Gamifying Structure Query Language (SQL): Learning through Competitive Query-Based Challenges

Darwin G. Raralio

Bachelor of Science in Information Technology Apayao State College Luna, Apayao, Philippines

DOI: https://doi.org/10.51244/IJRSI.2026.13020038

Received: 05 February 2026; Accepted: 10 February 2026; Published: 25 February 2026

ABSTRACT

Structured Query Language (SQL) is a foundational skill in database management; however, many students struggle to master it due to its abstract structure and logical complexity. While gamification has been widely recognized as an effective strategy for increasing engagement and motivation, elimination-based competition often limits participation and reduces learning opportunities for students who are removed early from play.

This study introduces a Point-Based SQL Survival Challenge designed to promote continuous participation while strengthening logical reasoning and query accuracy. Using a quasi-experimental design, undergraduate students were divided into control and experimental groups. The experimental group engaged in a team-based, turn-driven SQL challenge where correct queries earned points and incorrect queries resulted in penalties without eliminating participants. The system integrated roulette-based actions—SELECT, INSERT, DELETE, SAFE, and JOKER—to combine skill-based reasoning with strategic decision-making.

Results indicate that students exposed to the gamified approach demonstrated significantly higher gains in SQL proficiency, engagement, and collaborative problem-solving skills compared to traditional instruction. The findings suggest that point-based competitive mechanics can balance motivation with inclusivity while reinforcing logical reasoning and practical competence. This study contributes to emerging research on gamified database education and provides insights into designing inclusive competitive learning environments.

Keywords: Structured Query Language, Gamification, Point-Based Learning, Database Education, Student Engagement

INTRODUCTION (*HEADING 1*)

Structured Query Language (SQL) is the standard language for managing and manipulating relational databases, making it an essential skill for students pursuing computer science, information technology, and related fields. Despite its importance, many students find SQL abstract, challenging, and difficult to apply in practical scenarios. This difficulty often results in low engagement, limited practice, and incomplete mastery of essential database skills.

Gamification—the application of game design elements in non-game contexts—has emerged as a promising strategy to enhance learning motivation, engagement, and retention. Research has demonstrated that competitive and collaborative gamified activities can significantly improve students' understanding of complex concepts, encourage strategic thinking, and promote sustained participation. However, gamified approaches that rely on elimination mechanics often create a significant drawback: students who are eliminated lose opportunities to practice, reducing overall engagement and learning outcomes.

To address this limitation, this study introduces the Point-Based SQL Survival Challenge, a team-oriented, turn-driven competition in which students earn points for correctly executing SQL queries, with penalties for incorrect actions, but no student is removed from participation. The challenge incorporates roulette-based actions—SELECT, INSERT, DELETE, SAFE, and JOKER—to create a dynamic and strategic learning environment. By ensuring continuous participation, this approach promotes inclusive learning, enhances SQL proficiency, and fosters critical thinking and collaboration.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue II February 2026

This study aims to evaluate the effectiveness of a point-based gamified approach in improving SQL learning outcomes, engagement, and strategic problem-solving skills among undergraduate students.

Statement of The Problem

Structured Query Language (SQL) is a foundational skill for students in computer science and information technology, yet many struggle to master it due to its abstract nature and the limited opportunities for practical application. Traditional instruction methods often fail to engage students actively, leading to incomplete understanding and reduced retention of SQL concepts.

Previous attempts to gamify SQL learning, such as elimination-based competitions, have shown potential to increase engagement and motivation. However, they present a significant limitation: students who are eliminated early lose the chance to continue practicing, which reduces overall participation and hinders skill development. This exclusionary approach limits the benefits of gamification and can negatively affect student confidence and motivation.

Given these challenges, this study addresses the following research problems:

1. How can a point-based gamified system be designed to ensure continuous participation and engagement of all students in SQL learning?

2. Does participation in the Point-Based SQL Survival Challenge improve students' SQL proficiency, accuracy, and efficiency in constructing queries compared to traditional instruction?

3. How does a point-based gamified approach affect students' strategic thinking, collaboration, and motivation during SQL practice?

4. What are the perceived benefits and challenges of implementing a point-based competitive learning system in the classroom from the perspective of students and instructors?

This study seeks to address these problems by implementing and evaluating a point-based SQL learning competition, aiming to enhance learning outcomes, engagement, and inclusivity in database education.

REVIEW OF RELATED LITERATURE

1. Gamification in Education

Gamification involves applying game design elements—such as points, challenges, rewards, and competition—to non-game contexts, including education. Studies have shown that gamification can significantly increase student engagement, motivation, and learning outcomes across various subjects, particularly in computer science. Points, leaderboards, and badges encourage active participation, while team-based competitions foster collaboration and strategic thinking. However, research also highlights that elimination-based systems can reduce engagement for students removed early, emphasizing the need for inclusive game mechanics that maintain participation for all learners.

2. Gamification in Computer Science and Database Learning

In computer science education, gamified activities have been used to teach programming, algorithms, and database management. For instance, gamified quizzes, coding challenges, and SQL practice games have been shown to improve students' practical skills, accuracy, and retention. A study by Domínguez et al. (2013) found that game-based learning environments enhance motivation and engagement, leading to higher academic performance. Similarly, competition-driven learning can promote critical thinking and problem-solving skills, which are crucial for mastering SQL.

3. Limitations of Elimination-Based Gamification

While competitive gamification can be effective, elimination mechanics pose challenges. Research indicates that students who are eliminated early may feel excluded, miss practice opportunities, and experience reduced motivation. In the context of SQL learning, this limitation is critical because consistent query practice is necessary for skill mastery. Therefore, a shift toward point-based, continuous participation systems addresses this gap by keeping all students active and engaged throughout the learning activity.

4. Point-Based Learning Systems

Point-based gamification allows students to earn or lose points based on performance rather than being removed from play. This system has been applied successfully in educational settings to maintain engagement, encourage repeated practice, and develop strategic skills. Studies suggest that point-based systems improve learning outcomes, sustain participation, and foster healthy competition while avoiding the negative effects of elimination. By integrating points with team-based challenges, learners are motivated to collaborate, plan strategies, and actively apply knowledge.

5. SQL-Specific Gamified Approaches

Recent gamified approaches to SQL learning include challenges where students execute queries to solve reallife database problems, earning rewards for correct answers. Examples include Wordle-style query games, badges for accuracy, and timed query competitions. While these approaches show positive learning effects, most studies lack mechanisms to ensure continuous participation for all learners. The proposed Point-Based SQL Survival Challenge builds on these studies by incorporating point-based scoring, roulette-based actions (SELECT, INSERT, DELETE, SAFE, JOKER), and team collaboration, ensuring inclusive, strategic, and sustained SQL practice.

6. Synthesis

Existing literature supports the effectiveness of gamified learning for improving engagement and performance in computer science and database education. However, there is a research gap in inclusive, point-based competitive SQL learning that ensures continuous participation and hands-on practice for all students. The proposed study addresses this gap by implementing a point-based SQL Survival Challenge, designed to foster engagement, strategic thinking, collaboration, and proficiency in SQL among undergraduate learners.

METHODOLOGY

Research Design

This study employed a game-based learning approach to enhance students' understanding of basic SQL commands, specifically SELECT, INSERT, DELETE, and WHERE clauses. The approach integrates skill-based problem solving with chance-based mechanics to maintain student engagement while ensuring mastery of database querying concepts.

This study employed a quasi-experimental pre-test–post-test control group design. Random assignment was conducted at the group level due to classroom constraints. Statistical analysis included paired t-tests to measure within-group improvement and independent t-tests to compare gain scores between groups.

Participants

The participants of the study were students enrolled in an introductory database or SQL course. Students were divided into groups, with each group competing collaboratively during the game-based activity.

Instructional Game Mechanics

The instructional activity was conducted using a turn-based SQL query game. Each group's turn consisted of two sequential phases: the SELECT Phase and the Roulette Phase.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue II February 2026

Phase 1: SELECT Query Phase (Skill-Based Phase)

At the start of each turn, a group was required to execute a SELECT query with a WHERE clause based on a given scenario or condition.

- The SELECT query must be syntactically correct and logically accurate.
- Each correctly retrieved student record earned the group one (1) point.
- The total number of records returned by the query determined the group's score for the turn.
- Groups that failed to construct a valid SELECT query earned zero (0) points and were not allowed to proceed to the roulette phase.

This phase ensured that progression in the game was dependent on SQL competency rather than chance.

Phase 2: Roulette Phase (Chance-Based Phase)

After successfully completing the SELECT phase, the group was allowed to spin a roulette wheel. The roulette randomly assigned one of several outcomes, each requiring a specific SQL action or awarding bonus points.

Roulette Outcomes

- INSERT INTO The group executed an INSERT query using a student number. If the inserted student number belonged to a different group, the student was added to the executing group.
- DELETE FROM

The group executed a DELETE query using a student number. If the deleted student number belonged to another group, the affected group lost one (1) point. If it belonged to the executing group, the executing group lost one (1) point.

- JOKER+3

The group was awarded three (3) bonus points without executing an SQL query.

- JOKER+1

The group was awarded one (1) bonus point without executing an SQL query.

- Scoring System

Points were accumulated from two sources:

1. Correct SELECT queries, where each retrieved record earned one point.
2. Roulette outcomes, which could either increase or decrease points depending on the result.

No group was eliminated during the activity, allowing continuous participation and repeated practice of SQL commands.

Data Collection

Student performance was measured based on:

- Accuracy of SQL queries

- Number of correct SELECT query results
- Total points accumulated throughout the game

Observations on student engagement and participation were also recorded during the activity.

Ethical Considerations

Participation in the activity was conducted within a classroom setting and did not affect students' official academic grades. All data collected were used solely for instructional and research purposes.

RESULTS AND DISCUSSION

Participants

A total of 40 undergraduate students participated in the study, with 20 students in the experimental group (PointBased SQL Survival Challenge) and 20 students in the control group (traditional SQL instruction). Students were randomly assigned to groups, ensuring a balanced mix of prior SQL knowledge and gender.

Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	Gain (Mean)
Experimental	52.3 (8.7)	85.6 (7.2)	33.3
Control	53.1 (9.2)	70.2 (8.5)	17.1

Table1: SQL Proficiency (Pre-test and Post-Test)

Analysis:

- Paired t-tests showed significant improvement within both groups ($p < 0.001$).
- Independent t-test comparing gains between groups indicated the experimental group had a significantly higher gain than the control group ($t = 5.78$, $p < 0.001$).

Discussion

Participation in the Point-Based SQL Survival Challenge clearly enhanced SQL proficiency. The combination of continuous practice, point rewards, and team-based collaboration contributed to higher accuracy and faster query execution. Traditional instruction improved scores but at a lower rate, likely due to the absence of gamified engagement.

Group	Average Engagement Score*	SD
Experimental	4.6 / 5	0.3
Control	3.4 / 5	0.5

Table2: Engagement and Motivation

Measured using a 5-point Likert scale from student survey (1 = low engagement, 5 = highly engaged).

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue II February 2026

Discussion

The experimental group reported higher engagement and motivation. The point-based system kept all students active, while team collaboration and roulette-based actions made the learning experience dynamic and enjoyable. Students commented that the game "made SQL fun" and "encouraged thinking strategically about queries," reflecting both cognitive and affective benefits.

Strategic Thinking and Collaboration Observational data showed that:

- 85% of teams developed strategies to maximize points by allocating roles (queryer, validator, recorder).
- Teams actively discussed best approaches before executing INSERT, DELETE, or JOKER actions.
- Students in the experimental group displayed higher problem-solving confidence than the control group.

Discussion

The point-based mechanics encouraged strategic collaboration, requiring students to analyze scenarios, plan queries, and make decisions that affected overall team points. Unlike elimination-based systems, no student was sidelined, resulting in consistent engagement and skill application throughout the session.

Query Type	Correct Queries (Experimental)	Correct Queries (Control)
SELECT	92%	78%
INSERT	88%	70%
DELETE	81%	65%

Table3: Query Accuracy and Error Patterns

Discussion:

Students in the experimental group demonstrated higher accuracy across all query types. Continuous participation allowed repeated practice and peer feedback, reducing syntax and logical errors. The control group improved but lacked the interactive, motivational reinforcement provided by gamification.

Overall Discussion

The results support the effectiveness of point-based gamification in SQL learning:

1. Learning Outcomes: Experimental students achieved higher gains in proficiency, efficiency, and accuracy.

2. Engagement: Sustained participation and team competition increased motivation.

3. Strategic Skills: Teams practiced collaborative problem-solving and adaptive query strategies.

4. Pedagogical Implications: The study demonstrates that inclusive, point-based gamification provides both cognitive and motivational benefits, aligning with constructivist and active learning theories.

Conclusion from Results:

Implementing a Point-Based SQL Survival Challenge significantly improves student learning outcomes and engagement compared to traditional instruction. The system avoids the pitfalls of elimination-based games while fostering collaboration, critical thinking, and hands-on practice.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The findings of this study demonstrate that a point-based gamified approach significantly enhances SQL proficiency, engagement, and collaborative problem-solving among undergraduate students. By eliminating exclusionary mechanics and maintaining continuous participation, the Point-Based SQL Survival Challenge ensures sustained practice—an essential factor in mastering database querying skills.

Beyond improving technical accuracy, the intervention strengthened logical reasoning, strategic planning, and adaptive thinking—competencies critical for professional database development and technical assessments. While gamification does not replace foundational theoretical instruction, it serves as an effective bridge between conceptual understanding and applied competence.

Future implementations should incorporate adaptive difficulty levels, automated validation systems, and longitudinal tracking to measure long-term retention. Expanding the model into blended or online environments may further enhance accessibility and scalability. Overall, inclusive point-based gamification represents a pedagogically sound and practically relevant innovation in database education.

Recommendations

It is recommended that educators incorporate point-based gamified activities in SQL or other computer science courses to increase engagement and skill mastery. Continuous participation mechanics, such as point accumulation, should be prioritized to avoid disengagement, while team collaboration and strategic planning should be encouraged to foster problem-solving and critical thinking skills. Students are advised to actively participate in gamified challenges and reflect on strategies used during the activity to enhance their SQL proficiency and efficiency.

For future research, it is recommended to explore the adaptation of point-based gamification in larger classes or online learning environments, examine the long-term retention of skills, and investigate the integration of automated feedback tools or adaptive difficulty levels to further enhance learning outcomes. Curriculum developers may consider integrating gamified, point-based modules as a complementary approach to traditional instruction, using activity data, such as query logs and scores, to inform teaching strategies and identify areas requiring reinforcement. Overall, point-based gamified learning has proven to be an effective, inclusive, and practical approach for teaching SQL, supporting both technical proficiency and higher-order cognitive development among students.

REFERENCES

1. Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. Computers & Education, 63, 380–392. https://doi.org/10.1016/j.compedu.2012.12.020
2. Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining “gamification.” In Proceedings of the 15th International Academic MindTrek Conference (pp. 9–15). ACM. https://doi.org/10.1145/2181037.2181040
3. Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? — A literature review of empirical studies on gamification. In Proceedings of the 47th Hawaii International Conference on System Sciences (pp. 3025–3034). IEEE. https://doi.org/10.1109/HICSS.2014.377

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue II February 2026

4. Kapp, K. M. (2012). The gamification of learning and instruction: Game-based methods and strategies for training and education. Pfeiffer.
5. Marczewski, A. (2015). Even ninja monkeys like to play: Gamification, game thinking and motivational design. CreateSpace Independent Publishing Platform.
6. Sheldon, L. (2012). The multiplayer classroom: Designing coursework as a game. Cengage Learning.
7. Vassileva, J. (2012). Motivating participation in social computing applications: A user modeling perspective. User Modeling and User-Adapted Interaction, 22(1-2), 177–201.