Fun with Quizizz: Gamified Formative Assessment Utilizing Integer Operation Drills to Build Mastery in Polynomial Operations

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ABSTRACT

This study highlighted the value of gamified formative assessment through Quizizz in reinforcing foundational math skills and supporting confidence in complex operations, contributing to educational technology while noting the need for deeper learning and broader applicability. It aimed to determine the effectiveness of Quizizz as a gamified drill in enhancing student engagement and performance in solving operations involving integers and polynomials. A quasi-experimental action research design was employed involving two matched Grade 7 groups from the University of San Agustin Basic Education Department. One group used traditional drills, while the other engaged with Quizizz over 10 consecutive class days. Data were collected through pre- and post-tests, class records, journals, and informal interviews, and analyzed using mean, standard deviation, Wilcoxon Signed-Rank Test, and Mann-Whitney *U* Test. Results showed that both the Quizizz group (pretest M=56.40, SD=25.40; posttest M=75.70, SD=18.80; p=0.000) and the Traditional Drill group (pretest M=44.40, SD=23.00; posttest M=72.90, SD=14.00; p=0.000) significantly improved in performance. However, the difference between their posttest scores was not statistically significant (p=0.410). Despite similar gains in test scores, Quizizz demonstrated added value in boosting student motivation, participation, and lesson retention. Some students encountered connectivity issues, indicating the importance of technological preparedness in implementing gamified tools. The findings suggest that while both methods are effective, integrating gamified platforms like Quizizz can enhance student engagement and learning experience. Educators are encouraged to combine traditional and interactive approaches and consider students' digital readiness. Further research is recommended to investigate the long-term impact of gamification across various mathematical domains.

Keywords*:* gamification, Quizizz, student engagement, academic performance, technology integration

INTRODUCTION

Individual learning is dependent on several factors such as subjective effort, environmental influence, and psychological factors. These factors significantly contribute to the quality of learning that students may acquire. Students who are motivated, eager to learn, and have academic goals are considered deep students who are independent and need little supervision (Biggs & Tang, 2011). Meanwhile, students who do not worry much about their class standing, not interested in the subject, and the only goal is to pass the exam are surface students who do not have sufficient learning about the topic (Ramsden, 2004). The most prominent cause of such little engagement of students with the topic is their lack of enthusiasm and the academic boredom towards the lesson. Relationships between students' academic boredom and performance in Mathematics have shown to be significantly correlated. It reveals in several studies that when students are bored in the classroom they tend to not listen and participate in the discussion which later on produces poor performance in their assessments (Linnenbrink-Garcia & Pekrun, 2011; Maroldo, 1986; Sharp et al., 2018).

It was revealed that among 1000 middle school students, around 60% of them experienced the boring and monotonous approach in school (Sørlie & Nordahl, 1998; as cited by Özerk, 2020). According to these students,

they describe boredom as passivity, lack of interest, and an introverted resistance. Furthermore, the researchers found out that students consider boredom as an emotional form of reaction, which resulted in the school's difficulty in accomplishing its goals in communicating values, attitudes, and creating optimal conditions for learning. Moreover, the teachers experience that students' boredom implies a mental absence in the classroom (Sørlie & Nordahl, 1998; as cited by Özerk, 2020).

The following research shows various factors that can contribute to boredom in the school situation, such as monotonous and repetitive activities. Students identified monotonous teaching as one of the main reasons for the occurrence of boredom that hinders students' school-based learning. From an educational and psychological perspective, it is reasonable to ask for intervention for boredom where the main aim is to prevent academic boredom in classrooms and eventually improve students' academic performance. We also have to admit that it is impossible to totally eliminate boredom in our lives, neither in the classrooms. Therefore, it is an important task for school professionals to help students to develop capacities and the necessary strategies to cope with boredom as conscious individuals (Özerk, 2020).

Based on the perspectives of Linnenbrink-Garcia & Pekrun (2011), creation of classroom settings that prevent and help students to handle boredom necessitates following qualities: (1) Variety and excitement in the class that ensure involvement, (2) Experiencing the content (3) material and learning activities as meaningful, (4) Reasonable amount of stimulation and challenges, (5) Feeling of being in the class is better than being outside, (6) Good teacher-student relationship, (7) Enthusiasm, (8) Positive reinforcement, (9) Supporting students even after failure. From these suggested activities, the variety and excitement in the class that ensure involvement of the students will be the focus of this action research. Moreover, it was revealed that Huang and Hew (2015) found that learning through interactive sessions helps students learn more and improves their problem-solving cognitive abilities.

Game-based learning, by coordinating several capabilities into the learning process, is also considered to have the ability to increase students' engagement. Moreover, students who play educational games show, when compared to students who do not play such games, better educational gains in various subjects, including in regard to understanding the English language (Boctor, 2013). Thus, integrating learning with a game-based approach can be an effective means of harmonizing teachers' and students' preferences. In short, game-based learning contributes to improving students' engagement, coordination, and creativity (Adipat et al., 2021). Hence, the aim of the study is to improve student's engagement with the lesson, and to enhance their academic performance using gamified tool - Quizizz when teaching operations involving polynomials.

Entirely, this study aimed to compare the effectiveness of Quizizz and traditional drill by examining students' pre-test and post-test scores. It also sought to determine whether there were significant differences in the performance of students between the two methods before and after the intervention.

METHODS

This study utilized an action research design, specifically a quasi-experimental approach, to engage students in class and improve their performance in solving operations involving polynomials. Action research, according to Fraenkel et al. (2012), is used by teachers, administrators, or other educational professionals to solve problems at a local or smaller scale. The study was conducted with 27 Grade 7 students. Participants were divided into two groups based on matched pairs using their first quarter grades. The intervention lasted 10 consecutive class days, with lessons covering operations on polynomials (addition, subtraction, multiplication, and division) based on the DepEd Curriculum Guide.

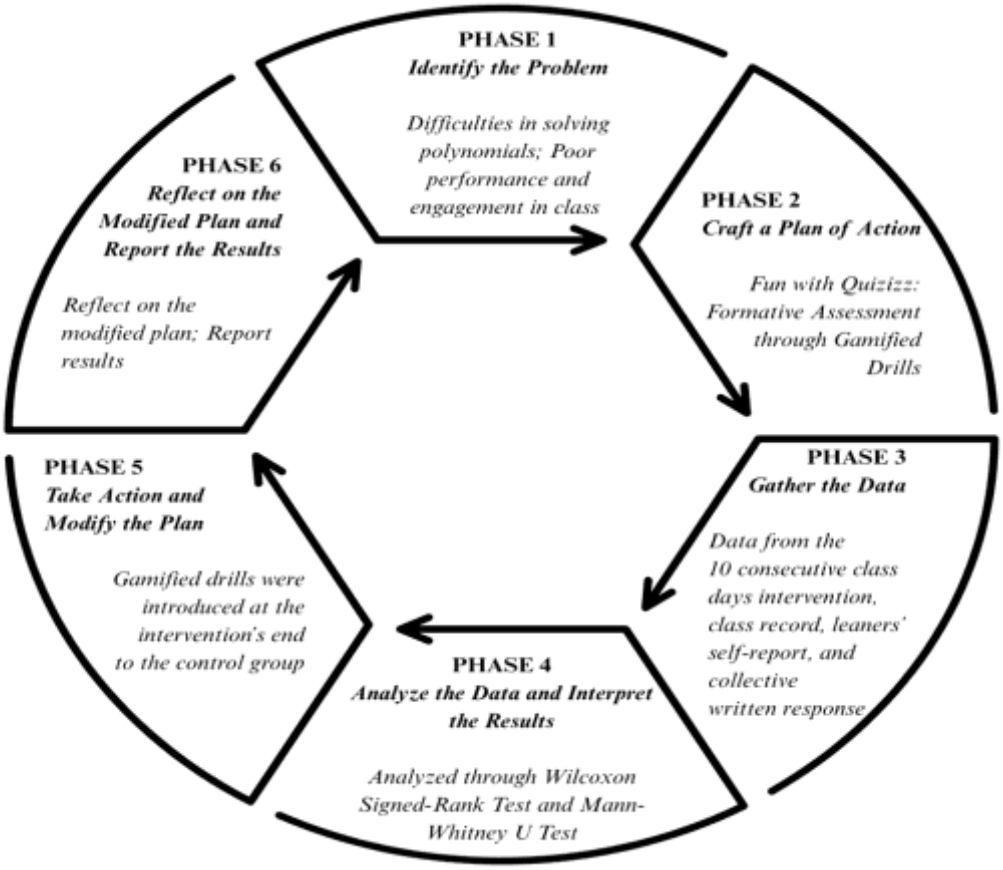
The experimental group used Quizizz as a drill while the control group used the usual routine with a PowerPoint presentation, both prepared with the same questions projected on the screen. Quizizz, defined as an educational application that incorporates game elements such as avatars, memes, music, and leaderboards to transform classroom activities into interactive and enjoyable experiences (Zhao, 2019; as cited in Setiyani et al., 2020), was used as a formative assessment tool to recall prior lessons and assess skills in operations involving integers. Test scores before and after the activities were analyzed to determine the tools' effect on student engagement and mathematics performance. In each session, the researchers also kept journal notes for reflective writing on

how each activity went, noting student participation, written comments, and potential modifications for subsequent lessons. Data-gathering instruments included class records, daily notes, participation levels, and student feedback.

The researchers ensured full compliance with ethical standards throughout the conduct of the study. Prior to implementation, consent was obtained from the Supervisor, and assent forms were distributed to participants to secure their voluntary involvement. The research protocol—including its objectives, methodology, data collection instruments, and treatment of participants—was carefully reviewed and found to adhere to established ethical principles. This adherence upholds the core values of respect for persons, beneficence, and justice, thereby safeguarding the rights, safety, and overall well-being of all students. Moreover, the study was carried out responsibly in alignment with institutional and national guidelines for ethical research. Scores used in this study were retrieved from academic records, and the researchers relied primarily on secondary data. Participants' responses, collected through daily journals and essays, were archived and made available for analysis, ensuring that no additional burden was placed on the learners. Importantly, the conduct of the study did not compromise student learning, as its duration was strictly aligned with the time frame prescribed in the curriculum and was not extended, ensuring equitable attention was given to other topics under the quarter.

Moreover, this action research follows a cyclical model to illustrate a step-by-step process. It consists of six phases adapted from Fraenkel et al. (2012): (1) Identify the Problem, (2) Craft a Plan of Action, (3) Gather the Data, (4) Analyze the Data and Interpret the Results, (5) Take Action and Modify the Plan, and (6) Reflect on the Modified Plan and Report the Results.

Figure 1 Iterative Steps in the Six-Phased Action Research Model



Note. This action research framework was adapted from Fraenkel et al. (2012).

Phase 1. Identify the Problem

The researchers identified a prevailing problem in the Grade 7 Mathematics class, wherein students exhibited

difficulties in solving polynomials. This concern was further reflected in their consistently declining academic performance and low engagement during lessons. To address this issue, the researchers focused on the students' poor engagement and unsatisfactory performance in class as the central problem of the study.

Two groups of students were identified and subjected to a matched-pairing process based on their first grading grades to minimize bias in group selection. The standard deviation of the students' first quarter grades was computed to establish the level of homogeneity between the groups. The first quarter coverage included integers and the four fundamental operations (addition, subtraction, multiplication, and division), which served as prerequisite skills for the succeeding lessons on polynomials.

To further validate the matched-pair process, a pretest was administered to both the experimental and control groups. The results of the pretest were analyzed to determine whether the two groups were statistically comparable in terms of their prior knowledge and skills. This step ensured that any significant differences observed in the posttest results could be attributed to the intervention rather than pre-existing disparities between the groups.

Phase 2. Craft a Plan of Action

In this phase, the researchers formulated a comprehensive plan to address the identified problem. Careful consideration was given to the selection of an appropriate intervention, with the primary strategy centered on the use of drills to reinforce prerequisite knowledge. A drill was designed as a form of gamification-based formative assessment, specifically employing Quizizz, to stimulate students' interest and engagement prior to the formal discussion of the lesson. The Quizizz activity functioned as a recall exercise targeting operations on integers, a foundational skill necessary for mastering polynomial operations.

To evaluate the effectiveness of this intervention, the students were randomly assigned into two groups: the control group and the experimental group. The experimental group was exposed to gamification through Quizizz as a drill, while the control group engaged in traditional drill exercises. This design allowed for a systematic comparison between the two approaches, thereby enabling the researchers to determine the relative impact of gamification-based drills versus conventional methods on students' engagement and performance.

Phase 3. Gather the Data

In this phase, the researchers systematically collected the data relevant to the study. Following the development of the intervention plan, the implementation was carried out over ten consecutive class days, with each session lasting one hour. The intervention was administered according to the class schedule: the first group participated from 10:00–11:00 a.m., while the second group was scheduled from 11:00 a.m.–12:00 p.m. To ensure accurate documentation, the researchers utilized class records and daily journals to capture students' responses, while informal interviews were also conducted to gain insights into students' progress and perceptions of the activity.

The ten-day intervention was structured progressively to reinforce and deepen students' mastery of integer operations. On Days 1–2, the focus was on recalling rules for adding integers. Days 3–4 involved slight drill modifications, such as paired and individual activities, to enhance collaboration and independent practice. Day 5 strengthened previously learned concepts, while Days 6–7 targeted multiplication of integers. Days 8–9 covered division of integers. On Day 10, both groups engaged in a review activity using Quizizz, which provided a fun and interactive experience despite minor connectivity issues. To further support students who struggled, a remediation activity was conducted throughout the intervention, which effectively enhanced foundational knowledge, clarified misconceptions, and addressed individual learning needs.

A uniform set of ten-item questions was used as drills for both the control and experimental groups. For the control group, the items were projected through a PowerPoint presentation. Students were instructed to write their answers in their mathematics notebooks, with one minute allotted per item. After completion, the answers were reviewed, and the correct solutions were discussed to provide immediate feedback.

In contrast, the experimental group engaged with the same set of drill questions through Quizizz. Students were given three minutes prior to the activity to log in to the platform. Each item allowed a maximum response time

of one minute, after which the researchers provided explanations to address misconceptions and reinforce correct answers. The platform's leaderboard displayed students' scores in real time, encouraging higher engagement, enthusiasm, and active participation compared to the traditional drills. At the conclusion of the activity, Quizizz generated a summary of results that highlighted students' ranks, errors, and overall performance. Observations revealed that Quizizz made mathematics lessons more enjoyable and interactive, with learners recalling rules on integer operations and participating eagerly in discussions, even if the overall difference in test scores between the groups was minimal.

Phase 4. Analyze the Data and Interpret the Results

In this phase, the researchers carefully analyzed the data collected in order to draw meaningful conclusions regarding the effectiveness of the intervention. The test results were systematically examined and interpreted to determine patterns of students' performance. Descriptive statistics, particularly the computation of the mean, were employed to establish the average scores of the groups. To assess the significance of the observed differences, non-parametric tests were utilized given the nature of the data. Specifically, the Wilcoxon Signed-Rank Test was applied to measure the differences between the pretest and posttest scores within each group, while the Mann–Whitney *U* Test was used to compare the posttest scores of the control and experimental groups. These statistical procedures provided a robust basis for evaluating whether the use of gamification through Quizizz as a drill activity yielded significant improvements compared to the traditional drill method.

Phase 5. Take Action and Modify the Plan

In this phase, the researchers implemented modifications to the intervention based on the findings and observations during the conduct of the study. Adjustments were introduced to further enhance student engagement and improve performance outcomes. The primary modification involved allowing the control group to experience the gamified drills through Quizizz toward the latter part of the intervention. Specifically, this adjustment was applied on the eighth day of implementation to provide the control group with exposure to the gamification strategy originally designed for the experimental group. This modification not only addressed issues of fairness and inclusivity but also enabled the researchers to observe the immediate effects of gamification on students who had previously been exposed only to traditional drills.

Additionally, the researchers identified least-mastered topics that contributed to students' difficulties and poor performance. To address this, remedial teaching was introduced as a supplementary measure. As emphasized by Rathod (2019), remedial teaching serves as an effective corrective technique aimed at addressing misconceptions and enhancing the teaching–learning process. The remedial sessions were conducted after the regular class period, from 4:00 to 5:00 p.m. Students who obtained scores below the passing mark were identified and required to attend. These sessions followed a structured approach similar to regular classes, including discussions, examples, and short assessments, but with a stronger emphasis on clarifying misconceptions and reinforcing unclear concepts to foster a deeper understanding of the lesson content.

Phase 6. Reflect on the Modified Plan and Report the Results

In this phase, the researchers engaged in a systematic reflection on the modified intervention plan to determine its effectiveness in addressing the identified classroom problem. The process involved a careful examination of the results obtained from both the control and experimental groups, as well as the integration of qualitative data gathered from student interviews. The analysis of results provided valuable insights into the impact of the gamified drills and remedial teaching on students' engagement and performance. Interviews with selected students further revealed their perceptions, challenges, and preferences regarding the strategies employed, thereby offering a more comprehensive understanding of the outcomes. Through this reflective process, the researchers ensured that the initial problem of poor engagement and declining performance was appropriately addressed by aligning instructional strategies with the students' needs. The reflection phase not only validated the effectiveness of introducing gamification and remedial sessions but also highlighted areas for continued improvement, reinforcing the importance of adapting instructional practices to meet the diverse learning needs of students.

RESULTS AND DISCUSSIONS

Pretest Results for Comparability between Two Groups Parallel to Matched-Pair Design

Before implementing the intervention, a pretest was administered to both groups to ensure baseline comparability in their academic performance. This step was conducted in parallel with the matched-pair design, where participants were paired based on similar characteristics such as prior achievement levels. Establishing this equivalence is crucial to ensure that any significant differences observed in the posttest outcomes can be confidently attributed to the instructional method rather than to initial academic discrepancies. The pretest results thus serve as a reliable basis for evaluating the true effect of the intervention.

Table 1 Pretest: Quizizz Versus Traditional Drill

Pretest	f	SD	M	U	p	Interpretation
Quizizz	27	25.40	56.40	266.000	0.089	Not Significant
Traditional Drill	27	23.00	44.40			

Note. There is no significant difference in the pretest scores of students between Quizizz (M=56.40, SD=25.40) and Traditional Drill (*M*=44.40, *SD*=23.00); i.e., *U*=266.000, *p*=0.089, at 95% confidence level.

*p<0.05 is significant

To assess initial equivalence between the two instructional groups—Quizizz and Traditional Drill—a pretest was conducted prior to the intervention. Results from the Mann-Whitney U test indicated no statistically significant difference between the groups, with Quizizz students scoring a mean of *M*=56.40 (*SD*=25.40) and Traditional Drill students scoring *M*=44.40 (*SD*=23.00), *U*=266.000, *p*=0.089. These results confirm that the two groups were comparable in academic ability at baseline, thereby validating the matched-pair design and ensuring that any post-intervention differences can be attributed to the instructional method rather than pre-existing disparities (Fraenkel et al., 2012).

This comparability is essential in educational research, as it allows for a fair and valid comparison of pedagogical effectiveness. As emphasized by Biggs and Tang (2011) and Ramsden (2004), aligning instruction with student readiness is critical for meaningful outcome interpretation. In this context, both Quizizz and traditional drill groups began at relatively similar levels, making it possible to investigate the true impact of each instructional approach on learning outcomes.

Furthermore, the comparable baseline highlights the neutral ground upon which digital gamified tools like Quizizz (Setiyani et al., 2020; Adipat et al., 2021) can be assessed alongside more conventional strategies such as drill-based instruction (Rathod, 2019). The equivalence also supports the argument that student engagement, motivation, and strategy—rather than prior ability—may be the differentiating factors in learning gains (Linnenbrink-Garcia & Pekrun, 2011; Buckley & Doyle, 2016). As boredom and emotional disengagement continue to be significant factors affecting performance (Özerk, 2020; Sharp et al., 2018), evaluating how each method addresses these elements in practice becomes even more relevant.

Entirely, the lack of a significant difference in pretest performance not only strengthens the study's internal validity but also sets a reliable but also sets a reliable foundation for comparing the effectiveness of innovative, game-based learning tools (Boctor, 2013; Huang & Hew, 2015) with traditional instructional techniques.

Students' Pre-Post Performance Through Quizizz and Traditional Drill

In recent years, the integration of digital tools in education has significantly transformed teaching and learning methods. One such tool, Quizizz, offers an interactive and gamified approach to student assessment, contrasting with traditional drill methods that emphasize repetition and memorization. This study explores the impact of these two approaches—Quizizz-based quizzes and conventional drills—on student performance before and after

instructional interventions. By comparing pre- and post-test results, the research aims to determine which method more effectively enhances student learning and retention, offering insights into the evolving landscape of educational strategies.

Table 2 Students' Performance in Quizizz: Pre-Post Comparison using Wilcoxon Signed-Rank Test

Quizizz	***f***	***SD***	***M***	***MD***	***W***	***p***	**Interpretation**
Pretest	27	25.40	56.40	-17.70	19.000*	0.000	Significant
Posttest	27	18.80	75.70				

Note. There is a significant increase in the test scores of students under Quizizz (Pretest: *M*=56.40, *SD*=25.40; Posttest: *M*=75.70, *SD*=18.80); i.e., *W*=19.000, *p*=0.000, at 95% confidence level.

*p<0.05 is significant

To evaluate the impact of gamified instruction through Quizizz, a pre-post analysis was conducted using the Wilcoxon Signed-Rank Test. Results indicated a statistically significant improvement in student performance following the intervention, with pretest scores averaging *M*=56.40 (*SD*=25.40) and posttest scores rising to *M*=75.70 (*SD*=18.80), *W*=19.000, *p*=0.000. This significant gain underscores the effectiveness of Quizizz as a learning tool that not only delivers content but also fosters greater student engagement and achievement. As Adipat et al. (2021) suggest, gamified platforms introduce an interactive learning environment that boosts motivation and cognitive involvement. These findings are further corroborated by Setiyani et al. (2020), who demonstrated that Quizizz enhances problem-solving and comprehension by encouraging active student participation.

This improvement aligns with Biggs and Tang's (2011) theory of constructive alignment, where student-centered learning environments facilitate deeper understanding and retention. Additionally, Boctor (2013) and Buckley & Doyle (2016) emphasize that gamification strengthens learning outcomes by reducing cognitive fatigue and promoting enjoyment in the learning process. Such engagement is particularly important given research on academic boredom and its negative effects on performance (Özerk, 2020; Sharp et al., 2018). The statistically significant rise in scores supports the notion that game-based learning tools can effectively counter disengagement by offering real-time feedback, competition, and rewards—core components of effective gamified design (Barata et al., 2013; Huang & Hew, 2015).

These findings validate the use of Quizizz as a pedagogical strategy that enhances student achievement through motivational and interactive learning processes. The post-intervention performance improvements are not only statistically significant but also pedagogically meaningful, indicating that technology-enhanced instruction has the potential to surpass traditional methods in promoting academic success.

Table 3 Students' Performance in Traditional Drill: Pre-Post Comparison using Wilcoxon Signed-Rank Test

Traditional Drill	***f***	***SD***	***M***	***MD***	***W***	***p***	**Interpretation**
Pretest	27	23.00	44.40	-28.00	0.000*	0.000	Significant
Posttest	27	14.00	72.90				

Note. There is a significant increase in the test scores of students under Traditional Drill (Pretest: *M*=44.40, *SD*=23.00; Posttest: *M*=72.90, *SD*=14.00); i.e., *W*=0.000, *p*=0.000, at 95% confidence level.

*p<0.05 is significant

The analysis of students' pre- and post-test scores reveals a statistically significant improvement in academic

performance following the use of traditional drill exercises. The mean pre-test score (*M*=44.40, *SD*=23.00) increased to a post-test mean of (*M*=72.90, *SD*=14.00), with a mean difference (*MD*) of -28.00. The Wilcoxon signed-rank test yielded *W*=0.000, *p*=0.000, indicating that the improvement in scores is statistically significant.

These results underscore the effectiveness of traditional drill as a method of reinforcing essential concepts and improving student learning outcomes. The large gap between the pre-test and post-test scores suggests that repeated, structured practice helped solidify foundational understanding and recall, which is particularly important in subjects requiring procedural fluency such as mathematics (Rathod, 2019). This supports the view of Fraenkel et al. (2012) that educational strategies rooted in systematic instruction and measurable outcomes can drive meaningful academic improvement.

While game-based learning continues to grow in popularity for its engagement potential (Adipat et al., 2021; Boctor, 2013), this study reaffirms that traditional drills remain relevant and effective. As Biggs and Tang (2011) highlight, constructive alignment between learning activities and outcomes is critical; traditional drills offer this alignment by targeting core skills through consistent repetition.

The implications extend beyond cognitive gains. In contexts where motivation and attention may be low, especially when students struggle with academic boredom (Özerk, 2020; Sharp et al., 2018), structured drill sessions provide a predictable and focused learning environment. While gamified learning environments (Buckley & Doyle, 2016; Huang & Hew, 2015) may enhance engagement through novelty and reward systems, traditional drills help students build confidence through mastery and repeated success. This approach may benefit students who find gamified environments distracting or overwhelming.

While innovation in education is vital, traditional strategies such as drills continue to offer strong benefits in skill development and content retention. The significant gains demonstrated in this study advocate for a balanced instructional design that combines both traditional and modern pedagogical approaches to meet diverse student needs.

Comparability of Formative Assessment Methods: Quizizz Versus Traditional Drill

The growing emphasis on formative assessment in education has led to the exploration of various methods to enhance student learning and engagement. Among these, digital platforms like Quizizz offer a gamified, interactive alternative to traditional drill-based practices, which rely on repetitive exercises to reinforce content mastery. As educational technologies continue to evolve, understanding the comparative effectiveness of such tools becomes increasingly important. This study examines the comparability of Quizizz and traditional drills as formative assessment methods, aiming to evaluate not only their impact on student performance but also their potential to influence motivation, engagement, and overall learning experience.

Table 4 Posttest: Quizizz Versus Traditional Drill

Posttest	f	SD	M	U	p	Interpretation
Quizizz	27	18.80	75.70	317.000	0.410	Not Significant
Traditional Drill	27	14.00	72.90			

Note. There is no significant difference in the pretest scores of students between Quizizz (*M*=75.70, *SD*=18.80) and Traditional Drill (*M*=72.90, *SD*=14.00); i.e., *U*=317.000, *p*=0.410, at 95% confidence level.

*p<0.05 is significant

To evaluate the effectiveness of the instructional methods following intervention, a posttest was administered to both groups—Quizizz and Traditional Drill. Analysis using the Mann-Whitney U test revealed no statistically significant difference in performance between the two groups, with the Quizizz group achieving a mean score of *M*=75.70 (*SD*=18.80) and the Traditional Drill group scoring *M*=72.90 (*SD*=14.00), *U*=317.000, *p*=0.410. This suggests that, despite the engaging and interactive nature of Quizizz, its effectiveness in enhancing

academic performance did not significantly surpass that of traditional drill-based instruction in this particular study context (Fraenkel et al., 2012).

These findings indicate that while gamification has been widely associated with improved motivation, participation, and emotional engagement (Adipat et al., 2021; Buckley & Doyle, 2016; Gündüz & Akkoyunlu, 2020), these benefits may not directly translate into statistically measurable learning gains when compared to conventional approaches. Previous studies have shown that tools like Quizizz can enhance student enjoyment and reduce boredom (Boctor, 2013; Pedro et al., 2015; Özerk, 2020), which are important factors in sustaining long-term engagement. However, as noted by Biggs and Tang (2011), quality learning is dependent not only on the medium of instruction but also on how well it aligns with learning objectives and assessment methods.

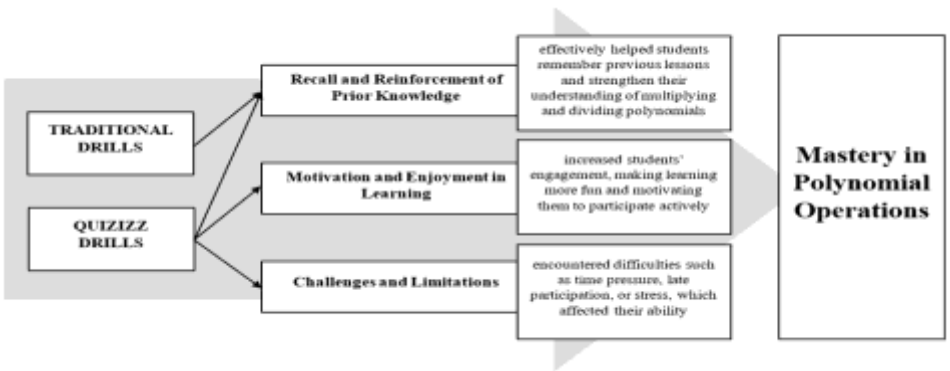
This result reflects the argument that both gamified and traditional techniques can be pedagogically sound when applied appropriately. While Quizizz may increase motivation through competitive features like points and leaderboards (Huang & Hew, 2015), and has shown potential in improving problem-solving skills (Setiyani et al., 2020), the cognitive benefits of repetitive practice and structured reinforcement inherent in traditional drills remain valid and effective, particularly in domains requiring procedural fluency (Rathod, 2019). As such, the implication is not that one method is categorically superior but that instructional effectiveness may depend on student needs, subject matter, and implementation fidelity. The absence of a significant difference suggests that both methods may be viable, and a blended approach could potentially harness the strengths of each to maximize learning outcomes.

Traditional Drill and Quizizz as Formative Assessment Method

Formative assessment plays a crucial role in the teaching and learning process because it allows educators to provide timely feedback and identify areas where students may need additional support. By continuously monitoring progress, teachers can adjust instruction to better meet students' needs and promote mastery of key concepts. Among the various strategies available, traditional drills and digital platforms such as Quizizz represent two contrasting yet effective methods of formative assessment. Traditional drills emphasize repeated practice and structured exercises, enabling students to reinforce their foundational skills and develop accuracy and fluency. This method is often regarded as a reliable approach since it focuses on consistency, discipline, and direct reinforcement of prior lessons, which are essential in subjects like mathematics.

In contrast, Quizizz introduces a more modern, gamified, and interactive dimension to assessment. With features such as real-time feedback, leaderboards, music, avatars, and engaging visuals, it transforms routine exercises into enjoyable learning experiences that encourage participation and healthy competition. This approach does not only make learning fun but also increases student motivation and engagement, particularly among digital-native students. The present study, therefore, seeks to examine the effectiveness of these two formative assessment methods—traditional drills and Quizizz—by analyzing their impact on student performance, motivation, and classroom engagement in mathematics. Through this comparison, the study aims to highlight how both conventional and technology-driven approaches can complement each other in fostering meaningful learning outcomes.

Figure 2 Educational Leads of Formative Drills Assessment



Note. This figure illustrates how traditional and Quizizz drills contribute to mastery in polynomial operations by reinforcing prior knowledge, enhancing motivation, and addressing challenges and limitations.

The above figure highlights how structured practice activities guide student learning and skill development. Formative drills serve as a driving force that directs students toward mastery by reinforcing previously learned concepts, identifying gaps in understanding, and providing immediate feedback to inform instructional adjustments. These drills also motivate students by offering achievable challenges and fostering a sense of progress, while helping teachers recognize difficulties and adapt their teaching strategies. In essence, formative drills act as educational leads by steering both students and educators toward the desired learning outcomes, ensuring that practice not only consolidates knowledge but also addresses misconceptions in a timely and supportive manner. To further the findings of this study, participants' responses were themed as reflected in the above figure.

Recall and Reinforcement of Prior Knowledge

Recall and reinforcement of prior knowledge serve as essential foundations for meaningful learning, as they enable students to connect new concepts with what they have already mastered. By activating existing knowledge structures, students are better able to retrieve relevant information, strengthen memory retention, and build deeper understanding of new lessons. Reinforcement activities, such as drills, reviews, and guided practice, ensure that previously learned skills are not forgotten but instead solidified and applied in new contexts. This process not only fosters continuity in learning but also enhances confidence, accuracy, and readiness for more complex problem-solving tasks.

Gamified Drills through Quizizz	**Traditional Drills**
Student 1: "the quizizz review helped me understand the topic better"	Student 17: "A drill can help us to remember how to multiply and divide polynomials by repetitive exercises."
Student 2: "quizizz drill helps me because it guides me on multiplication and division of polynomials"	Student 18: "The drill sharpened my memory of [learning] polynomials [involving] multiplication and division rules for quicker recall."
Student 3: "…it helped me recall dividing integers. Also, in the lesson, I learned a lot about the Dividing of Polynomials."	Student 19: "The drill helped me a lot and it recalled everything I forgot."
Student 4: "It helped me recall the previous lesson I learned in elementary and it became useful for me again and made my learning experience less difficult."	Student 20: "It helped me recall because I forgot how to do it."
Student 5: "It helps me a lot because I know how to multiply and divide polynomials. It helped me to solve it. It made me active to solve it."	Student 21: "This made it easier for me to remember all the past lessons."
Student 6: "It helped me remember and on how to multiply and divide polynomials."	
Student 7: "It helped me recall [my lesson through] ma'am Jo's teaching even [though] I didn't understand it well, I did understand it at the end by multiplying and dividing polynomials."	

Student 9: "It made it easier for me to remember all the past lessons." Student 10: "It helped me and my partner refresh our mind [to] prepare the lesson and understand it in advance." Student 11: "The Quizizz recalls my past mistakes [in solving] Multiplication and Division of [integers]." Student 13: "The Quizizz drill helped me recall and warmed-up my brain." Student 14: "It help[s] me to know how to solve." Student 16: "The drill helped me in recalling the rules of multiplying and dividing polynomials by telling me what to do first and for solving it."	

Both traditional and gamified drills successfully lead to the ultimate goal of student mastery. The primary benefit of both methods is their effectiveness in promoting recall and reinforcement of prior knowledge. As cited in the text, students using either method found that the drills helped them "remember previous lessons" and "strengthen their understanding of multiplying and dividing polynomials". This aligns with Rathod's (2019) finding that remedial teaching significantly improves academic achievement and fosters a deeper understanding of mathematical concepts.

The unique benefit of the gamified approach is its profound impact on motivation and engagement. The use of Quizizz, with its rankings and leaderboards, created a highly interactive and fun environment. This heightened motivation is a key factor in improving learning outcomes, as affirmed by Buckley and Doyle (2016), who found favorable effects from gamified interventions. Huang and Hew (2015) also noted that participants in a gamified environment were "actively involved cognitively" and demonstrated "increased motivation to dedicate more effort to learning". This emotional and attitudinal benefit is a significant advantage over traditional methods, which, while effective, do not elicit the same level of enthusiasm.

Motivation and Enjoyment in Learning

Motivation and enjoyment are central drivers of effective learning, as they influence students' engagement, persistence, and overall academic performance. When students are motivated, they demonstrate greater willingness to participate actively in tasks, sustain effort despite challenges, and take ownership of their learning process. Likewise, enjoyment fosters a positive emotional climate in the classroom, making learning experiences more meaningful and memorable. In the context of modern education, strategies such as gamification, collaborative activities, and interactive technologies have been shown to enhance both motivation and enjoyment, thereby transforming routine drills or complex concepts into opportunities for active exploration and mastery.

Gamified Drills through Quizizz	**Traditional Drills**
Student 3: "In this lesson, I enjoyed a lot by playing quizizz…" Student 6: "The game was fun and really fun to learn from."	(No direct statements fall here; all focus mainly on recall.)

Student 8: "I enjoyed the game a lot. [The game is] fun." Student 12: "[The game] is okay because my brain is not asleep." Student 14: "I enjoy the Quizizz." Student 16: "I love the teacher also."	

The narratives provide a rich account of the student experience, which directly reflects the benefits and challenges of each method. The experience of the gamified group was characterized by enthusiasm and active participation. A student noted, "The game was challenging and hard but fun", while others expressed that it helped them be "active to solve it" and kept their "brain... not asleep". This positive perception shows how gamification can change a student's attitude toward math, making it a subject they perceive as "fun and interesting".

Conversely, the experience of the traditional group, while still effective for learning, was described as more serious and focused, but less active. Students in this group noted the practical benefits of the drills for memory and recall, but the text lacks the same level of excitement or enjoyment found in the gamified group's responses. The contrast in experiences—anxiety due to connectivity in the gamified group versus a lack of dynamic engagement in the traditional group—underscores the trade-offs that educators must consider when choosing a formative assessment tool.

Challenges and Limitations

Every research endeavor inevitably encounters challenges and limitations that shape both the process and the outcomes of the study. These factors may arise from methodological constraints, contextual conditions, or participant-related concerns that can influence data collection, interpretation, and generalizability of findings. Acknowledging these challenges is essential not only to establish the credibility and transparency of the research but also to provide valuable insights for future studies aiming to build upon or improve the current investigation. By identifying and reflecting on these limitations, the researcher demonstrates critical awareness of the study's boundaries while emphasizing the reliability of the conclusions drawn.

Gamified Drills through Quizizz	**Traditional Drills**
Student 6: "It was a bit challenging at first trying to understand but now I finally got it." Student 8: "The game was challenging and hard…" Student 15: "It did not help at all; we entered late and [got panicked]." Student 16: "The game on quizizz is stressful because we didn't have enough time."	(No direct statements fall here; none mention struggles, time pressure, or negative experiences.)

While the benefits are clear, each method presents its own set of challenges. The primary limitation of the gamified drill is its reliance on technology. As observed, connectivity issues were a major source of stress. Students who experienced "slow internet" or "low connectivity" while playing the game felt "panicked and stressed", hindering their ability to perform. This technical fragility is a significant downside. In contrast, the

traditional drill is free from this particular challenge, described as being "smoothly answered". However, the traditional method faces its own inherent limitation in that it may not be as effective in capturing student interest and participation compared to its gamified counterpart.

Reflection on Modified Plan

The researchers initially designed the action plan with the control group engaging in traditional or written drills, while the experimental group utilized gamified assessments through Quizizz. This setup was intended to provide a clear comparison between the effects of conventional drill methods and game-based learning on students' engagement and performance. However, as the intervention progressed, feedback and classroom observations indicated a need for modification. By the eighth day, it became evident that the traditional drill format was not sustaining student interest in the control group, prompting the researchers to revisit the plan to ensure both groups had meaningful learning experiences.

Several participants from the control group expressed their sentiments openly during class discussions and informal interviews. They reported that traditional drills often felt monotonous and failed to sustain their motivation, leading to a lack of enthusiasm for mathematics activities. Students also shared that the repetitive nature of the written drills created a tense classroom atmosphere, with some feeling pressured or anxious each time a new set of exercises was given. More importantly, many students conveyed a strong interest in experiencing online game-based activities similar to those enjoyed by the experimental group, highlighting a desire for more engaging and interactive learning experiences.

In response to these concerns, the researchers decided to integrate Quizizz into the sessions of both groups. This adjustment allowed all learners to experience the benefits of gamification, including increased enjoyment, active participation, and a more relaxed classroom environment. While the majority of students found Quizizz to be fun, interesting, and highly motivating, not all experiences were positive. Some learners encountered difficulties related to internet connectivity, which disrupted their participation and, in some cases, led to feelings of anxiety and frustration. Despite these challenges, the overall feedback suggested that the integration of Quizizz enhanced students' engagement and made the mathematics drills more interactive and meaningful.

CONCLUSION

The study demonstrated that both traditional drills and Quizizz-based gamified drills significantly improved students' performance in solving operations involving integers and polynomials. While no statistically significant difference was found between the posttest scores of the two groups, the Quizizz group showed higher levels of engagement, participation, and recall. However, the implementation of gamified activities posed logistical challenges, including preparation time and internet connectivity issues. Despite these, students found the game-based approach enjoyable and motivating. The liveliness and energy observed in the Quizizz class suggest its potential in creating a more interactive learning environment, though it requires proper planning and support. Moreover, the findings highlight that fundamental skills in integer operations are essential in building mastery in polynomial operations, and that traditional drills hold the same level of importance as gamified drills through Quizizz in strengthening mathematical proficiency.

RECOMMENDATIONS

Based on the findings and experiences during the intervention, the researchers recommend extending the implementation period to at least one month or a full quarter to better observe the long-term effects of the strategies on student performance and engagement. To prevent disruptions during lessons, ensuring reliable internet connectivity is essential, or alternatively, teachers may consider using gamified tools with offline features. Regular documentation through journals, surveys, photos, and videos is also encouraged, as these can serve as valuable references for instructional adjustments and reflections on student progress. Moreover, blending gamified approaches like Quizizz with traditional strategies is advised to strike a balance between engagement and structure, depending on the needs and dynamics of the class. Ongoing communication between teachers and students should also be fostered to identify potential challenges early and provide timely support.

For remediation, small group sessions may be implemented to address specific learning gaps and misconceptions more effectively.

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