2025), who analyzed active learning strategies aimed at developing competencies in computer engineering students. That study reported improvements in technical competencies, team cohesion, and maturity, as well as deeper and more transferable learning, accompanied by greater participation and academic engagement. The results obtained in this study show a similar trend, especially in the dimensions related to technical and professional competencies, collaboration, active participation, and academic engagement.

Overall, a comparison with the reviewed studies reveals that the results of this research are consistent with a trend identified in previous studies: database instruction can be strengthened when students have opportunities to practice, interact with technological tools, solve contextualized problems, and receive guidance throughout the process.

Finally, the qualitative results allowed us to identify advantages and conditions associated with the integration of the platform. Among these, the possibility of conducting practical activities, working on contextualized projects, and fostering interaction stand out. At the same time, some limitations were identified related to the need for initial familiarization with the tool and connectivity issues—aspects that must be considered for future implementations.

In general terms, the results support the conclusion that the combination of a technological platform, hands-on activities, and contextualized projects enhanced the learning process for relational databases. The evidence obtained shows a favorable assessment by students across the main dimensions analyzed and a statistically significant change in their performance following the intervention. Furthermore, the qualitative results reveal that the platform's usefulness does not depend exclusively on the technological tool itself, but rather on its integration into a pedagogical strategy accompanied by hands-on activities, context-based projects, and faculty guidance.

## CONCLUSIONS

One of the most significant aspects in achieving the overall objective was the evidence that implementing the technological platform helped bridge the gap between theoretical knowledge and its practical application. Students not only gained an understanding of the fundamental concepts of relational databases but were also able to apply them in real-world contexts through

the development of authentic projects. In this regard, students gave a favorable assessment of the application of theoretical knowledge in real-world situations, as well as of their work on authentic projects.

Another significant factor was the positive impact on students' academic engagement and active participation. The incorporation of the technology platform created an environment in which students took on a more active, dynamic, and interactive role in their educational process. Students expressed a favorable assessment of active participation, academic engagement, and collaboration during the activities carried out.

The results related to the development of technical and professional competencies were also favorable; students rated the strengthening of these competencies highly, which aligns with the objective of analyzing the strategy's impact on the development of skills related to the design and management of relational databases.

Overall, the results obtained allow us to conclude that the implementation of the technological platform, integrated with practical activities and contextualized projects, constituted a successful strategy for strengthening the learning of relational databases in the university context. The research demonstrates that, when technology is appropriately integrated into the learning process, it is possible to create more meaningful experiences that contribute to the development of students' technical competencies, active participation, collaboration, and academic engagement.

Regarding hypothesis testing, the McNemar test, applied to data collected before and after the intervention, allowed us to reject the null hypothesis, indicating the presence of a statistically significant change in the students' responses over time. The calculated statistic was 5.14, higher than the critical value of 2.7055 used in the analysis, providing evidence of a favorable change following the implementation of the technology platform.

Finally, this study provides evidence of the importance of transforming traditional educational practices by promoting innovative approaches that respond to the current demands of the professional environment. In this regard, the integration of technological platforms should be understood as a means to enrich the learning process, fostering students' well-rounded education and preparing them to face the challenges of the workforce.

## FUTURE RESEARCH

Based on the results obtained, at least two lines of research are identified that could be pursued in the future.

First line: longitudinal tracking of competency development. Future research could extend the period of student follow-up to determine whether the competencies developed through the use of the technological platform are maintained throughout subsequent semesters. This follow-up would make it possible to identify whether the knowledge and skills related to database design and management are transferred to other courses or professional situations.

Second line of research: comparison of strategies and technological tools for teaching databases. Further research could compare different technological platforms and instructional strategies to determine which ones best promote the learning of relational databases, active participation, and academic engagement. This type of study would help identify the characteristics of the tools and instructional activities that yield the best results in various university contexts.

## CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

## DATA AVAILABILITY

All datasets relevant to the results of this study are available in their entirety in the article.

## FUNDING SOURCE

This study did not receive funding from any organization.

## STATEMENT ON GENERATIVE AI

The authors declare that no generative artificial intelligence tools were used at any stage of this study.

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## COLLABORATIVE WORK TABLE

| Role | Author(s) |
|---|---|
| Design of data collection instruments | Yareny Rivera García, Luis Alberto Espejo Ponce |
| Application of a diagnostic test | Luis Alberto Espejo Ponce |
| Administration of the Initial Questionnaire | Luis Alberto Espejo Ponce |
| Conducting Initial Interviews | Yareny Rivera García |
| Implementation of the tool and monitoring of student performance students | Yareny Rivera García |
| Administering midterm exams | Yareny Rivera García |
| Administering the final exam | Luis Alberto Espejo Ponce |

| | |
|---|---|
| Administration of the final questionnaire | Luis Alberto Espejo Ponce |
| Conducting final interviews | Yareny Rivera García |
| Statistical analysis of data | Yareny Rivera García, Luis Alberto Espejo Ponce |
| Qualitative analysis | Yareny Rivera García, Luis Alberto Espejo Ponce |
| Fundraising | Yareny Rivera García |

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