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ORIGINAL

Improving Grade 11 Learners Conceptual Understanding On Evolution Through Who Wants To Be A Quizizz Millionaire

Mejorar La Comprensión Conceptual De La Evolución Por Parte De Los Estudiantes De 11.º Grado A Través De ¿Quién Quiere Ser Millonario En Quizizz?

Vanjoreeh A. Madale[1], Douglas A. Salazar[1], Monera A. Salic-Hairulla[1], Angeline P. Dinoro[2], John Jr G. Adil[2], Arlyn R. Alcopra[2]

[1]Faculty, College of Education-Department of Science and Mathematics Education, Mindanao State University-Iligan Institute of Technology, Iligan City, Philippines
[2]Faculty, College of Education-Department of Professional Education, Mindanao State University-Iligan Institute of Technology, Iligan City, Philippines

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Corresponding Author: Vanjoreeh A. Madale

ABSTRACT

This study aimed to improve Grade 11 learners' conceptual understanding of evolution through the gamified intervention Who Wants to Be a Quizizz Millionaire. Utilizing a quasi-experimental pretest-posttest design, the study compared the performance of an experimental group that participated in the gamified activity with a control group that received traditional instruction. Results indicated a significant improvement in the experimental group's posttest scores ($p<0,001$); demonstrating the effectiveness of the intervention. The gamified approach increased engagement, reinforced learning, and simplified complex evolutionary concepts. Thematic analysis of student feedback highlighted key themes such as Engagement, Ease of Understanding, and Reinforcement of Learning, with students expressing enthusiasm and a preference for interactive learning methods. However, challenges such as poor internet connectivity were noted. The study concludes that gamified learning strategies can enhance student motivation, comprehension, and retention, making them valuable tools for teaching challenging science topics. Recommendations include improving technological infrastructure, providing teacher training in gamified strategies, and addressing individual learning needs. Despite limitations like sample size and technological constraints, this research supports the integration of gamification to create dynamic, effective, and enjoyable learning environments in science education.

Keywords: Gamified Learning; Conceptual Understanding; Evolution Education; Student Engagement; Quizizz.

RESUMEN

Este estudio tuvo como objetivo mejorar la comprensión conceptual de la evolución de los estudiantes de 11º grado a través de la intervención gamificada ¿Quién quiere ser millonario de Quizizz? Utilizando un diseño cuasiexperimental de preprueba y posprueba, el estudio comparó el desempeño de un grupo experimental que participó en la actividad gamificada con un grupo de control que recibió instrucción tradicional. Los resultados indicaron una mejora significativa en las puntuaciones de la posprueba del grupo experimental ($p < 0,001$); lo que demuestra la eficacia de la intervención. El enfoque gamificado aumentó la participación, reforzó el aprendizaje y simplificó conceptos evolutivos complejos. El análisis temático de la retroalimentación de los estudiantes destacó temas clave como la participación, la facilidad de comprensión y el refuerzo del aprendizaje,

y los estudiantes expresaron entusiasmo y una preferencia por los métodos de aprendizaje interactivos. Sin embargo, se observaron desafíos como la mala conectividad a Internet. El estudio concluye que las estrategias de aprendizaje gamificadas pueden mejorar la motivación, la comprensión y la retención de los estudiantes, lo que las convierte en herramientas valiosas para la enseñanza de temas científicos desafiantes. Las recomendaciones incluyen mejorar la infraestructura tecnológica, brindar capacitación a los docentes en estrategias gamificadas y abordar las necesidades de aprendizaje individuales. A pesar de limitaciones como el tamaño de la muestra y las limitaciones tecnológicas, esta investigación apoya la integración de la gamificación para crear entornos de aprendizaje dinámicos, efectivos y agradables en la educación científica.

Palabras clave: Aprendizaje Gamificado; Comprensión Conceptual; Educación Evolutiva; Participación Estudiantil; Quizizz.

INTRODUCTION

Teaching evolutionary biology to senior high school students presents numerous pedagogical challenges that can significantly impact students' understanding and acceptance of this fundamental scientific concept. Despite the critical importance of evolutionary theory in biology, many educators face obstacles that hinder effective instruction. These challenges include inadequate teacher preparedness, persistent student misconceptions, cultural resistance, and the need for innovative teaching strategies. One of the most pressing issues in teaching evolutionary biology is the lack of adequate subject matter knowledge among teachers. Research indicates that many high school biology teachers do not present evolution in alignment with scientific recommendations, with only about one in three teachers consistently teaching evolution as endorsed by leading scientific authorities.[1] This lack of preparedness can lead to ineffective instruction and a failure to address students' misconceptions adequately. Furthermore, teachers' own beliefs about evolution can influence their teaching practices, often resulting in a reluctance to engage with the topic fully.[1]

Students frequently enter biology classes with preconceived notions and misconceptions about evolution, which can be deeply rooted in cultural and religious beliefs. Studies have shown that misconceptions about evolutionary theory are prevalent among high school students, often stemming from cognitive, emotional, and epistemological factors.[2] These misconceptions can persist despite instruction, making it essential for educators to develop strategies that not only convey scientific content but also engage students in discussions about their beliefs and how they can coexist with scientific understanding.[2] Cultural and religious beliefs can create significant barriers to the acceptance of evolutionary theory in the classroom. Many students perceive evolution as incompatible with their faith, leading to resistance in accepting evolutionary concepts.[3] This cultural resistance necessitates pedagogical approaches that acknowledge and address these concerns, promoting a dialogue between scientific and religious perspectives.[3] Without addressing these cultural factors, educators may struggle to foster an environment conducive to learning about evolution.

Evolutionary biology is often taught in isolation from other scientific disciplines, limiting students' understanding of its relevance to real-world issues. Integrating evolutionary concepts with topics such as public health, genetics, and environmental science can enhance students' appreciation of the practical applications of evolutionary theory. However, many curricula fail to make these connections, resulting in a fragmented understanding of biology and its implications for society.[4]

Traditional teaching methods may not be sufficient to engage students with complex evolutionary concepts. Innovative approaches, such as inquiry-based learning and the use of technology, have been shown to improve student engagement and understanding. However, many educators may not be familiar with these methods or lack the resources to implement them effectively. The integration of technology, such as augmented reality and bioinformatics, has the potential to create immersive learning experiences that enhance students' understanding of evolutionary concepts.[5,6] Nonetheless, the incorporation of such technologies into the curriculum remains limited.

Gamification, the integration of game-like elements into non-game contexts, has emerged as a transformative educational strategy that enhances student engagement and motivation across various learning environments. By incorporating elements such as points, badges, leaderboards, and challenges, gamification fosters a more interactive and enjoyable learning experience. This approach not only makes learning more appealing but also encourages students to take ownership of their educational journeys. Recent studies have highlighted the numerous benefits of gamification in education, demonstrating its effectiveness in improving learning outcomes, enhancing motivation, and promoting collaboration among students. One of the primary benefits of gamification is its ability to increase student engagement. Research indicates that gamification elements can significantly enhance learners' motivation by providing immediate feedback and a sense of achievement. For instance, Zhang and Hasim[7] found that gamification in English as a Foreign Language (EFL) instruction led to

increased student engagement and awareness of their progress, fostering healthy competition and collaboration among peers. Similarly, Filha et al.[8] reported that gamification improved the learning experiences of students in physical education classes, highlighting the positive impact on intrinsic motivation and enjoyment.

Moreover, gamification has been shown to facilitate meaningful learning experiences. Fiuza-Fernández et al.[9] emphasized that the implementation of gamification in classrooms has proven beneficial in various educational contexts, leading to enhanced student participation and knowledge retention. By transforming traditional learning environments into dynamic and interactive spaces, gamification encourages active participation and deeper engagement with the material. This active involvement is crucial for fostering critical thinking and problem-solving skills, which are essential for success in today's rapidly changing world.[10]

In addition to enhancing engagement and learning outcomes, gamification promotes collaboration among students. By incorporating competitive elements and team-based challenges, gamification encourages students to work together, share knowledge, and support one another in achieving common goals.[11] This collaborative approach not only enhances social skills but also fosters a sense of community within the classroom, creating a supportive learning environment that can lead to improved academic performance.[12]

Furthermore, gamification can help address diverse learning needs by providing personalized learning experiences. As educators implement gamified strategies, they can tailor challenges and rewards to meet individual student preferences and abilities, allowing for differentiated instruction.[13] This adaptability ensures that all students can benefit from the gamified learning experience, regardless of their starting point.

The use of Quizizz in teaching biology has gained traction as an effective educational tool that enhances student engagement, motivation, and learning outcomes. Quizizz is an interactive quiz platform that allows educators to create and administer quizzes in a gamified format, making the learning process more enjoyable and interactive for students. One of the primary benefits of using Quizizz in biology education is its ability to significantly enhance student engagement. The gamified nature of Quizizz, which includes features such as points, leaderboards, and instant feedback, creates a competitive yet fun learning environment. Research by Setyaningsih and Dayu[14] indicates that incorporating Quizizz into lessons can lead to increased student interest and participation, particularly in the context of post-COVID-19 education, where traditional engagement methods may have faltered. The interactive format encourages students to actively participate in their learning, making the subject matter more relatable and enjoyable.

In addition to boosting engagement, Quizizz has been shown to improve learning outcomes in various subjects. A study by Harefa et al.[15] found that the integration of Quizizz in chemistry education positively impacted students' critical thinking skills and overall learning evaluation. This finding suggests that similar benefits can be expected in biology education, where critical thinking is essential for understanding complex concepts such as evolution, ecology, and genetics. By providing immediate feedback and allowing students to learn at their own pace, Quizizz helps reinforce knowledge and improve retention.

The use of gamification in teaching evolutionary biology offers a promising approach to enhance student engagement, motivation, and understanding of complex biological concepts. By integrating game-like elements into the learning process, educators can create a more interactive and enjoyable educational experience that resonates with students, particularly in a subject that often faces challenges related to misconceptions and cultural resistance. One of the primary advantages of gamification is its ability to significantly boost student engagement and motivation. Research has shown that incorporating game mechanics, such as points, badges, and leaderboards, can transform traditional learning environments into dynamic spaces that encourage active participation. For instance, Puspitasari[16] highlights that gamification enhances student motivation by leveraging gaming elements to increase participation and engagement in educational contexts.

Gamification not only fosters engagement but also improves learning outcomes. Studies indicate that gamified learning experiences can lead to better retention of information and deeper understanding of complex topics. For example, Hashim[17] demonstrated that using board games as a learning strategy significantly enhanced students' comprehension of scientific concepts, suggesting that non-digital gamification approaches can be particularly effective in science education.

The main objective of the study is to improve the conceptual understanding of Grade 11 learners about evolution using "Who Wants to Be a Quizizz Millionaire" at Iligan City East National Highschool-Hinaplanon, Iligan City, Philippines, specifically to answer the following questions:

1. What is the level of conceptual understanding of Grade 11 learners in both the experimental and control groups before and after the intervention?

2. How does the mean score of the experimental and control groups compare before and after the intervention?

3. What are the learners' perceptions of their experience while participating in the "Who Wants to Be a Quizizz Millionaire" activity?

METHOD

Research Design

The study employed a quasi-experimental research design, specifically a pretest-posttest control group design. This design allowed the comparison of the conceptual understanding of evolution among Grade 11 learners in both the experimental and control groups before and after the intervention (the "Who Wants to Be a Quizizz Millionaire" game).

The quantitative aspect of the study focuses on measuring and comparing the conceptual understanding of evolution among Grade 11 learners in both the experimental and control groups. Using a pretest-posttest control group design, the study administered an adapted conceptual understanding test to both groups before (pretest) and after (posttest) the intervention. The experimental group will undergo the intervention, which is the gamified learning strategy "Who Wants to Be a Quizizz Millionaire," while the control group will be taught using conventional teaching methods. Statistical analyses are performed to determine if there are significant differences in the pretest and posttest scores within and between the groups. This quantitative data reveals the effectiveness of the gamified strategy in enhancing students' understanding of evolution.

The qualitative aspect of the study explores the learners' perceptions, experiences, and feedback regarding the intervention. A semi-structured interview was conducted with the learners in the experimental group to gather insights into how the gamified strategy impacted their engagement, motivation, and learning experiences. Qualitative data was analyzed thematically, providing a deeper understanding of how and why the gamified approach influences learners' conceptual understanding, motivation, and engagement.

Research Participants

The respondents of this study are Grade 11 learners from Iligan City East National High School-Hinaplanon, Iligan City, Philippines, enrolled in the HUMSS Track. The study involved two groups: an experimental group, which will undergo the "Who Wants to Be a Quizizz Millionaire" game-based learning intervention, and a control group, which received a traditional lecture-based instruction. A purposive sampling method has been used to assign participants to the two groups, with each group consist of 32 participants. Inclusion criteria include being enrolled in Grade 11 and in a science subject that includes evolution, with informed consent obtained from both students and their parents/guardians.

Data Gathering Procedure

The data gathering procedure for this study follows a structured and systematic approach that involves multiple stages to collect both quantitative and qualitative data, focusing solely on the students.

Pre-Intervention Phase:

In the initial phase, participants are recruited from Grade 11 learners in a selected high school. Ethical approval is sought, and informed consent is obtained from the students and their guardians to ensure voluntary participation and confidentiality. Participants are then randomly assigned to either the experimental group, which will engage with the gamified learning strategy "Who Wants to Be a Quizizz Millionaire," or the control group, which will receive traditional science instruction without gamified elements.

Quantitative Data Collection:

The study employs a pretest-posttest control group design to measure the impact of the intervention. A validated conceptual understanding test is administered to both groups before the intervention (pretest) to establish baseline knowledge. The experimental group then participates in the gamified learning strategy, while the control group continues with conventional teaching methods. After the intervention, a posttest identical to the pretest is administered to both groups to evaluate any changes in conceptual understanding of evolution. The quantitative data from the pretest and posttest are analyzed using statistical methods such as t-tests or ANCOVA to compare mean scores between the experimental and control groups, allowing for the assessment of the gamified strategy's effectiveness.

Qualitative Data Collection:

The qualitative aspect of the study employs a questionnaire with open-ended questions to collect feedback from the students in the experimental group. This questionnaire is administered after the intervention and aims to capture the students' experiences, perceptions, and reflections on the gamified learning strategy. The open-ended questions are designed to elicit detailed responses regarding their engagement, motivation, learning outcomes, and any challenges faced during the intervention. The responses from the questionnaires are then analyzed thematically to identify key themes and patterns related to the impact of the intervention. This qualitative data complements the quantitative findings, providing a richer understanding of how the gamified

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strategy influences student learning.

Data Analysis

The data collected from the pretest, posttest, and learner experience surveys were analyzed using both descriptive and inferential statistics. Descriptive statistics, including mean and standard deviation, summarized the pretest and posttest scores for both the experimental and control groups and identified changes in learners' conceptual understanding of evolution. Paired sample t-tests were used to compare the pretest and posttest scores within each group, while independent samples t-tests compared the posttest scores between the two groups to assess the effect of the intervention. Additionally, learner experience survey responses were analyzed using thematic analysis for open-ended questions to explore students' perceptions of the game. The results were interpreted to evaluate the impact of the game-based learning intervention on students' understanding of evolution and their overall experience with the activity.

The table 1 below categorizes learners' performance into five descriptive levels based on their raw scores and corresponding percentage scores. The raw scores, ranging from 0 to 30, are translated into percentage scores, which provide a standardized measure of performance. These percentage scores are further classified into descriptive levels to qualitatively interpret learners' achievement. The "Advanced" level, corresponding to raw scores of 27-30 and percentage scores of 100-90 %, signifies exceptional mastery of the material, while the "Proficient" level (raw scores 25-26, 85-89 %) indicates a strong understanding. The "Approaching Proficiency" level (raw score 24, 80-84 %) suggests learners are close to proficiency but still require some improvement. Scores in the "Developing" level (raw scores 22-23, 75-79 %) reflect a basic understanding with noticeable gaps, and those in the "Beginning" level (raw scores 0-21, below 75 %) indicate minimal comprehension or difficulty grasping the content. This categorization helps educators identify areas where learners excel or struggle, guiding targeted interventions and instructional strategies while recognizing outstanding performance. The framework supports meaningful assessment aligned with educational goals and learning objectives.

Table 1. Achievement Test Scores Range

Raw score	Percentage score (%)	Descriptive level
27-30	100-90	Advanced
25-26	85-89	Proficient
24	80-84	Approaching Proficiency
22-23	75-79	Developing
0-21	Below 75	Beginning

Source: *Department of Education (DepEd) Philippines, 2024.*

Ethical Considerations

The study was conducted with careful attention to ethical principles to protect the rights and well-being of all participants. Informed consent was obtained from the students and their guardians, ensuring they were fully aware of the study's purpose, procedures, and potential risks. Participation in the study was entirely voluntary, and students were free to withdraw at any time without any consequences. Confidentiality was maintained throughout the study, with all data coded to protect the identities of the participants. Any potential risks, such as discomfort from answering open-ended questions, were minimized through careful question design and debriefing sessions.

Ethical Approval

The study was conducted with careful attention to ethical principles to protect the rights and well-being of all participants. Ethical approval was sought before data collection, ensuring that the study adhered to institutional and national ethical guidelines.

Informed Consent

Informed consent was obtained from all participants before the study. Parental or guardian consent was also secured for learners under legal age. Participants were fully informed of the study's purpose, procedures, potential risks, and their rights to withdraw at any time without consequences.

Statement Regarding Research Involving Human Participants and/or Animals

This research involved human participants, specifically Grade 11 learners from Iligan City East National High School-Hinaplanon, Iligan City, Philippines. No animals were used in this study. All research procedures were carried out in accordance with ethical guidelines for research involving human participants.

Consent to Participate

Participants voluntarily took part in the study after receiving detailed information about the research objectives and procedures. Their consent was documented, ensuring that their participation was based on informed decision-making.

Consent to Publish

The authors obtained consent from the participants to use anonymized data for publication purposes. All responses and personal identifiers were removed to maintain confidentiality and data protection.

RESULTS AND DISCUSSION

The table 2 compares the pretest and posttest scores of the control group, revealing significant shifts in student performance across different proficiency levels. In the pretest, the majority of students (84 %) fell within the "Beginning" category (0-21 range), indicating limited understanding of the material, while only 16 % reached the "Developing" category (22-23 range). None of the students demonstrated "Approaching Proficiency," "Proficient," or "Advanced" levels. Following the posttest, notable improvements were observed: the percentage of students in the "Beginning" category decreased to 16 %, while 50 % progressed to the "Developing" category. Additionally, 19 % achieved "Approaching Proficiency" scores (24 range), and 16 % reached the "Proficient" level (25-26 range).

Table 2. Comparison Between the Pretest and Posttest of the Controlled Group

Range Scores	Control Group				Interpretation
	Pretest		Posttest		
	f	%	f	%	
27-30 (90 %-100 %)	0	0 %	0	0 %	Advanced
25-26 (85 %-89 %)	0	0 %	5	16 %	Proficient
24 (80 %-84 %)	0	0 %	6	19 %	Approaching Proficiency
22-23 (75 %-79 %)	5	16 %	16	50 %	Developing
0-21 (Below 75 %)	27	84 %	5	16 %	Beginning
Total	32	100 %	32	100 %	

***Legend**: f-Frequency.*

Despite these gains, no students attained the "Advanced" category, indicating room for further improvement. These results suggest that traditional instructional methods facilitated some learning gains, but their effectiveness was limited in advancing students to higher proficiency levels. The absence of "Advanced" scores highlights the need for more dynamic and engaging teaching strategies, such as gamified learning interventions, to support deeper understanding and mastery of the subject matter. This underscores the potential of innovative methods to bridge gaps in learning and enhance overall academic performance.

Table 3. Paired Samples t-Test Results for Pretest and Posttest Scores of the Controlled Group

Group and Test Compared		N	Mean	SD	t	df	Sig. (2-tailed)	Decision
Within Groups	Controlled Group: Pretest vs Posttest	32	-7,03	5,24	-7,36	29	0,000	Significant

The table 3 above presents the paired samples t-test results comparing the pretest and posttest scores of the controlled group, consisting of 32 participants. The mean difference between the pretest and posttest scores is -7,03; with a standard deviation (SD) of 5,24; indicating some variability in the extent of improvement among participants. The t-value is -7,36 with 29 degrees of freedom (df), and the p-value (Sig. (2-tailed)) is 0,000; which is less than the significance level of 0,05.

These results indicate a statistically significant difference between the pretest and posttest scores of the controlled group. This suggests that the traditional teaching approach employed in the control group contributed to an improvement in students' understanding. However, the mean difference of -7,03 reflects a moderate effect, indicating that while the traditional approach facilitated learning to some extent, it may not be as effective as more dynamic or interactive methods.

In conclusion, the significant improvement in scores demonstrates the effectiveness of traditional teaching in enhancing learning outcomes, albeit with limitations in advancing students to higher proficiency levels, as seen in other analysis results. This underscores the potential value of integrating innovative teaching methods to achieve more impactful learning outcomes.

The table 4 compares the pretest and posttest scores of the experimental group, highlighting significant improvements in student performance following the gamified intervention *Who Wants to Be a Quizizz Millionaire*. Before the intervention, the vast majority of students (97 %) were in the "Beginning" category (0-21 range), indicating minimal understanding of the material. Only one student (3 %) was in the "Developing" category (22-23 range), and no students achieved scores in the higher proficiency levels, such as "Approaching Proficiency," "Proficient," or "Advanced."

Table 4. Comparison Between the Pretest and Posttest of the Experimental Group

Range Scores	Experimental Group				Interpretation
	Pretest		Posttest		
	f	P	f	P	
27-30 (90 %-100 %)	0	0 %	2	6 %	Advanced
25-26 (85 %-89 %)	0	0 %	7	22 %	Proficient
24 (80 %-84 %)	0	0 %	13	41 %	Approaching Proficiency
22-23 (75 %-79 %)	1	3 %	10	31 %	Developing
0-21 (Below 75 %)	31	97 %	0	0 %	Beginning
Total	32	100 %	32	100 %	

Legend: f-Frequency, P-Percentage

In the posttest, a striking transformation is observed. The "Beginning" category dropped to 0 %, showing that all students moved out of the lowest level of performance. The largest proportion of students (41 %) achieved the "Approaching Proficiency" level (24 range), while 31 % reached the "Developing" category. Notably, 22 % of students attained the "Proficient" level (25-26 range), and 6 % advanced to the highest "Advanced" category (27-30 range). These results demonstrate the effectiveness of the gamified intervention in elevating students' conceptual understanding.

The data underscores the significant impact of the gamified learning strategy, as students not only progressed out of the "Beginning" category but also achieved higher proficiency levels. Compared to traditional teaching methods, this approach proved more effective in fostering deep learning, enhancing engagement, and bridging knowledge gaps in evolution education. This highlights the potential of gamified strategies to transform learning outcomes and create meaningful educational experiences.

Table 5. Paired Samples t-Test Results for Pretest and Posttest Scores of the Experimental Group

Group and Test Compared		n	Mean	SD	t	df	Sig. (2-tailed)	Decision
Within Groups	Experimental Group: Pretest vs Posttest	32	-7,4	4,01	-10,1	29	0,000	Significant

Table 5 above presents the results of a paired samples t-test comparing the pretest and posttest scores of the experimental group after implementing the Who Wants to Be a Quizizz Millionaire game. The mean difference between the pretest and posttest scores is -7,40; indicating that posttest scores were significantly higher than pretest scores. The standard deviation of 4,01 shows some variability in the participants' improvement, while the standard error of 0,73 reflects the precision of the mean difference estimate. The 95 % confidence interval for the difference, ranging from -8,90 to -5,90; confirms that posttest scores are consistently higher than pretest scores with 95 % confidence. The large t-value of -10,10 underscores the magnitude of improvement, and the p-value of 0,000 ($p<0,001$) indicates that the results are statistically significant, making it highly unlikely that this improvement occurred by chance. These findings demonstrate that the *Who Wants to Be a Quizizz Millionaire* game was an effective intervention for enhancing participants' conceptual understanding of the subject matter, supporting the value of game-based learning strategies in science education.

Table 6. Independent Samples t-Test Results for Pretest Scores of Experimental and Control Groups

Leven's Test for Equality of Variances		T-Test for Equality of Means							Decision
F	Sig.	t	df	Sig. (2-tailed)	Mean	Std. Error Dif.	95 % Confidence Interval of the Dif.		
							Lower	Upper	
0,65	0,424	-2,31	58,00	0,025	-5,13	2,22	-9,58	-0,68	Significant
-	-	-2,31	56,14	0,025	-5,13	2,22	-9,59	-0,68	

Table 6 presents the results of an independent samples t-test comparing the pretest scores of the experimental

and control groups before any intervention was applied. The table begins with Levene's Test for Equality of Variances, where the F-value is 0,65 and the significance level (Sig.) is 0,424; Since the significance value is greater than 0,05; we assume that the variances of the two groups are equal.

Under the assumption of equal variances, the t-test for equality of means shows a t-value of -2,31 with 58 degrees of freedom (df). The p-value (Sig. 2-tailed) is 0,025; which is less than 0,05; This indicates a statistically significant difference between the pretest scores of the experimental and control groups even before the intervention was introduced. The mean difference is -5,13; showing that the experimental group had lower pretest scores compared to the control group. The standard error of the difference is 2,22; which reflects the variability in the difference between the means. The 95 % confidence interval for the mean difference ranges from -9,58 to -0,68; confirming that the difference between the two groups' pretest scores is statistically significant.

In summary, the results indicate that there was an initial disparity in the pretest scores of the experimental and control groups, with the experimental group starting with lower scores. This suggests that prior to the intervention, the groups were not perfectly equivalent, and this difference should be considered when interpreting the post-intervention results.

Table 7. Independent Samples t-Test Results for Posttest Scores of Experimental and Control Groups

Leven's Test for Equality of Variances		T-Test for Equality of Means							
F	Sig.	t	df	Sig. (2-tailed)	Mean	Std. Error Dif.	95% Confidence Interval of the Dif. Lower	Upper	Decision
0,41	0,527	-2,72	58,00	0,025	-5,50	2,02	-9,55	-1,45	Significant
		-2,72	57,81	0,025	-5,50	2,02	-9,55	-1,45	

As shown in the table 7 above, the results of an independent samples t-test comparing the posttest scores of the experimental and control groups. The analysis begins with Levene's Test for Equality of Variances, where the F-value is 0,41 and the significance level (Sig.) is 0,527. Since the significance value is greater than 0,05; the assumption of equal variances is valid for this data set.

Based on the assumption of equal variances, the t-test for equality of means shows a t-value of -2,72 with 58 degrees of freedom (df). The p-value (Sig. 2-tailed) is 0,009; which is less than 0,05; indicating that the difference between the posttest scores of the experimental and control groups is statistically significant. The mean difference is -5,50; meaning that the experimental group scored significantly higher than the control group. The standard error of the difference is 2,02; reflecting the precision of the mean difference estimate. The 95 % confidence interval for the mean difference ranges from -9,55 to -1,45; and because the entire interval is negative, it confirms that the posttest scores of the experimental group are consistently higher than those of the control group.

These results demonstrate that the intervention, *Who Wants to Be a Quizizz Millionaire*, significantly improved the conceptual understanding of participants in the experimental group compared to the control group. The statistically significant difference in posttest scores indicates that the game-based learning approach was effective in enhancing learning outcomes, validating the use of interactive and engaging instructional methods in science education.

The table 8 shows the thematic analysis of student perceptions. This highlights the effectiveness of the gamified learning activity *Who Wants to Be a Quizizz Millionaire* in enhancing engagement, understanding, and knowledge retention. Most students found the activity fun, interactive, and engaging, which helped sustain their interest and motivation. Additionally, the game simplified complex scientific concepts and reinforced prior knowledge, making learning more accessible and enjoyable. However, challenges were noted, primarily technical issues such as poor internet connection and lag, which disrupted participation. Some students also experienced knowledge gaps, struggling with certain concepts despite the engaging format. Despite these challenges, game-based assessments were seen as advantageous, as they reduced test anxiety, improved focus, and encouraged active participation compared to traditional exams. The overwhelming majority of students expressed satisfaction with the activity, with minimal suggestions for improvement aside from better internet connectivity. This analysis underscores the potential of gamification as an effective instructional strategy, fostering a more engaging and dynamic learning environment while promoting deeper understanding of the subject matter.

Table 8. Thematic Analysis of the Students Perceptions

	Themes	Key Findings
Students Insights	Engagement, Ease of Understanding, Reinforcement of Learning	Most students found the activity fun, interesting, and engaging. Some responses indicated that the activity simplified complex concepts. The game reinforced prior knowledge and introduced new insights.
Identified Challenges	Technical Issues, Knowledge Gaps	The most common challenge was poor internet connection and lag, which hindered participation. Some students struggled due to gaps in their prior knowledge. No major concerns beyond technical difficulties and prior knowledge gaps.
Identified Advantages	Engagement, Learning and Knowledge	Game-based assessments made learning enjoyable and interactive, increasing motivation and participation. Students found that the game helped reinforce concepts, improve retention, and facilitate understanding. The assessment method reduced test anxiety compared to traditional exams.
Suggestions	Technical Improvements	Many students believed the activity was already effective and required no changes. A few suggested improving internet connectivity to enhance the experience. Overall, students expressed satisfaction with the game-based assessment.

Educators should consider incorporating gamified strategies like *Who Wants to Be a Quizizz Millionaire* into their teaching practices to enhance student engagement, motivation, and understanding, particularly for challenging topics like evolution. To optimize the effectiveness of gamified learning, schools should invest in reliable internet connections and adequate technological infrastructure to minimize disruptions caused by lag or poor connectivity. Additionally, providing differentiated support and review sessions for students who show minimal improvement can help address individual learning needs and prior knowledge gaps. Conducting professional development workshops for teachers will familiarize them with gamified learning platforms and innovative teaching strategies, enabling more effective implementation in the classroom. Further, exploring the use of gamification in other science subjects and grade levels can assess its broader applicability and impact on learning outcomes. Regular feedback mechanisms should also be implemented to gather student input and continuously improve the design and delivery of gamified learning activities. By addressing these recommendations, educators can create a more dynamic and effective learning environment that fosters deeper conceptual understanding and sustained student engagement.

Despite its contributions, the study had several limitations. The sample size was limited to Grade 11 learners from a single school, which may restrict the generalizability of the findings to broader populations or other educational contexts. Technological constraints, such as poor internet connectivity and lagging devices, also affected the effectiveness of the gamified intervention and may have hindered some students' engagement and performance. The short duration of the intervention may have limited the potential for long-term retention and deeper conceptual understanding, suggesting that a longer implementation period could provide more comprehensive insights. Additionally, students had varying levels of prior knowledge about evolution, which may have influenced their ability to benefit fully from the gamified approach. The qualitative data relied on self-reported feedback, which could be influenced by personal biases, engagement levels, and motivation, potentially affecting the validity of responses. Cultural and contextual factors also played a role, as the study was conducted in the Philippines, where attitudes toward evolution may differ from other regions, influencing students' receptiveness to the subject matter. Lastly, the instructor's familiarity with the gamified approach and their ability to facilitate the activity may have impacted the results, as variability in teaching styles could influence the consistency of the intervention's effectiveness. Addressing these limitations in future research could provide a more comprehensive understanding of the potential and challenges of gamified learning strategies in science education.

CONCLUSION

The study aimed to improve Grade 11 learners' conceptual understanding of evolution through the gamified intervention Who Wants to Be a Quizizz Millionaire. The findings revealed a significant improvement in the posttest scores of the experimental group compared to the control group. The mean difference demonstrated the effectiveness of the gamified approach in enhancing students' comprehension of evolutionary concepts. The game-based strategy increased engagement, facilitated deeper learning, and supported knowledge retention. Additionally, qualitative data highlighted positive student perceptions, emphasizing themes such

as Engagement, Ease of Understanding, and Reinforcement of Learning. Despite some technical challenges, the intervention proved successful in creating an enjoyable and interactive learning environment, addressing common misconceptions, and overcoming traditional barriers to teaching evolution.

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AUTHORSHIP CONTRIBUTION

Conceptualization: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Data curation: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Formal analysis: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Acquisition of funds: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Research: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Methodology: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Project management: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Resources: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Software: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Supervision: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Validation: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Display: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Drafting - original draft: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra

Writing - proofreading and editing: Vanjoreeh A. Madale, Douglas A. Salazar, Monera A. Salic-Hairulla, Angeline P. Dinoro, John Jr G. Adil, Arlyn R. Alcopra