The Effectiveness of Game-Based Assessment Tools (GBAT) in Teaching Technology and Livelihood Education (TLE)

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ABSTRACT

This study examines the effectiveness of Game-Based Assessment Tools (GBAT) in enhancing student engagement and content knowledge in Technology and Livelihood Education (TLE) subjects. Conducted in select schools in Bulacan, the study utilized a quantitative approach, combining descriptive and quasi-experimental designs. Student engagement was assessed through a Likert scale survey, while content knowledge was measured via pre-tests and post-tests. Results showed that GBAT positively impacted both engagement and knowledge retention, with students displaying increased motivation and improved scores in drills and checking for understanding activities. The Analysis of Variance (ANOVA) indicated a significant difference in content knowledge improvement, particularly in the experimental group. Overall, the findings suggest that GBAT offers a promising approach to fostering deeper learning and engagement in TLE subjects, paving the way for its broader application in educational settings.

Keywords: Game-Based Assessment Tools, student engagement, content knowledge, Technology and Livelihood Education, Quizizz, educational technology

INTRODUCTION

The Technology and Livelihood Education (TLE) Learning Hub is an online platform that was a product of developmental research by Santos et al. (2023). It serves as a pivotal tool in the evaluation of students' performance in TLE subjects within the Junior and Senior High School levels, integral to the Department of Education's K-12 Program in the Philippines. This initiative draws upon Game-Based Assessment Tools (GBATs) to engage students effectively. The content of the TLE Learning Hub stems from the contributions of students enrolled in the Bachelor of Technology and Livelihood Education (BTLEd) and Bachelor of Technical-Vocational Teacher Education (BTVTEd) programs at the College of Education (COEd), during the first semester of the academic year 2020 – 2021.

Research by Santos et al. (2023) underscores the significant enhancement in teaching methodologies facilitated by the TLE Learning Hub, with commendable ratings for usability and accessibility. Despite contending with challenges such as internet instability, both the platform and its accompanying tools have proven invaluable for online pedagogy, particularly amidst the pandemic.

Central to the TLE Learning Hub's framework is Quizizz, a versatile gamified learning platform lauded for its capacity to cater to diverse learners, offering varied question formats and fostering higher-order thinking skills while ensuring compliance with accessibility standards (Quizizz, 2024). As noted by Zuhriyah and Pratolo (2020) Quizizz cultivates students' confidence, motivation, and reading skills. Amalia (2020) corroborates this sentiment, highlighting Quizizz's visually engaging interface, its ability to foster a competitive classroom atmosphere, and its superiority over traditional offline assessments.

Empirical data further supports Quizizz's efficacy, with a majority of respondents expressing a preference for the platform over conventional assessment methods such as paper-based tests or Google Forms (Handoko et al., 2021). This preference can be attributed to Quizizz's integration of technology, multimedia elements, and incentivization strategies, which contrast favorably with rote learning approaches (Segaran & Hashim, 2022).

However, conflicting perspectives exist within the scholarly discourse. While Zuhriyah and Pratolo (2020) advocate for Quizizz's positive impact on student engagement through its gamification elements, Buccafusca (2023) cautions against excessive reliance on point-based incentives, advocating for a balanced approach to gamification to ensure sustained student focus.

Quizizz serves a variety of functions in both synchronous and asynchronous learning settings. In synchronous classes, it acts as a versatile tool for drills, review sessions, comprehension checks, and formative tests. Conversely, in asynchronous environments, it can be leveraged for homework assignments (Quizizz, 2024). Regular users of Quizizz often express strong agreement with its usability, its ability to generate interest, its capacity to enhance focus during class, and its effectiveness in reducing distractions from electronic devices (Zhao, 2019). However, research conducted by Permana and Permatawati (2020) suggests that students generally prefer engaging with Quizizz tasks during live classroom sessions rather than as homework.

Santos et al. (2023) advocate for further research aimed at enhancing TLE teachers' proficiency in utilizing Quizizz and contributing to the TLE Learning Hub. They also recommend improvements to the platform's user interface design and question structure.

This study seeks to delve deeper into the efficacy of the TLE Learning Hub, specifically focusing on the role of Quizizz as its GBAT, in enhancing TLE instruction and learning outcomes in Agriculture, Entrepreneurship, and Information and Communications Technology (ICT) components. Through rigorous assessment, this study aims to provide insights into the effectiveness of Quizizz in the TLE context and offer recommendations for its optimal utilization.

Statement of the Problem

The central question of this study is: How can the effectiveness of GBAT in teaching TLE be evaluated?

Specifically, this study will seek to answer the following questions:

1. How can the level of engagement of the students be assessed and the increase in their content-knowledge in drill using GBAT?

2. Is there a significant difference in the level of student engagement and content-knowledge of students using drills in the implementation of GBAT?

3. What are the results of the pre-test and post-test of the students before and after GBAT implementation in checking for understanding?

4. Is there a significant difference in post-test scores between students in the controlled and experimental groups in drills and checking for understanding?

REVIEW OF RELATED LITERATURE

Quizizz has been shown to positively impact student learning in several studies with the findings on its ability to enhance student engagement, improve learning outcomes, facilitate formative assessment practices, and promote collaborative learning experiences.

Game-based Learning Using Quizizz

In the study by Segaran and Hashim (2022), the results demonstrated that Quizizz triggers intrinsic and extrinsic motivation among learners to compete with their peers to obtain better scores and ranks. In the data

obtained from pre-test and post-test scores, the learners demonstrated significant improvement after using online quiz tools. The results of the study revealed that elements such as gamification techniques, rewards and scores, immediate feedback, music, and graphics involved in these online quiz tools helped the pupils to learn grammar better. The same result was identified by Nanda et al. (2018), in which the use of Quizizz application in improving reading comprehension skills was investigated. The data were obtained through a pre-test and a post-test. The results revealed that using the Quizizz application showed better learning outcomes than before it was applied. Nanda et al. (2018) also stated that Quizizz was very enjoyable in the learning process and it could help that designing the learning purpose appropriately, may ease teachers to use the Quizizz Application in improving students' reading comprehension skills.

In the study of Zhao (2019), Quizizz was applied to in-class exercises in an introductory accounting class for two consecutive semesters. The study finds that Quizizz enhances students' learning experiences because it is easy to use, stimulates their interest, helps them concentrate in class, and reduces distraction caused by electronic devices. Furthermore, the results also revealed that students who use Quizizz more frequently show higher scores to the instructor. In the study of Dewi et al. (2020), Mobile Assisted Language Learning (MALL) strategy through Quizizz is applied. It investigates the effect of the aforementioned strategy on the students' grammar mastery at the higher education level. The design of this research was a quasi-experimental research with a post-test-only control group design. The treatment for each group was given six times and once for the post-test. The findings proved that there was a significant effect of the MALL strategy through the Quizizz application on students' grammar mastery. The study by Munuyandi et al. (2021) explored the effectiveness of the Quizizz application for teaching and learning Malay grammar in year-four Tamil school students from 15 Tamil schools in Manjung district with 130 participants. The results showed that it became essential to use Quizizz to learn and teach Malay grammar to Tamil students, stating that it is helpful for teachers to consider using fun and entertaining technology quizzing tools to teach Malay grammar.

Additionally, Pham (2023) identified the impact of gamified learning using Quizizz which focused on English as a Second Language (ESL) learners' grammar achievement. A pre-test and post-test control was applied to the 63 freshmen. There were 33 students from the experimental group doing the quizzes on Quizizz, while 30 participants from the control group did the same quizzes in a paper and pencil test format. Pham (2023) revealed that although students from two groups improved their scores on the post-test compared to the pre-test, the treatment group achieved significantly higher scores than those from the control group. The findings of the study indicate that Quizizz can improve ESL students' scores on the grammar achievement test.

In conclusion, these studies collectively highlight the positive impact of Quizizz as an effective tool for enhancing student learning across various subjects, including grammar and reading comprehension.

Students' Perspectives on Using Quizizz

Quizizz, as an online platform, plays an important role and has a high impact on the students for interactive learning. Based on various students' perspectives, here are few common proofs that this is an effective tool as an aid for learning.

From the study of Basuki and Hidayati (2019), he used Kahoot! as a tool to (1) know the students' perceptions of Kahoot! and Quizizz efficacy in a daily online quiz, (2) figure out the students' choices and (3) find their reasons. In the data obtained from a close-ended questionnaire and analyzed quantitatively by implementing the Likert Scale, the study concluded that Quizizz efficacy gained supportive responses with a total score of 15.484 and proved that this was more effective to foster students' enthusiasm for learning and better than Kahoot! with a total score of 12.248, from the responses of 250 students of the English Education Department of STKIP PGRI Trenggalek.

The same result was identified by Amalia (2020) form her study "Quizizz Website as an Online Assessment for English Teaching and Learning: Students' Perspectives" that aimed to investigate the students' perspectives toward the use of Quizizz as an online assessment tool for English teaching and learning, especially on a formative assessment. The respondents of the study were 20 students from the Dynamic English Course. The data was collected by asking the students to fill the questionnaire and data analysis was

implemented using the Likert scale. The obtained result was the students strongly agreed that Quizizz has an attractive display which they discovered interesting and fun. On a teacher's note, students can't cheat during the test. This application creates a competitive atmosphere in the classroom, and Quizizz is better than the offline traditional test method.

In addition, Zuhriyah and Pratolo (2020) identified from his study "Exploring Students' Views in the USe of Quizizz as an Assessment Tool in English as a Foreign Language (EFL) Class" that aimed to explore students' views in using Quizizz as an assessment tool in an English class and utilized a semi-structured interview to gather data and information. The participants were students from one of the private universities in Yogyakarta in Indonesia. The results revealed that some of the students' views regarding the use of Quizizz are: (1) an interesting tool, (2) encouraging students' confidence, (3) increasing students' motivation, and (4) improving their reading ability. Furthermore, the students gave a positive response to the use of the Quizizz in the classroom.

Moreover, Patisung (2020) identified among the 25 students who attended a tutorial school in Chonburi Province, Thailand on October 2020, aimed to investigate Thai High School students' attitudes towards using Quizizz on English vocabulary learning in terms of satisfaction, advantages, disadvantages, and other suggestions. The obtained results of the students' attitudes towards Quizizz attempted to answer the following research questions: (1) To what extent are the students satisfied with using Quizizz to learn English vocabulary? (2) What are the students' perceived advantages and disadvantages in using Quizizz in English vocabulary learning? and (3) What are the students' suggestions towards the use of Quizizz in English vocabulary in Learning? The findings gained from the questionnaires that illustrated the overall mean score of the students' satisfaction towards learning vocabulary using Quizizz was 4.58. This score interpreted that the students had a very high satisfactory level in using the application.

In conclusion, students generally perceive Quizizz Application positively as a valuable and engaging learning tool that effectively combines education with gamified instructions. It strengthens in promoting active learning through immediate feedback, self-paced progression, fun, enjoyable, and interactive environment in the classroom. Overall, the Quizizz Application is widely appreciated not only by the students but also to teachers for making the learning process more interactive, accessible, and enjoyable.

Game-Based Assessment Using Quizizz

Game-based assessment is an innovative approach to evaluating students' knowledge and skills by integrating game elements into the learning process. Quizizz is a popular tool and platform that embodies this method, offering a dynamic way to assess the students while keeping them engaged inside the classroom.

The study by Permana and Permatawari (2020) from their study, "Using Quizizz as Formative Assessment Tool in German Classrooms," involves a group consisting of two classes, namely Class A with 32 students and Class B with 29 students. The two classes received an equal treatment using the Quizizz Application. The study aimed to examine the effect of using Quizizz as a formative test tool in German classrooms. The survey results showed that students prefer to work on the Quizizz tasks live in the classroom instead of as a homework assignment. 36% of the students are against the idea that the usual form of paper-based evaluation should be used and replaced by the Quizizz Application. This formative test allows the students to repeat the material and get direct feedback on their level of control. Most of the students have responded positively to the Quizizz application in the classroom. As a result, Quizizz is one of the tools for a formative assessment that can be used effectively in German lessons, especially to increase the grammar and vocabulary mastery of the students.

In the study of Mumuyandi et. al., (2021) with regard to the "Effectiveness of Quizizz in Interactive Teaching and Learning in Malay Grammar" with the different applications that had been developed in Malaysia as assessment tools. It is considered Quizizz as a game-based online quiz in teaching and learning. The study used a descriptive questionnaire research design among 130 students from Tamil schools by following the simple random sampling strategy. They explored the effectiveness of the Quizizz application as a formative assessment tool for quizzes of year-four Tamil school students from 15 Tamil schools in the Manjung District. The result showed that it was imperative to use Quizizz as a formative assessment tool to learn and teach

Malay grammar to Tamil students. Students also responded positively to the use of Quizizz in the classroom through survey questionnaire results. In the end, the researchers concluded that it is important for teachers to consider using fun and entertaining technology quiz applications as an assessment tool to teach Malay grammar.

Additionally, Handoko, et. al., (2021) from the study "Gamification in Learning using Quizizz Application as Assessment Tools" discovered that this tool for studying activities in project management information systems subject and the method used in this study is technology-based applied research. The assessment tool in this study used Quizizz in midterms. The exam was attended by 29 students of the Information Systems Department STMIK Royal. The obtained result with the use of Quizizz has a positive impact. The level of students who answered the questions correctly is 51%. Then 66% prefer Quizizz as an assessment tool to paper and google forms.

In conclusion, game-based assessment through Quizizz presents a dynamic and effective tool for both teaching and evaluating students. By combining immediate feedback, motivational elements, and game-like features, Quizizz enhances student engagement and offers valuable insights into student performance. Quizizz transforms traditional assessments like pen and paper into an engaging learning experience. It is also important to strike and consider a balanced use between game elements and educational objectives to maximize its effectiveness in the classroom. When this is utilized thoughtfully, Quizizz can significantly enrich the assessment process, making it both fun and educational.

METHODOLOGY

This study employed a quantitative research approach to select schools of the Department of Education in Bulacan. The study utilized descriptive and experimental research design. For the descriptive research, the study utilized the GBAT for the Information and Communications Technology (ICT) and Entrepreneurship subjects, with the teachers using the hub twice a week for five weeks for the level of engagement and 6 weeks for drills. To assess student engagement levels, all respondents completed a Likert scale survey questionnaire at the beginning and end of each week. The survey, sourced from the study by Hart et al. (2011), was developed and validated by scholars from over nineteen countries. Although the original survey comprised eight areas, this study focused on three areas—affective, behavioral, and cognitive—that were deemed most appropriate for its objectives.

The quasi-experimental research involved the subject of Agriculture. The same group of students participated in this phase, with pre-tests and post-tests administered to determine the effectiveness of the GBAT in checking for understanding activities. The groups of students were taught by the same teacher and were sectioned heterogeneously. Both groups are distributed based on pre-tests and also equally distributed through their digital literacy. Instruments for the pre-test and post-test were developed by the teacher and validated by the head teacher.

The study was conducted in the 4th quarter of the Academic Year 2023-2024 with select students from DepEd schools in Bulacan. Data gathered were interpreted and analyzed using mean, standard deviation, analysis of variance (ANOVA), and t-test for two independent samples.

GBAT was implemented by two teachers by using it in the classroom to measure the level of engagement twice a week for five weeks and increasing the content knowledge using drills in six meetings. One teacher integrated GBAT during checking for understanding in five weeks. These teachers included the use of GBAT in their daily lesson logs.

RESULTS AND DISCUSSION

Level of Engagement of the Students in Using GBAT

Student engagement, a critical component of successful education, has garnered significant attention in recent years. **S**tudent engagement, characterized by students' active involvement in the learning process, has emerged

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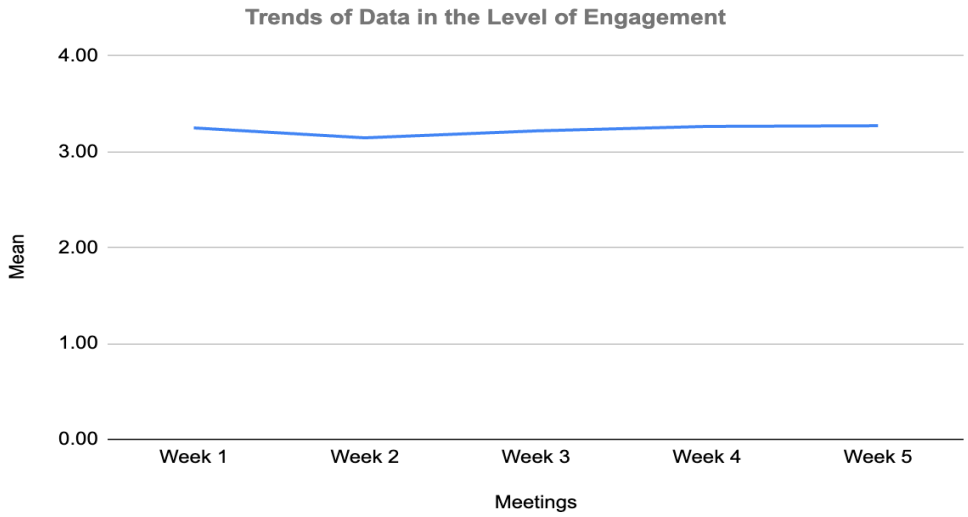
as a critical factor influencing academic outcomes. Beyond mere attendance, engagement encompasses behavioral, emotional, and cognitive dimensions (Skinner, 2016). Research consistently demonstrates that engaged students exhibit higher levels of motivation, persistence, and achievement (Wang & Fredricks, 2014). As educational landscapes evolve with the integration of technology and diverse learning modalities, understanding and fostering student engagement remains a paramount challenge for educators (Barkoukis et al., 2014). Engaging students in the learning process is no longer an option but a necessity in today's rapidly evolving education.

Incorporating GBAT into classroom drills has proven to be an effective way to increase students' knowledge levels by making learning interactive and engaging. The researcher observed firsthand how the platform's gamified features, such as instant feedback, points, and leaderboards, capture students' attention and motivate them to participate actively in lessons. This heightened engagement translates into better retention and understanding of the material. Students often show noticeable improvement in their comprehension and recall of information after participating in Quizizz under GBAT activities, as they can immediately identify and address their learning gaps. The competitive yet enjoyable atmosphere encourages students to focus and strive for higher scores, leading to a deeper understanding of the subject matter. Overall, using GBAT especially Quizizz in classroom drills has positively impacted students' learning experiences and outcomes, helping them gain more knowledge effectively.

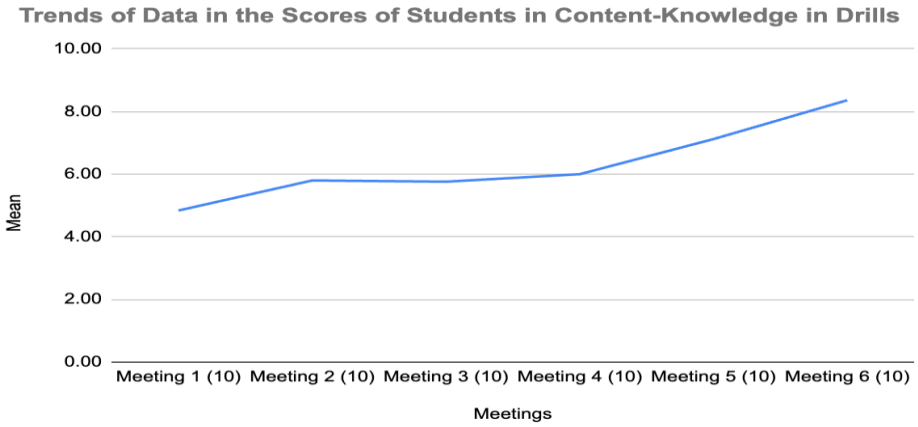
Figure 1 Descriptive Measures of the Level of Engagement of the Students in Using GBAT



The data on the mean level of engagement over five weeks indicates a generally stable trend with minor fluctuations. In Week 1, the engagement starts at a mean of 3.25, but it slightly dips to 3.15 in Week 2. This is the lowest point in the observed period. Following this decline, the engagement mean increases to 3.22 in Week 3, and continues to rise slightly to 3.27 in Week 4, where it remains steady through Week 5. The graph visualizes these changes, showing a subtle dip followed by a gradual rise and stabilization. Overall, the level of engagement is relatively consistent, with no significant upward or downward trends. Despite the slight variations, the data suggests a stable engagement level among participants throughout the five-week period.

In recent years, the integration of digital tools in education, particularly in language learning, has been the focus of various studies aimed at enhancing student engagement and motivation. One such study by Fadilah (2023) explores the use of Quizizz as a learning media in English language learning at SMKN 5 Makassar. This study revealed that Quizizz positively impacts students' motivation and interest by providing interactive quizzes and immediate feedback. The students were more engaged, actively participating in the quizzes, and displayed a higher level of interest in learning the language. Moreover, this research is consistent with the study of Zhao (2020), which highlighted the effectiveness of gamified learning platforms like Quizizz in maintaining students' attention and interest in learning.

Figure 2 Trend Graph of the Content-Knowledge of Student in Drill using GBAT



The graph shows a clear upward trend in student scores on content-knowledge drills over six meetings. Starting from a mean score of 4.84 in Meeting 1, the scores increase steadily, reaching 8.36 in Meeting 6. The line graph highlights this consistent improvement, with a particularly notable rise between Meetings 4 and 5, where the mean jumps from 6.00 to 7.12. The general trend indicates that the instructional methods are effective, leading to progressively higher scores. The steepening slope towards the end of the period suggests accelerated improvement, reinforcing the positive impact of the drills on student performance.

These findings is supported by the study (Maraza-Quispe, 2024), which stated that the use of online gamification tools such as Kahoot and Quizizz enhances the feedback process in educational technology. These platforms have consistently shown their ability to improve students' understanding and knowledge in Information Technology in Healthcare by offering timely and effective feedback. By integrating game-like elements into the learning process, these tools engage students in a way that traditional methods often do not, fostering an interactive environment that promotes active learning and retention of information. This approach allows students to quickly identify areas of improvement and build on their strengths, leading to a deeper comprehension of the subject matter.

Difference in the Level of Engagement of Students and their Content-Knowledge

Table 1 Comparison of the scores of the level of engagement of student using ANOVA

Source	**SS**	**df**	**MS**	
Between-treatments	0.4958	4	0.124	F = 0.38704
Within-treatments	72.9761	230	0.3173	
Error	58.9283	184	0.3203	

The data presented in Table 1 evaluates the level of engagement of students through an Analysis of Variance (ANOVA). The analysis distinguishes the sources of variability into between-treatments, within-treatments, and error. The between-treatments source, representing the variability attributed to different groups, has a sum of squares (SS) of 0.4958, with 4 degrees of freedom (df), and a mean square (MS) of 0.124. The within-treatments source, representing variability within each group, shows a SS of 72.9761 with 230 df and an MS of 0.3173. The error source, accounting for unexplained variability, has a SS of 58.9283 and 184 df, leading to an MS of 0.3203.

The computed F-ratio is 0.38704, which is the ratio of the MS between-treatments to the MS within-treatments. This low F-ratio indicates that the variability between the group means is not substantially greater than the variability within the groups. Furthermore, the p-value associated with the F-ratio is 0.817743, which is much higher than the conventional significance level of 0.05. Consequently, this result is not statistically

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significant, implying that there is no substantial difference in the level of engagement among the different student groups.

Therefore, we fail to reject the null hypothesis, which suggests that the treatments or interventions applied to the groups do not have a significant effect on student engagement. The results indicate that any observed differences in engagement levels among the groups are likely due to random variation rather than the effects of the treatments. Further research might be needed to explore other factors affecting student engagement or to apply different methodologies for more definitive insights.

In the study of Ayu et al. (2021), they found that Quizizz can promote student engagement, but its effectiveness may vary depending on how it is used. Similar to the result of the current study, this reported that student engagement levels did not significantly differ across different groups using Quizizz. The study suggested that while Quizizz is useful for gamifying learning, the actual impact on engagement may depend on additional factors such as content, class dynamics, or teacher facilitation.

Table 2 Comparison of the scores of the increase of content-knowledge of students using ANOVA

	Type III Sum of Squares	**df**	**Mean Squares**	**F**	**p**	**η2**
Treatment	191.95	5	38.39	34.93	<.001	0.59
Residual	131.88	120	1.1			

The table presents the results of an ANOVA analysis comparing the increase of content-knowledge of students across different treatments. The analysis reveals that the treatment effect is substantial, with a Type III Sum of Squares of 191.95 compared to the residual sum of squares of 131.88. The degrees of freedom for treatment and residual are 5 and 120, respectively, leading to mean squares of 38.39 for treatment and 1.1 for residual. The calculated F-ratio is 34.93, indicating that the variance between the treatment groups is significantly larger than the variance within the groups. The p-value is less than 0.001, showing a highly significant result. This means that the likelihood of observing such a difference among the group by random chance is less than 0.1%, thus allowing us to reject the null hypothesis. Furthermore, the eta squared (η^2) value of 0.59 suggests that 59% of the total variance in the increase of content-knowledge scores can be attributed to the treatment, indicating a large effect size. Overall, these results suggest that the treatments have a significant and substantial impact on the increase of content-knowledge among students.

Pre-test and Post-test of Control Group and Experimental Group

In today's generation, life skills are crucial to teach. Beyond fostering critical and creative thinking, educators should also address global challenges such as food scarcity and production. By equipping learners with life skills, we empower them to be environmentally conscious and self-reliant. In schools with ample land suitable for farming, agriculture is a vital life skill competency. It not only involves caring for crops and plants but also educates students on the proper use and disposal of agricultural materials, tools, and equipment. These practical skills are essential for everyday farming experiences. Engaging in agricultural activities not only equips students with practical skills but also fosters environmental awareness. Whether approached as a leisure pursuit or a potential business venture in their future careers, understanding the environmental impact of agriculture is crucial. By integrating technology like GBAT (Game-Based Assessment Tools), educators can create effective and engaging learning experiences that encourage more students to explore the field of agriculture.

Table 3 Descriptive Measures of the Pre-test and Post-test in Checking of Understanding Using GBAT

	CONTROL GROUP		**EXPERIMENTAL GROUP**	
MEAN	8.74	9.40	6.05	8.49

SD	0.53	0.39	0.70	0.62

The table presents pre-test and post-test scores for control and experimental groups in checking understanding using GBAT. The control group's mean scores improved slightly from 8.74 to 9.40, with a decrease in standard deviation from 0.53 to 0.39, indicating more consistent scores. In contrast, the experimental group showed a significant increase in mean scores from 6.05 to 8.49, with the standard deviation decreasing from 0.70 to 0.62, reflecting improved consistency. Comparatively, the experimental group exhibited a more substantial improvement (2.44 points) than the control group (0.66 points), indicating the experimental intervention was particularly effective in enhancing understanding. Both groups' reduced standard deviations suggest that the interventions led to more uniform performance among students. Overall, the experimental group's greater mean score increase and improved consistency highlight the success of the intervention in significantly boosting students' understanding.

Education is becoming more advanced with increasingly sophisticated technology. The use of education-based technology has evolved since the mid-twentieth century promoting e-learning as an alternative to facilitating student learning. This finding is supported by the study of Zuriyah and Pratalo, (2020) that assessed and explore the students' views in using Quizizz as an assessment tool which revealed that this is an effective tool that encourage students' confidence, increase students' motivation, and most importantly improves their reading ability through their positive response to the use of Quizizz in the classroom. Therefore, the level of student's participation and engagement in learning experience and intervention can also influence their success. Through adaptability, GBATs can be tailored to individual learning styles and paces. This allows for personalized learning experiences where students can work at their own pace and level while improving their understanding. GBATs also cover a range of skills like critical thinking and problem-solving which can help students reinforce various aspects of the subject matter. Overall, GBATs can significantly enhance student's understanding by making learning more engaging, personalized, and interactive.

Difference between the post-test scores of students before and after the implementation of GBAT

Table 4 T-test between Posttest of both groups

Variables	**t**	**Sig-value**	**Decision**	**Interpretation**
Posttest (Control) and Posttest (Experimental)	-6.34592	.00001	Reject Ho	The intervention is effective.

The table presents the results of a t-test comparing the posttest scores between a control group and an experimental group. The t-value is -6.34592, indicating a substantial difference between the two groups' posttest scores, with the experimental group performing significantly better. The p-value is 0.00001, far below the typical significance threshold of 0.05, confirming that this difference is statistically significant. Consequently, the null hypothesis is rejected, leading to the conclusion that the intervention applied to the experimental group was effective. This significant improvement in the experimental group's performance suggests that the intervention had a positive impact, validating its efficacy and potential for broader application under similar conditions. These findings align with the study conducted by Zhao (2020), which also explored the impact of Quizizz on student achievement.

Zhao (2020) found that students in the experimental group who used Quizizz for learning and assessment outperformed the control group significantly. The study highlighted that Quizizz's interactive features, such as real-time feedback and gamification, increased student motivation and understanding, contributing to higher posttest scores. Both Zhao's study and the current research confirm the effectiveness of Quizizz as an educational tool, validating its potential for enhancing student learning in various contexts.

By drawing parallels with Zhao (2020), the current research reinforces the conclusion that Quizizz is a highly effective platform for improving academic performance, particularly through its engaging and motivating approach.

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CONCLUSION AND RECOMMENDATIONS

Conclusion

This study assessed the effectiveness of Game-Based Assessment Tools (GBAT), specifically Quizizz, in enhancing student engagement and content knowledge in the subjects of Information and Communications Technology (ICT), Entrepreneurship, and Agriculture. The results demonstrated that the integration of GBAT significantly impacts students' engagement levels and content knowledge acquisition during classroom drills and checking for understanding activities.

Regarding student engagement, the findings indicate that using GBAT creates an interactive learning environment that fosters behavioral, affective, and cognitive engagement. Despite minor fluctuations, students consistently exhibited stable engagement throughout the study period. Gamified features such as instant feedback, point systems, and leaderboards effectively captured students' attention and motivated them to actively participate in the learning process. These findings are consistent with prior research (e.g., Fadilah, 2023; Zhao, 2020), which emphasized the positive role of gamification in maintaining student interest and motivation.

In terms of content knowledge, the students' performance showed significant improvement, with a clear upward trend in their drill scores over six meetings. The results of the ANOVA confirmed a substantial treatment effect, with GBAT contributing to 59% of the variance in content knowledge improvement. The experimental group, which participated in checking for understanding activities using GBAT, demonstrated a significantly higher mean score increase compared to the control group. This suggests that GBAT is an effective tool for enhancing student understanding and knowledge retention.

The t-test results further validate the effectiveness of GBAT, with the experimental group's post-test scores significantly outperforming those of the control group. This highlights the potential of GBAT to not only increase student engagement but also to facilitate deeper comprehension and better performance outcomes in subjects like Agriculture, which require the practical application of life skills.

Recommendations

Based on the findings of this study, the following recommendations are proposed. Given the positive impact of GBAT on student engagement and content knowledge, it is recommended that schools expand its use in other Technology and Livelihood Education (TLE) subjects beyond ICT, Entrepreneurship, and Agriculture. Subjects that require frequent drills and checking for understanding, such as Home Economics and Industrial Arts, may also benefit from the gamified approach. To maximize the potential of GBAT in classrooms, teachers should be provided with regular training on how to effectively integrate these tools into their lessons. Professional development workshops focusing on creating gamified assessments and interpreting data from platforms like Quizizz would equip educators with the necessary skills to improve student learning outcomes. Teachers should consider customizing GBAT activities to cater to students with varying learning needs and preferences. By offering differentiated assessments based on student ability levels, educators can ensure that all students, including those who may struggle with traditional methods, can benefit from the interactive nature of GBAT.

By adopting these recommendations, educators can continue to harness the benefits of game-based learning to improve student outcomes and engagement, ultimately contributing to more dynamic and effective learning environments.

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