INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS

ISSN(print): 2643-9840, ISSN(online): 2643-9875

Volume 09 Issue 11 November 2026

DOI: 10.47191/ijmra/v9-i11-20, Impact Factor: 8.685

Page No. 7599-7609

Project GAME (Gamification and Mathematical Engagement) in Teaching Statistics & Probability to Senior High School Students

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ABSTRACT: The study aimed to assess the effectiveness of the gamification intervention in improving students' understanding of statistics and probability concepts during the school year 2024- 2025. It used a quasi-experimental research design, employing a 30-item multiple-choice test for pre- and post-tests in Statistics and Probability. Purposive sampling was used to select the sample participants who were Academic -A and TVL-1A students. Project GAME (Gamification and Mathematical Engagement) effectively improved senior high school students' performance in Statistics and Probability. Initially, both the Academic - A and TVL - IA groups were performing below expectations, but after the intervention, both groups performed satisfactorily in Statistics and Probability. The improvement was statistically significant, demonstrating that Project GAME strategies helped students better understand complex concepts in Statistics and Probability. Based on the findings, the school may formalize the integration of gamified learning methods, especially in subjects like Statistics and Probability, where students often struggle. Gamification can significantly boost student engagement and academic performance, and policies may ensure that teachers are properly trained to implement these strategies effectively. Another recommendation is to adopt personalized learning approaches by using adaptive learning technologies. These technologies can tailor content to each student's needs, offering targeted support where necessary and ensuring that all learners are appropriately challenged.

KEYWORDS: Project GAME (Gamification and Mathematical Engagement), Statistics and Probability, Personalized Learning Approaches

Context and Rationale

Gamification uses various aspects of games, such as points, scores, badges, rewards, leaderboards, levels, challenges, and quests, within the teaching-learning environment to increase student interest, motivation, participation, and academic success. Gamification provides an engaging or interactive learning experience for students that enables them to become actively involved in the learning process. Gamification also helps students gain self-confidence as they advance from one learning activity to another, and gamification provides students with the opportunity to proceed through the learning process at their own rate (Deterding, Dixon, Khaled, & Nacke, 2011). In the Philippine educational setting, its implementation supports the learner-centered approach of the K–12 Curriculum Framework, Department Order No. 42, s. 2016, DepEd Memorandum No. 39, s. 2020, and Republic Act No. 9155, which encourage innovative, flexible, and inclusive teaching practices. These policies provide opportunities for teachers to explore alternative instructional strategies that respond to the diverse learning needs of students.

Teaching Statistics and Probability to Senior High School students can be made more engaging, comprehensible, and relatable to their everyday lives by incorporating the gamification approach. Fardo (2013) stresses that using game-based approaches can help enhance students' engagement and understanding. In addition, Gee (2003) mentioned that utilizing levels and meaningful challenges in the learning process can help to sustain the interest of the learners and helps them build important math skills. Also, the importance of collaboration, teamwork, and social interaction by using the gamification approach is brought up by Hamari, Koivisto, and Sarsa (2014). Finally, students can monitor their performance, identify mistakes, and improve their understanding during the learning process by using the technology and instant feedback.

Additionally, gamification and mathematical engagement can help students struggling with learning, especially those who read slowly or have trouble understanding what they read. Traditional teaching often just doesn't give these learners enough chances to really grasp math concepts. With interactive games, things they can do with their hands, pictures and videos, and group projects, students can check out mathematical ideas in ways that are easier and just more fun. Gamified applications will also give

them feedback right away. This lets learners catch their own mistakes and fix them, and also build up their confidence. Things like points and badges can make them want to keep trying, and doing stuff in groups gets them working together and building good relationships with other classmates (Ma, Wing Lam Chan, & Cheng, 2019). And putting real-world problems into the mix helps students see why math matters, which is something that can really boost their ability to remember concepts over time (Gee, 2003). Gamification mixes seeing, hearing, and doing for learning. It just makes the classroom more open for everyone, so students don't have to be so worried about messing up or failing.

Despite these instructional opportunities, Filipino learners continue to face challenges in developing mathematical competencies, particularly in higher-order thinking, problem-solving, and applying mathematical concepts to real-life situations. Results from the 2019 National Achievement Test (NAT) indicated that Grade 6 learners obtained a mean percentage score of 62.7%, while Grade 12 learners recorded only 39.1%, reflecting the need to strengthen mathematics instruction and learning outcomes. These findings emphasize the importance of improving teaching approaches, providing appropriate teacher preparation, and developing students' critical-thinking and problem-solving abilities. In the researcher's context, the academic performance of Grade 11 students also showed areas for improvement. Among Academic Track students, 46% obtained general average grades ranging from 75 to 79, while 49% of students in the TVL Track, particularly Fish and Food Processing-1A (FFP-1A), received grades within the same range. These results suggest that although students demonstrate satisfactory academic performance, additional instructional support and engaging learning strategies are needed to strengthen their mathematical understanding. Consequently, the researcher proposed Project GAME (Gamification and Mathematical Engagement) as an intervention to improve students' participation, motivation, and learning performance in Statistics and Probability.

Hamari, Koivisto, and Sarsa (2016) emphasized the importance of considering the academic when evaluating the effectiveness of gamification. Schools must also provide adequate technological resources and encourage continuous evaluation of instructional interventions to determine their contributions to student learning. Furthermore, collaboration among teachers, parents, school administrators, and other stakeholders can help establish a supportive learning environment. In this regard, the present study focuses on the implementation of Project GAME in teaching Statistics and Probability among Grade 11 Academic Track-A and TVL-1A students who demonstrated difficulty in the least-mastered competencies during School Year 2024–2025. The study aims to determine how gamification and mathematical engagement can help address their learning needs, improve their understanding of mathematical concepts, and enhance their overall academic performance.

INNOVATION, INTERVENTION AND STRATEGY

Through creative teaching techniques focused on gamification, **Project GAME** (**G**amification **A**nd **M**athematical **E**ngagement) sought to improve the learning experience of Senior High School students studying statistics and probability. Students' involvement, understanding, and application of mathematical ideas were all enhanced by this method. Through gamification, the goals were to increase student engagement and comprehension of statistical concepts; encourage teamwork through team-based activities; and cultivate motivation by establishing an enjoyable and competitive mathematics learning environment.

INNOVATION

Simulation and Role-Playing: Real-world scenarios that call for statistical judgment, such as assessing market trends or figuring out election odds, are replicated. In order to solve actual statistical problems, students engaged in role-playing games where they could assume the roles of statisticians, data scientists, or analysts. Sabo (2016, 319).

Utilization of Technology: A mobile app or web platform was developed with statistics and probability-based leaderboards, challenges, and quizzes. Interactive tools, such as and Google Forms, were used during assessments to keep students engaged and motivated. (Raju, Shreeranga Bhat, and Singh 2021, 713).

Game-Based Projects: To promote creativity and a deeper comprehension of the subject matter, students were urged to develop original games that incorporate statistical ideas. Students had the opportunity to showcase their games and discuss the mathematical concepts that underlie them. (Rodrigues, Oliveira, and Rodrigues 2019).

EVALUATION, ASSESSMENT AND EXPECTED OUTCOMES

Pre- and Post-Assessment: It was crucial to conduct tests both before and after implementing the gamified curriculum. The Probability and Statistics 30-item multiple-choice exam was employed. This made it easier to gauge the students' level of learning engagement and the amount of knowledge they have acquired.

Student Input: Gathered quantitative and qualitative input from students regarding their experiences using the gamified method. This data revealed their perceptions of the advantages and difficulties of this approach.

Performance Metrics: Tracked students' performance on probability and statistics exams. This data helped analyze how effective the gamification strategy has been in improving their understanding and skills**.**

Increased Student Engagement: It was anticipated that the gamified curriculum would increase participation rates and spark a greater interest in studying probability and statistics. Pupils were more eager and engaged in class activities.

Soft skill development: The project assisted students in acquiring critical thinking, problem-solving, and teamwork, among other crucial soft skills. These skills helped them grow as individuals and in their future employment.

Positive Learning Environment: The goal of the gamified approach was to establish a classroom environment that fosters creativity and learning. Pupils were at ease taking chances and experimenting with concepts.

PHASES OF THE PROJECT GAME

Project GAME aimed to transform senior high school statistics and probability instruction. The project aimed to use gamification to make learning more dynamic, collaborative, and relevant to real-world scenarios, which motivated students to become proficient and enthusiastic about applying mathematics in their daily lives. The project was conducted for the period of 3 months or one quarter period.

1. **Planning and Preparation (Week 1)**

The project started by identifying the participating students—Grade 11 learners from the ABM strand and the TVL FFP-1A section—and pinpointing the main learning goal: mastering how to find the mean and variance of the sampling distribution of the sample mean, with emphasis on data analysis. The teacher-researcher then crafted lesson plans, chose engaging online platforms like Kahoot, Quizizz, and Google Forms, and developed interactive simulation and role-playing activities. Before diving in, students were introduced to the gamified learning approach and clearly briefed on how they would actively take part in the process.

2. **Orientation and Baseline Assessment (Week 2)**

The goals of Project GAME (Gamification and Mathematical Engagement), which was presented to the students, were to make probability and statistics more interesting, cooperative, and applicable to everyday situations. The instructor went over the principles of gamified learning, such as the use of technology, point systems, and group projects. In order to establish a baseline for subsequent assessments, a pre-test was administered to gauge students' preliminary comprehension of the subject.

3. **Initial Game-Based Lessons (Week 3- week 8)**

Students collaborated in groups to create sample data, calculate sample means and variances, and compare outcomes with theoretical values during the project's initial simulation games. To assess understanding in real time, these exercises combined offline group projects with online tests through Kahoot and Quizizz. Additionally, role-playing exercises were added, in which students took on the roles of statisticians, researchers, or analysts entrusted with applying sampling distribution concepts to solve real-world problems.

4. **Integration of Technology and Student-Created Games (Week 3- Week 8)**

Technology integration gained prominence during the middle phase. Google Forms was integrated into the lessons to collect data and provide automated feedback, and Quizizz and Kahoot were still utilized for competitive review sessions. Students were urged to use the statistical procedures they had studied to create their own simulation games. Peer-to-peer teaching, creativity, and ownership of learning were all encouraged by these student-led activities. Examples included survey-based projects that required calculating the mean and variance of the sampling distribution, product testing simulations for TVL-FFP learners, and simulated business scenarios for ABM students.

5. **Culminating Game Challenges (Week 9-Week 11)**

All of the skills learned—data collection, computation, and interpretation—were combined in a series of final tasks. Teams used simulated or real datasets to solve statistical problems under time constraints. In order to guarantee both conceptual comprehension and computational accuracy, the exercises combined role-playing, simulation, and online tests. Students showed that they could interpret results for decision-making in addition to performing calculations.

6. **Final Assessment and Reflection (Weeks 12–13)**

A post-test was given at the conclusion of the grading period to gauge learning progress in relation to the pre-test findings. Along with completing a reflection form and taking part in a feedback session, students discussed how gamification impacted their confidence, interest, and engagement in statistics and probability. The findings demonstrated a more positive attitude toward

mathematics, greater participation in classes, and an improved comprehension of statistical concepts. The gamified method worked well for tying classroom instruction to practical problem-solving.

The strategy outlined in Project GAME was in line with the ideas of continuous evaluation and phased implementation that have been covered by a number of activites in the fields of gamification and educational technology. They highlighted the importance of adaptive teaching techniques and iterative assessment in incorporating novel tactics like gamification. Furthermore, the activities in the GAME emphasize the significance of methodical implementation and continuous engagement to improve learning outcomes in their groundbreaking work on gamification principles. Thus, the continuous assessment and phased approach are reminiscent of ideas from the work of Deterding et al. (2011) on adaptive educational strategies.

The researcher reflected that Project GAME's phased implementation offered a clear framework that not only made it easier to carry out activities but also made sure that students' progress was regularly monitored. After thorough planning and focused orientation, the project progressively transitioned from teacher-led simulations to student-led game development, empowering students to take charge of their own learning. Technology was incorporated into the phases to improve engagement, enable immediate feedback, and streamline assessment. The importance of integrating gamification, real-world applications, and collaborative learning was demonstrated by watching students change from reluctant participants to self-assured problem-solvers. The findings supported the researcher's hypothesis that understanding and attitudes toward statistics and probability can be greatly enhanced by carefully thought out, phased strategies that are based on ongoing evaluation and active engagement.

KEY ELEMENTS OF PROJECT GAME

1. **Gamification Approach –** Incorporated points, rewards, and leaderboards to create a competitive yet fun learning atmosphere.
2. **Interactive Learning Activities –** Used simulations, role-playing, and group challenges to promote collaboration and active participation.
3. **Real-World Application:** By relating statistical ideas to real-world situations, students were able to understand the significance of what they were studying.
4. **Student-Created Games:** Promoted creativity and a deeper understanding by allowing students to create their own quizzes and simulations.
5. **Constant Feedback:** Students were able to track their progress with the use of technology by receiving instant feedback and frequent formative assessments.

ACTION RESEARCH QUESTIONS

This study aimed to assess the effectiveness of Project - GAME (Gamification and Mathematical Engagement) in improving students' understanding of statistics and probability concepts during the school year 2024- 2025. Specifically, this study sought to answer the following research questions:

1. What is the pretest result of the senior high school students in Statistics and Probability before the intervention?
2. What is the posttest result of the senior high school students in Statistics and Probability after Project - GAME was used?
3. Is there a significant difference in the pretest and posttest results of the senior high school students in Statistics and Probability after Project - GAME was used?
4. Based on the findings, what proposed intervention can be used to further improve the project?

ACTION RESEARCH METHODS

Research Design

This quantitative study aimed to assess the performance of Grade 11 senior high school students in statistics and probability when gamification techniques were used in teaching. To measure students' learning, pre-tests and post-tests were administered during the third and fourth grading periods. The study employed a quasi-experimental research design, which is commonly used when random assignment of participants is not possible. Unlike true experimental designs, quasi-experiments do not rely on randomization, but they still aim to determine whether an intervention has a significant effect on outcomes.

According to Gopalan, Rosinger, and Bin Ahn (2020), quasi-experimental designs attempt to establish a cause-and-effect relationship by comparing a treatment group with a group that has similar characteristics before the intervention. This helps ensure that any observed differences in performance can be reasonably attributed to the intervention itself. In this study, the design allowed the researcher to examine how gamification influenced students' learning outcomes.

One of the key advantages of using a quasi-experimental design is its applicability in real-life settings. As explained by Thyer (2012), this approach is particularly useful in natural environments such as classrooms, where random assignment may not be practical or ethical. By conducting the study in an actual classroom context, the researcher was able to observe authentic student behaviors and learning experiences, making the findings more relevant and applicable to real educational situations.

Participants and Other Sources of Data and Information

Students in Grade 11 who were enrolled in the 2024–2025 school year and who acquired the least mastered skills during the first semester were the study's participants. The researcher selected the students who demonstrated the least proficiency in Statistics and Probability during the first semester by compiling the grades of each section. The study samples were chosen by the researcher using the purposive sampling technique. As a result, the researcher selected Academic 11 ABM and TVL-FFP-1A as the study's samples. Both groups included 49 students, and their math performance level of 80 was deemed satisfactory.

Research Instrument

A 30-item Multiple Choice Exam in Statistics and Probability served as the study's research tool, and it was used for both the pre and post-tests. The instrument, which was used to assess students' performance, was taken from the CapSLET and Self-Learning Module. The Math Master Teachers, who are authorities on content validity, validated the tool. The instrument's applicability and students' ability to respond were both confirmed by the experts. The final draft included the validators' comments and recommendations. Item analysis was performed on the instrument in order to assess its validity and reliability. The norm-referenced item analysis was used to compute and statistically analyze the data. The norm-referenced test yielded a reliability test result of.907, indicating the validity and reliability of the instrument.

Data Gathering Procedure

After the research proposal was approved, data collection was carried out. In order to collect data from the Grade 11 students at School A, the researcher obtained permission from the Schools Division Superintendent via a letter. After the study was approved, the data collection began by presenting the permission letter to the school principal and District Supervisor. The principal was shown the authorized letter by the researcher.

When classes resumed for the second quarter, the researcher collected all of the students' grades from each unit and evaluated each student's proficiency level based first on the most crucial learning competencies and then on the proficiency level for each section. The researcher chose the two parts with the lowest pretest scores for the second grading session. On the second day of instruction, the researcher observed the math teacher's class and asked the teachers to perform several conditioning exercises.

In addition, the researcher gave a summary of the topic and asked educators to include gamification techniques in their lesson plans. The researcher explained to the participants that an educational experiment will be carried out. To agree to be included in the study, they were given a consent form to sign. At the next meeting with the respondents, the researcher and teachers gave both parts a 30-item multiple-choice test. The respondents were given about an hour to reply. After distributing the pretest materials, the teachers completed the usual task using gamification strategies. After the intervention, the researcher gathered, administered, and personally assessed the posttest materials. The researcher then tallied the data for statistical analysis. Lastly, the researcher reviewed, analyzed, and discussed the results of the study.

Data Analysis

The performance of Grade 11 senior high school students before and after gamification approaches were applied to teach probability and statistics was compared using the Mean/Average. This was also utilized to find the senior high school students' probability and statistics pretest results prior to the intervention. The statistics and probability posttest results of senior high school students after project GAME was implemented were also determined using this method. Additionally, the Paired-Sample T-test was used to determine whether there was a significant difference between the senior high school students' pretest and posttest results in Statistics and Probability following the implementation of project GAME.

RESULTS AND DISCUSSION

Pretest Result of the senior high school students in Statistics and Probability before the intervention. Table 1 shows that students in the Academic-A track obtained an average score of 4.74 with a standard deviation of 1.23, which is equivalent to a score of 64. Based on the grading scale in DepEd Memorandum 042, s. 2020, this falls under the “Did not meet expectations” category. In the same way, students from the TVL-IA track had a mean score of 4.35 and a standard deviation of 1.23, resulting in an equivalent score of 65, which is also classified as “Did not meet expectations.”

Table 1: Pretest Result of the Students in Probability and Statistics

Section/Track	Mean	Std. Dev	Equivalent	Description
Academic - A	4.74	1.23	64	Did not meet expectations
TVL – IA	4.35	1.23	65	Did not meet expectations

Legend. 90-100 = Outstanding; 85-89 = Very satisfactory; 80-84 = Satisfactory; 75-79 = Fairly Satisfactory; Below 75 = Did not meet expectations

The standard deviation in Table 1 reflects how spread out or dispersed the students' scores are from the mean score. In both the Academic – A track and the TVL - IA track, the standard deviation is 1.23, which indicates that the individual scores within each group are relatively close to the average, but still show some variation. Essentially, a standard deviation of 1.23 means that most students' scores are within a few points of the average score (around 4.74 for Academic -A and 4.35 for TVL-IA), but there are still some students who scored slightly higher or lower.

Understanding the significance of this helps to highlight the consistency or variability in student performance. A lower standard deviation, like the 1.23 in both tracks, suggests that while students are not all scoring the same, their scores are fairly consistent and don't deviate too widely from the average. This could imply that, despite the overall low scores (below the expectations), the students in both tracks had similar levels of understanding or struggled in similar ways with the subject.

The pretest scores for both tracks indicate that the students' understanding of Statistics and Probability is currently below expectations, suggesting that the initial level of competence in the subject matter is low. This finding is significant, as it points to a need for effective intervention to improve their grasp of these concepts.

These findings suggest that in order to improve their comprehension and performance in the subject, the students may need more focused and interesting teaching strategies. This result is supported by research, which has shown that active learning techniques like problem-based learning and interactive content can improve students' conceptual grasp of statistics and mathematics (Vergara, Balasta, and Regencia 2025, 217). Furthermore, as demonstrated in the study by Fasco et. al., (2024) students gain from a classroom setting that promotes engagement and practical exercises, especially in subjects like statistics and probability that are frequently seen as difficult.

In summary, the pretest results indicate that teaching statistics and probability to these students requires a customized approach. In light of their present performance, interventions must concentrate on imparting fundamental knowledge and encouraging a more thorough comprehension of important statistical concepts in order to meet the subject's academic requirements.

Posttest Result of the senior high school students in Statistics and Probability after Project GAME (Gamification and Mathematical Engagement). Table 2 shows the posttest performance of the students. Those in the Academic-A track recorded an average score of 18.16 with a standard deviation of 2.33, which is equivalent to a score of 84 and is described as “Satisfactory.” Similarly, the students in the TVL - IA track obtained a mean score of 16.84, with a standard deviation of 3.07, which corresponds to an equivalent score of 82, also placing them in the "Satisfactory" range.

Table 2: Posttest Result of Students in Statistics and Probability

Section/Track	Mean	Std. Dev.	Equivalent	Description
Academic - A	18.16	2.33	84	Satisfactory
TVL – IA	16.84	3.07	82	Satisfactory

Legend. 90-100 = Outstanding; 85-89 = Very satisfactory; 80-84 = Satisfactory; 75-79 = Fairly Satisfactory; Below 75 = Did not meet expectations

The standard deviation in Table 2 helps us understand how spread out the students' scores are in each track after the Project GAME intervention. For the Academic - A track, the standard deviation is 2.33, while for the TVL – IA track, it’s 3.07. These values show that the scores in both tracks still vary somewhat, but the TVL – IA track has a wider spread compared to Academic-A. In simpler terms, this means that in the TVL – IA group, there was more difference in how students performed—some did much better, while others didn’t improve as much. On the other hand, the Academic-A group had scores that were more closely packed together, with less variation.

The significance of this is that while both groups improved from their pretest scores, the TVL – IA group shows more variability in how much each student benefited from the project. This could suggest that the gamification approach in Project GAME had a stronger effect on some students than others. In contrast, the Academic-A group showed more consistent results, meaning the

intervention worked in a more uniform way for that group. These differences could help teachers tailor future interventions, perhaps using more targeted strategies for students who may need additional support.

These results demonstrate a significant improvement compared to the pretest scores, where both groups scored below expectations. The shift from a "Did not meet expectations" performance to a "Satisfactory" outcome suggests that the Project GAME intervention was effective in enhancing students' understanding of Statistics and Probability.

These results suggest that Project GAME's gamification and active participation enhanced students' learning. The subject matter was probably made more interactive, interesting, and approachable by the inclusion of game elements in the teaching process. This can boost student motivation and help them remember important ideas. This supports the findings of Rodrigues, Oliveira, and Rodrigues (2019), who contended that by allowing students to apply ideas in real-world, hands-on ways, active learning environments promote deeper understanding. Furthermore, research like that conducted by Deterding et al. (2011) demonstrates that gamification raises learner engagement, which can enhance learning outcomes, particularly in subjects like statistics and mathematics that many students find challenging.

To sum up, the posttest results indicate that Project GAME significantly improved students' performance in Statistics and Probability, bringing them up from the "Did not meet expectations" baseline to the "Satisfactory" category. This demonstrates how gamification can be an effective strategy for raising student achievement and engagement, especially in subjects that defy conventional teaching methods.

Testing the difference in the pretest and posttest results of the senior high school students in Statistics and Probability before and after Project GAME (Gamification and Mathematical Engagement).

Table 3: The Result of the t-Test before and after Project GAME *(Gamification and Mathematical Engagement)*

Respondents	Pre Test	Post Test	t-value	P-value	Interpretation
Academic - A	4.74	18.16	-16.911	0.000	Significant
TVL – IA	4.35	16.84	-23.836	0.000	Significant

Note: *Significant at @=0.05

Table 3 presents the paired samples t-test results comparing the pretest and posttest scores of students under the Academic-A track. The mean score increased from 4.74 in the pretest to 18.16 in the posttest. The computed t-value of -16.911 and p-value of 0.000 are both lower than the set significance level of $\alpha = 0.05$. This indicates a statistically significant difference between the two sets of scores, suggesting that the Project GAME intervention had a substantial positive effect on students' performance in Statistics and Probability.

Similarly, students under the TVL–IA track had a pretest mean of 4.35, which increased to 16.84 in the posttest. The computed t-value of -23.836 and a p-value of 0.000 indicate a statistically significant difference between the two scores. This result shows that learners in this track also experienced notable improvement following the intervention.

The findings clearly demonstrate that Project GAME had an impact on both groups of students, leading to a significant improvement in their understanding of Statistics and Probability. The very low p-values (0.000) indicate that the improvement was not due to chance, further supporting the conclusion that the project effectively helped students grasp the concepts more successfully.

These findings indicate that active learning strategies and gamification can be highly effective in improving student performance, especially in subjects like Statistics that many learners find difficult. Active learning encourages students to participate more actively in the learning process, helping them better understand and retain concepts, as noted by Gee (2003). In the same way, Toda et al. (2019) found that gamification can boost students' motivation and make learning more enjoyable, which can lead to better academic outcomes. The results imply that implementing Project GAME is a beneficial approach for enhancing the academic performance of Grade 11 senior high school students.

In summary, the clear improvement between the pretest and posttest scores shows that Project GAME was effective in enhancing students' skills in Statistics and Probability. This suggests that using gamification can be a powerful way to make challenging topics more engaging and easier for students to understand.

Based on the findings, here are three key interventions to improve **Project GAME (Gamification and Mathematical Engagement)**:

1. **Personalized Learning Path:** The gamified system should incorporate personalized learning paths to meet the various needs of the students. This would entail adapting the content to each student's comprehension level using adaptive learning

technology or pre-assessment results. Everyone would benefit from a more interesting and successful learning experience if advanced students were given increasingly difficult assignments and those who required more assistance were given foundational material. By making sure that every student works on assignments that are appropriate for their current skills and challenges, personalized learning can increase student engagement (Anderson & Krathwohl, 2001, 42).

2. **Improved Peer Learning and Collaboration:** Including collaborative components like group activities or team-based challenges may encourage social learning. In addition to keeping students interested, these interactive opportunities would encourage peer support by enabling them to work through issues and clarify ideas with one another. It has been demonstrated that group-based learning improves knowledge application and retention while fostering a more dynamic and collaborative learning environment. According to Anderson & Krathwohl (2001, 42), group learning improves retention, particularly when students instruct or explain ideas to one another.
3. **Immediate Feedback, Recognition, and Reflection:** Students would be more motivated, and learning would be reinforced if they received immediate feedback following each challenge, in addition to badges or rewards. Students could also monitor their progress and develop their metacognitive abilities by implementing reflective practices like self-evaluation or in-game journaling. Students would stay motivated and gain a better understanding of their strengths and areas for growth if they received both immediate recognition and reflective learning. Instant feedback and rewards can greatly boost motivation and engagement, which further enhances students' learning experiences, as suggested by Deterding et al. (2011).

CONCLUSION AND RECOMMENDATION

The Project GAME (Gamification and Mathematical Engagement) significantly improved senior high school students' performance in Statistics and Probability. Initially, both the Academic - A and TVL - IA groups were performing below expectations, but after the intervention, both groups performed satisfactory in Statistics and Probability. The improvement was statistically significant, demonstrating that Project GAME strategies helped students better understand complex concepts in Statistics and Probability. Hence, Project GAME is effective in improving students' understanding of statistics and probability concepts. The success of Project GAME aligns with educational theories that emphasize the importance of active participation, engagement, and personalized learning. This study highlights the potential of gamification to enhance student motivation and retention, particularly in challenging subjects. Based on the findings, the school may formalize the integration of gamified learning methods, especially in subjects like Statistics and Probability, where students often struggle. Project GAME can significantly boost student engagement and academic performance, and policies should ensure that teachers are properly trained to implement these strategies effectively. Another recommendation is to adopt personalized learning approaches by using adaptive learning technologies. These technologies can tailor content to each student's needs, offering targeted support where necessary and ensuring that all learners are appropriately challenged. By supporting teacher training and providing the required technology resources, school administrators can encourage the use of gamified learning strategies. Teachers can use adaptive technologies to personalize instruction, incorporate elements like leaderboards, badges, points, and simulations to keep students interested, and promote teamwork through student-designed activities and group challenges. Active participation, taking ownership of their education through group projects and simulations, creative application of ideas in games and real-world problem-solving, and using feedback to enhance performance and critical thinking are all expected of students.

Table 4: Action Plan for Project GAME (Gamification and Mathematical Engagement)

Objectives	Strategies/Activities	Time Frame	Persons Involved
1. Personalize Learning Paths for Students	- Implement adaptive learning technology to tailor content based on student performance.	3-4 months (Implementation phase)	- Teachers
	- Create differentiated tasks based on pre-assessment results for varied learning levels.		- IT support staff (for tech integration)
	- Provide students with customized challenges based on their progress in the game.		
	- Introduce team-based challenges and peer-to-peer	Ongoing (throughout academic year)	- Teachers

	teaching sessions within the game.		
2. Increase Peer Collaboration and Group Learning	- Organize group discussions or study groups for sharing strategies and solutions.		- Students (as team members)
	- Encourage students to collaborate in solving problems and competing in group challenges.		
3. Ensure Timely and Meaningful Feedback	- Implement real-time feedback mechanisms in the game after each task or challenge.	2-3 months (Implementation phase)	- Teachers
	- Use game-based rewards (badges, points) to acknowledge improvements and achievements.		- Students
	- Set up a system for reflection where students evaluate their progress through in-game journals.		
4. Continuously Monitor Student Progress and Engagement	- Regularly track student performance through the game's built-in progress monitoring system.	Ongoing	- Teachers
	- Adjust the difficulty of tasks based on performance data to ensure engagement and challenge.		- Educational Technologists
5. Expand Gamification Strategies to Other Subjects	- Explore the use of Project GAME in other subjects like Math, Science, and English.	6-8 months (Pilot phase)	- Subject Area Teachers
	- Develop subject-specific gamified learning modules and activities.		- Curriculum Developers
	- Collect feedback from students and teachers on the effectiveness of gamification in new subjects.		- Teachers, Students
6. Provide Technical Assistance and Support	- Organize technical assistance for support the integration of gamification techniques on the lesson	1-2 months (Initial phase)	- Educational Administrators
	- Offer training on using adaptive learning tools and providing real-time feedback.		- Teachers
7. Assess the Effectiveness of Project GAME	- Conduct post-implementation assessments (pretests and posttests) to evaluate progress.	1-2 months (after intervention)	- Researcher, Teachers
	- Collect qualitative feedback from students and teachers on their experience with the game.		- Students, Teachers

	- Analyze data and refine Project GAME based on feedback and results.		- Researchers, Teachers
8. Dissemination of the Project	Disseminate the Project GAME in the Leaning Action Cell (LAC) session of the school.	1 hour	-School Heads -Teachers -Researcher

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