INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print); 2222-5234 (Online)
Website: https://www.innspub.net
Email contact: info@innspub.net
Vol. 27, Issue: 5, p. 106-122, 2025

RESEARCH PAPER OPEN ACCESS

Gamification, utilization of SM chart, and engaging student-teachers (G.U.E.S.T.) strategy in teaching science

Violeta F. Collado*

Don Mariano Marcos Memorial State University, Bacnotan, La Union, Philippines

Key words: Action research, Attitude, Teaching performance, Teaching strategy, Teacher education

DOI: https://dx.doi.org/10.12692/ijb/27.5.106-122 Published: November 11, 2025

ABSTRACT

Future teachers learn and use various pedagogies to be effective in the classroom. Extensive preparation is essential for them to become competent and dedicated educators. This study focused on the development and implementation of strategies for teacher education students specializing in science. The action research process utilizing quasi-experimental (One group pretest and posttest) methods. Total enumeration was employed for data collection. Data were gathered in a real classroom setting over one semester. Descriptive statistics such as frequencies, mode, percentages and weighted means were used for data analysis. The study found that 76.47% of the respondents had a highly positive attitude towards teaching, with an average baseline teaching performance of 87.35 (Satisfactory). The implementation of G.U.E.S.T. strategy as intervention increased the number of students' with Highly positive attitudes to 88.24% and teaching performance to 89.76 (Very satisfactory).

***Corresponding author:** Violeta F. Collado ✉ vcollado@dmmmsu.edu.ph

INTRODUCTION

Teaching as a profession is formally the duty of skilled and educated educators who are saddled with all pedagogical ideas and practices and have a mission to ensure the overall development of learners at all levels of education. Teaching is a complex process with several basic components, including objectives, material, methods, evaluation (marking and reporting), the teacher's personality, and the learner's ability (Ayua, 2017).

Considering the fact that performance orientations are motivational aspects of learning that differentiate between mastery and mastery goals. Mastery goals involve intellectual development, knowledge acquisition, effort investment, and higher-order cognitive strategies, while performance orientations focus on achieving learning outcomes (Hattie and Donoghue, 2016). When the teacher enters the classroom, he or she considers all of these factors.

Gamification is defined as the functionality of interactive systems that use game aspects and mechanics to inspire or engage end users (Seaborn and Fels, 2015). Gamification also refers to technologies that try to boost intrinsic motivation for various tasks, generally through the use of game design features (Hamari and Koivisto, 2015). Also, gamification provides help and complementary supports for both teachers and students where it involves effective learning with the help of the games and computers to serve the purpose of learning aids.

Furthermore, the issue of ICT integration and games in schools, especially in the classroom is vital. This is because; the use of technology and games in education contributes a lot to the pedagogical aspects in which the application of ICT will lead to effective learning with the help and support from ICT elements and components (Jamieson-Procter *et al.*, 2013). This is also to prepare the pedagogical knowledge of students for the teaching internship.

The constantly shifting age of technology has led to classrooms acquiring more equipment and needing to integrate it into the education of their students. Technology has the potential to improve student learning, but it can also have negative effects on the educational process. A study assessing 7th-grade students' higher-order thinking skills revealed that 79.7% of students were at lower levels, with more male students. The study suggests that all students need to improve their synthesis and evaluation skills for better science creativity. To better prepare students for the science and technology of the 21st century, the current science education reforms ask science teachers to integrate technology and inquiry-based teaching into their instruction.

However, the problem of teacher education includes a lack of foundations in education, issues with student prior knowledge and experience, failure to experience meaningful diversity, inadequate and inappropriate field experiences, failure to understand the nature of the teaching-learning process, and the need to highlight intentional program design. Furthermore, attitudes play a crucial role in students' standardized test performance, with upper-elementary teachers significantly impacting self-efficacy in math and classroom behavior. Teaching techniques like emotional support and classroom structure predict these attitudes. Effective teachers often enhance test scores, but not pupils' attitudes and conduct. Therefore, initiatives to improve teachers' skills in all areas of teaching are essential for long-term success (Blazar and Kraft, 2017).

Moreover, for a locale scenario a study conducted by Collado and Espero (2023) revealed that 67.77% of DMMMSU NLUC College of Education alumni need training on teaching strategies, commitment to teaching, and classroom management. Cubero (2022) from Davao de Oro state college found a positive correlation between professional qualities of teachers and pre-service teachers' academic performance, while personal qualities did not. It recommends teachers to continuously update and learn new teaching methods.

In addition, supporters and school implementers advise teachers to look for ways to successfully

enhance learning and draw students' attention to the subject matter, especially in the current generation where advanced technology dominates every aspect of students' lives. The Research Management Guidelines (RMG) to guide in managing research initiatives at the national, regional, school division, and school levels can help teachers improve their performance.

Currently, engaging activities are crucial in education for personal, social, and professional development. However, limited competence and less time can hinder effective and quality education.

To address this, the researcher used three methods of teaching: (1) gamification, (2) utilization of SM charts, and (3) engaging student-teachers. Through gamification, pre-service teachers are required to plan and execute a lesson utilizing any type of game (online games or traditional games) aligned to his/her lesson at the second-year level of taking a teacher education course.

For the utilization of the SM chart, the Score-Minus (SM) chart was prepared before actual teaching. This chart was used to manage class participation and behavior during the presentation.

The concept of Iskandar *et al.* (2024), who stated that reward and punishment are strategies used in developing discipline in schools. In this study, the researcher and pre-service teacher will reward students by giving praise for positive behavior, encouraging them to keep trying and behaving better, and minus points for unnecessary actions. In addition, the use of instructional technologies has several advantages for both the teacher and the students. Engaging Student Teachers is a way of coaching pre-service teachers on how to teach. Demo teaching activities were implemented to target the creation level of students using the new Bloom's taxonomy. The combination of these three schemes is called gamification, utilization of the score-minus chart, and engaging student-teachers (G.U.E.S.T.) strategy. GUEST in the Oxford dictionary means a person who is invited to take part in a function organized by another. To justify G.U.E.S.T. as a strategy, the students served as guests to discuss the topics through demo-teaching. Moreover, this study focuses on innovating classroom instruction by incorporating games, varied activities, and effective classroom management in teaching science, enhancing teacher and pre-service teachers teaching performance and attitude, thereby promoting further exploration and discovery of new knowledge.

This study aimed to determine the usefulness of the G.U.E.S.T. strategy in teaching science to prepare future science educators in the field of teaching during the school year 2024-2025. Validated product and process of GUEST Strategy were the output of this study.

Specifically, the study seeks to answer the following questions:

1. What is the attitude of the students towards teaching before the implementation of G.U.E.S.T. strategy?
2. What is the teaching performance of the students before the implementation of G.U.E.S.T. strategy?
3. What is the attitude of the students towards teaching after the implementation of G.U.E.S.T. strategy?
4. What is the teaching performance of the students after the implementation of G.U.E.S.T. strategy?
5. Is there an improvement in the attitude and teaching performance of the students after the intervention?

MATERIALS AND METHODS

Scientific basis/theoretical framework

Goal theory is a motivational approach that emphasizes establishing intrinsic motivation through goals. It suggests that success in goal-oriented learning is influenced by factors such as goal acceptance, specificity, difficulty, and feedback. Goals can be categorized as mastery, performance, or avoidance approaches. While widely accepted due to empirical research and its effectiveness, it can be challenging to use as a stand-alone theory due to potential conflicts or

prioritization issues. It is best used in conjunction with other theories but may not be as effective as a standalone approach. This theory applies to the use of GUEST strategy since it focuses on training student-teachers as early as the second year, employing games, SM charts, and engaging students to teach. The student-teachers' goal is to complete demo teaching and become the best presenter in the class. Teacher, on the other hand, will encourage student-teachers to plan, prepare, and implement the best possible teaching and learning process, including the use of games as a strategy. Their teacher will guide them by checking their lesson plan prior to implementation.

Classical conditioning by Pavlov is a behavioral procedure where a biologically potent stimulus is paired with a neutral stimulus, resulting in an automatic, conditioned response, such as the sound of a musical triangle, to create a specific response. Operant conditioning, sometimes called instrumental conditioning or Skinnerian conditioning, is a method of learning that uses rewards and punishment to modify behavior. Through operant conditioning, behavior that is rewarded is likely to be repeated, while behavior that is punished is prone to happen less. These theories will be applied to ensure classroom discipline. Mind conditioning must be done to get good feedback or action. the use of the Score-Minus (SM) chart, where additional points will be provided to students/groups who answered the questions properly, participated entirely, and followed the class rules. Likewise, deduction points would be given if they engaged in unnecessary activities like creating noise, bullying, etc. (refer to the process of using GUEST strategy).

Personalized learning is a unique approach to education that focuses on tailoring the teaching and learning experience to each individual learner's specific goals, abilities, interests, and needs. This differs from traditional classrooms, which typically involve one instructor teaching a group of students with uniform materials and expectations. Personalized learning allows for more personalized attention, providing immediate feedback on progress and ensuring understanding of the material. This flexibility and personalization make it an effective choice for students looking to improve their learning experience. This applies to student teachers' demonstration teaching, which will involve them in teaching and learning, as well as how to teach and manage a class.

Their actual learning experience will guide them toward their dream of becoming a future educator, improve their teaching performance, and involve them in teaching and learning activities. Personalized learning will also assist teachers in guiding or facilitating instruction, as well as training future teachers.

Teaching and learning

Science is a crucial subject in school curriculum, but ineffective learning can be attributed to several factors. Teachers often have limited knowledge in their chosen electives, such as Physics, Chemistry, or Biology, which is essential for teaching fundamental concepts. They may struggle with quick sketches, diagrams, and linking scientific content with everyday examples.

Additionally, teachers often lack the resources, time, and inclination to collect ample background information.

A study conducted by Vishnupriya and Bharathi (2022) study revealed that audio and visual aids as teaching tools for enhancing learners' attention spans. The tools, including discussions, debates, and lectures, have been found to be effective in enhancing learning abilities. The findings suggest that the use of these tools can be a motivating technique for teachers.

Technology with games has the potential to improve science teaching and learning, but it has not always been effective due to the lack of tailored materials and cultural differences. In the past, educational films produced abroad may not match the local curriculum

and be difficult to understand due to different accents. To address this issue, teachers can use reward and punishment strategies in developing discipline in schools. The utilization of the Score-Minus (SM) Chart targets higher-order thinking Skill (HOTS) questions in science and requires students' comprehension.

A study conducted by Mayor (2024) found a significant difference in students' performance before and after incorporating HOTS into their reading comprehension. This intervention effectively improves reading performance by activating prior knowledge and enhancing students' creative and critical thinking abilities. Gamification in teaching enhances students' thinking, communication skills, and intrinsic motivation. It allows students to adjust learning methods based on game elements, such as rankings, levels, and challenges. This results in higher test scores for gamified teaching groups, enhancing motivation and enjoyment of learning.

Whereas Sensoy *et al.* (2018) studied the impacts of science teaching enriched with technological applications on the science course achievement levels of 7th-grade students, Muhibbuddin *et al.* (2023) aimed to test the effectiveness of habituation to Higher Other Thinking Skill (HOTS)-based science questions in improving students' critical thinking skills in science. Serin (2011) investigated the effects of computer-based instruction on the achievements and problem-solving skills of science and technology students. Their studies denote positive outcomes.

In addition, adaptive gamification has gained attention in science education, prompting researchers to explore adaptive gamification. This study tested an adaptive gamification environment for sixth-grade students in primary school, incorporating adaptive criteria, learning strategies, and gaming elements. Results showed that students were more motivated to learn science when using an adaptive gamification environment, and students generally liked the game elements.

Digital games have become popular in education, with serious games designed to improve critical thinking skills. However, research on science education is limited. This study aims to design a serious game model for Higher-Order Thinking Skills (HOTS) in science education (PKBATDPS Model), validated using the Electric Circuit prototype. The results show that the PKBATDPS Model can effectively increase students' HOTS and motivation in science education.

Another study conducted by Kalogiannakis *et al.* (2021) reviewed 24 empirical research papers published between 2012 and 2020, revealing emerging trends, challenges, and impediments. It provides a framework for future research on content areas, educational levels, theoretical models, outcomes, methodologies, game elements, and assessment tools, aiming to promote scientific thinking and engagement.

Besides, Koasar *et al.*'s (2015) study aimed to evaluate the effectiveness of CAI vs. classroom lectures for computer science at the ICS level. The findings indicated that the total gain in the cognitive domain by CAI was significantly superior to the total gain in the cognitive domain by the CRL teaching method. Bakac's (2011) study observed the effect of computer-assisted instruction (CAI) with simulation techniques used in teaching the subject of "Elective Current" on the successes of students.

In conclusion, technology with games has the potential to improve science teaching and learning by addressing individual teacher needs, utilizing reward and punishment strategies, and promoting critical thinking skills. Future research should focus on incorporating gamification in science education to enhance student engagement and success.

Local studies

In the Philippines, various studies have been conducted to explore the use of gamification strategies in classroom instruction. Bangcaya *et al.* (2021) found that gamified learning activities improved students' attention, confidence, and

satisfaction, suggesting that educational game-based learning strategies can be effective.

Lansangan and Orleans (2024) explored the critical thinking profile of Filipino students in science laboratory classes, finding that openness to different ideas is the most practiced aspect, while planning and organization of information are the least. The importance of gathering information to support position is the most agreed upon factor, and strategies in thinking of problems in experiments are the least.

The Versatile Instrumentation System for Science Educational and Research (VISSER) project by Alfonso *et al.* (n.d.) aims to improve science laboratory activities in the Philippines by developing higher-order thinking skills (HOTS) through laboratory activities. VISSER uses a microcontroller platform, reliable sensors, and educational modules to address issues like lack of science equipment. Furthermore, Ragasa (2017) compared computer-assisted instruction and traditional methods of teaching basic statistics, finding that the treatment group had a higher estimated marginal mean than the control group and reversed the attitude. Gorra *et al.* (2016) studied student perceptions of technology use in the classroom at higher education institutions, focusing on factors affecting student acceptance of e-learning technology, particularly on Learning Management Systems (LMS) in the Filipino context.

Moreover, Garcia's (2019) study focused on E-learning Technology Adoption in the Philippines, examining the relationships between factors to explain students' adoption of e-learning technology from the information system acceptance point of view. Jaloker *et al.* (2019) conducted a study on the performance of Grade 3 pupils of Baliwag University, assessing the teaching outcome of traditional and computer-aided instruction. Barlis and Fajardo (2013) also investigated the effectiveness of simulation and computer-assisted instruction (CAI) on the performance of students under segmental training on multiple-choice questions and problem-solving on selected topics in Physics II. The results showed that both traditional and experimental methods, individually, are effective in teaching students, with significant improvements in multiple-choice questions and problem-solving. The aforementioned relevant studies were conducted separately. This study will employ a combination of three approaches to instruction to determine whether student-teachers' attitudes and teaching performance will improve. The above-mentioned related studies will be used to check the similarity and differences of the research results in this study.

Research paradigm of the study

The research paradigm of the study follows a cyclical process that begins with the observation and gathering of baseline data on teachers' attitude and teaching performance. This initial phase identifies existing strengths and weaknesses, providing the foundation for designing an appropriate intervention. Based on these findings, the next phase involves the planning and finalization of the G.U.E.S.T Strategy, ensuring that the intervention aligns with the needs detected during the baseline assessment (Fig. 1).

Once the strategy is finalized, it is implemented in the actual teaching setting. During this phase, additional data are gathered to measure changes or improvements in teachers' attitude and teaching performance as a result of the intervention. After implementation, the researcher analyzes the collected data to draw conclusions on the effectiveness of the G.U.E.S.T Strategy. The final phase involves formulating recommendations based on the conclusions, which may guide future improvements, further studies, or broader application of the intervention.

Fig. 1. Research paradigm of the study showing the action research process

Research design

The action research process using quasi-experiments were used in this study. Quasi-experiments are studies that aim to evaluate interventions but that do not use randomization. Similar to randomized trials, quasi-experiments seek to establish causation between an intervention and an outcome, Harris (2005). Pretesting and treating a single group of research participants or subject is one of the most frequently used quasi-experimental research design, Colman (2015). In this study quasi experimental using one group pretest-posttest was utilized to test the usefulness of intervention and to describe the attitudes and teaching performance of students before and after the intervention.

Subjects of the study

The respondents of the study were seventeen (17) BSE-Science II students of DMMMSU NLUC College of Education enrolled in SESE 105—Anatomy and Physiology on the 2nd semester School Year 2024-2025. This class was handled by the researcher. Action research requires constant monitoring and supervision when collecting actual data. Thus, the study was limited to the seventeen (17) BSE-Science II students of DMMMSU NLUC College of Education enrolled the subject SESE 105—Anatomy and Physiology.

Data gathering tool

The necessary data for this study were gathered through a survey questionnaire on the attitude of students toward teaching and an evaluation tool for teaching performance which were both adopted from the College of Education (Evaluation Form for Final Demonstration Teaching and Holistic Rubric for Practice Teacher's Performance).

Data gathering procedure

The survey questionnaire and evaluation tool were given to the respondents and evaluators before and after the implementation. A panel of evaluators (Self-rating, Peer, Supervisor) were requested with a proper communication letter before a preliminary demo teaching to gather baseline data. After the initial evaluation, an orientation was conducted explaining the processes.

Responses/ratings were tabulated and tallied

SM chart rules were explained properly before the actual demo-teaching. Corresponding points were given to the student/group who answered questions asked by the demo teacher. 1 point for easy questions targeting the (Remembering) level of Bloom's Taxonomy, 2 points for the average (Understanding), 3 points for the difficult (Application), and 4 or more for the questions targeting the Analyzing, Evaluating, or Creating levels. A minus/demerit was also given to the students/group who created unnecessary actions. The utilization of the SM Chart was strictly used by the demo teacher throughout the delivery of the lesson. The remaining students in the class functioned as the participants and peer evaluators. Retrieval of evaluation results was conducted after every presenter. Scores were announced through post-conference, results were tabulated, and they were properly recorded.

To guarantee that the teaching and learning process transpired and for the students to do the tasks/activities, strict monitoring and evaluation (Self-rating, Peer, Supervisor) were applied.

Demo-teaching (reporting) is a requirement of the course for students enrolled in SESE 105—Anatomy and Physiology. Their demo-teaching performance served as one of the bases of their class standing (60%). Teaching performance was part of the student's grade, and this was also used as one tool to evaluate the usefulness of the GUEST strategy. The SM Chart (score sheet) was used as a tool for the recitation/participation of students during class hours. The topics assigned were based on the syllabus of the course. Applying the 21st-century teaching and learning concept. This action served as a strategy to engage pre-service teachers in teaching the lesson assigned to them. Consequently, to boost students' engagement, a

selection of Best Presenter and Best Challenger were conducted. A demo teaching schedule was prepared prior to implementation. Guidelines and procedures were properly communicated. Prior to the implementation, the objectives of the study were explained and their consent was requisite. The evaluation results per presenter was recorded with utmost confidentiality. The researcher ensured that the respondents' rights were well protected. A post conference was also applied. well protected. A post conference was also applied.

Data analysis

In this study, descriptive statistics such as frequency count, percentages, weighted mean were used. in determining the attitudes of students towards teaching frequency count and percentages were used. For the teaching performance weighted mean was utilized. Before and After Improvement = {(After value - Before value) / Before value)}× 100% was employed to measure the rate of improvement of the respondents on the attitudes and teaching performance before and after the intervention.

RESULTS AND DISCUSSION

The attitude of the students towards teaching before the implementation of G.U.E.S.T. strategy

Table 1 denotes that 14 out of 17 students or seventy-six-point forty-seven percent (76.47%) of the students had high positive attitude towards teaching. This implies that the students who are already very interested in teaching and learning are more likely embrace new teaching pedagogies like G.U.E.S.T strategy, which could enhance their effectiveness and adoption.

Research studies consistently shown that positive attitudes enhance motivation, engagement, self-efficacy and persistence, which are all essential for professional growth (Karakose *et al.*, 2023). A high initial attitude implies that every intervention can show added value whether it maintains positively or elevates it even better.

Table 1. The attitude of the students towards teaching before the implementation of G.U.E.S.T strategy

	Frequency (mode)	Percentage	Remarks
	13	76.47	Highly positive
	4	23.53	Much Positive
Total	17	100	

5-Highly positive, 4-Much Positive, 3-Moderately Positive, 2-Slightly Positive, 1-Negative

This is similar to the study conducted by Gonzalez *et al.* (2024), meta-analysis in mathematics education found that student-centered and cooperative strategies significantly improve course attitude (effect size g≈0.757). Furthermore, active learning interventions like flipped classrooms led to statistically significant improvement in both attitude and achievement in Chemistry, College Algebra, and Physics classes (Lee and Ramos, 2023; Nja *et al.*, 2022). Moreover, Nja *et al.* (2022) conducted a study following a flipped classroom intervention to Nigerian College students in Chemistry, result demonstrated improved attitudes and test scores. In the Philippines Karjanto and Acelajado (2022) found that similar pedagogy increased college algebra students' sense of confidence, motivation, and responsibility. Further, a study of Philippine pre-service teachers found that teaching style significantly influences positive attitudes and self-concept, which in turn relate to perceived competence (Awado *et al.*, 2024). Moreover, Fulmer *et al.* (2019) revealed that aligning teaching styles to students' preferences, like cooperative learning, is linked to better attitudes toward science.

The above-mentioned studies presumably emphasize that active or cooperative teaching methods like G.U.E.S.T strategy could boost both attitude and academic performance. Implementing G.U.E.S.T may help sustain or deepen the positive attitudes already exist in students, reinforcing preparedness and engagement as future educators. G.U.E.S.T. strategy thus builds upon a strong foundation and aligns with international best practices. Collecting structured post-intervention data will help confirm its usefulness and support further refinement.

The teaching performance of the students before the implementation of G.U.E.S.T. strategy

Data on Table 2 reflect a well- rounded and consistent performance across various evaluators. A self-rating (88.53) indicates students rated themselves in the Very Satisfactory (VS) range, signifying strong awareness of their abilities and skills. The peer evaluation rating was also given Very Satisfactory (88.00), which supported the idea that the students are confident in their performance and that it is in line with expectations and goals. Rating from supervisor was Satisfactory (85.41), a little lower than ratings from peer and self-rating could highlight areas for improvement such as in the areas of art of questioning, alignment of games to the lesson objectives, and authentic assessment that are not immediately apparent to peers. The overall performance of 87.31 (Satisfactory) baseline teaching performance means the students are good enough in their teaching but there is still a need to enhance their performance through Gamification, Utilization of SM Chart, and Engaging Student-Teachers (G.U.E.S.T) Strategy in Teaching Science their teaching could still be improved. The baseline score suggests that 2nd year pre-service teachers have a solid foundation for delivering science instruction. However, while commendable, this level implies that there is still probable for improvement, particularly in terms of devising teaching more creative, student-centered, and successful in encouraging deeper knowledge. The implication is that while old or contemporary teaching methods are effective to some level, they may not fully come across the demands of 21st-century learners, who gain more from synergistic and technology-integrated approaches. In order to improve the rating to excellent or Very Satisfactory, G.U.E.S.T. Strategy could help to improve teaching skills.

This give a chance to apply the G.U.E.S.T. Strategy (Gamification, Use of the SM Chart, and Engaging Student-Teachers) as a targeted intervention to enhance teaching performance. Its utilization is believed to promote active learning, boost motivation, and strengthen conceptual comprehension in teaching science.

Table 2. The teaching performance of respondents before the intervention

	Self	Peer	Supervisor	Over-all	Remarks
Total	88.53	88.00	85.41	87.31	S

95-100 Excellent (E), 88-94 Very Satisfactory (VS), 81-87 Satisfactory(S)

Despite being rated "Satisfactory," the baseline performance demonstrates competency rather than mastery. Different issues are likely unmet in their educational approaches, such as keeping student engagement, encourage higher-order thinking abilities, and effectively incorporating technological tools.

Gamification allows student-teachers to make motivating and immersive science classes, transforming concepts into a participatory rather than passive experience. According to research, gamified learning environments aid students enhance their attention span, memory retention, and desire for learning.

The use of an SM Chart (Score Minus Chart) gives a visual and procedural framework for systematic giving of scores, encouraging systematic thinking, logical reasoning, and problem-solving abilities—all important skills in teacher education. This way guarantees that learners follow the consistent and structured manner of giving points.

This is supported by Nkhoma *et al.* (2020), reviewed rubric design and application, highlighting the advantages, challenges and effectiveness of authentic assessment tool across educational contexts and instructional planning. They recommend using generic, task-specific, holistic, and analytic rubrics for different educational contexts. These tools increase metacognition, organized decision-making, and student responsibility, which is related to the goal of an SM chart.

Additionally, rubrics, such as the SM Chart, distinctly represent performance objectives and promote structured, accurate grading. Furthermore, Panadero and Jonsson (2013) found that scoring rubrics improve organized assessment, higher-order thinking, and logical reasoning.

They enable students and teachers to communicate in a common language of performance. Also, Aban *et al.* (2020), stressed that scoring tools (like SM charts) are fundamental to evaluating and improving instructional competence. In this context, the SM Chart serves a similar purpose to rubrics, helping student-teachers and learners in understanding the reasoning behind results. In addition, Brookhart (2013) contends that good scoring tools, whether rubrics or other forms, improve learning by making thinking perceptible, which fosters logical evaluation and procedural discipline. The SM Chart, as a personalized scoring tool, adheres to this idea and provides a consistent system of scoring that aids teacher growth. The research cited above repeatedly demonstrate the educational benefit of visual, organized scoring tools for fostering systematic reasoning, logical judgment, and assessment literacy—all of which are essential components of teacher education. The Score Minus (SM) Chart, while not often known in the literature, falls into the rubric or analytic scoring category and is consistent with these best practices. Its procedural clarity ensures fair grading and encourages cognitive honesty in performance evaluation like demo-teaching.

The attitude of the students towards teaching after the implementation of G.U.E.S.T. strategy

Data on Table 3 indicate a positive shift in the attitude of the respondents from 13 Highly positive and 4 much positive attitude status before the intervention (G.U.E.S.T. strategy) to 15 Highly positive attitudes and 2 much positive attitudes afterwards. This imply that the implemented intervention had a considerable and positive effect. The improvement indicates that the plan of action implemented effectively improved respondents' understanding, and attitude towards teaching.

Table 3. The attitude of the students towards teaching after the implementation of G.U.E.S.T strategy

	Frequency (mode)	Percentage	Remarks
	15	88.23	Highly positive
	2	11.76	Much Positive
Total	17	100	

This finding influence to the idea that planned, intentional interventions, particularly those that are matched with learner needs and based on practical pedagogical methods, can have measurable results. This is similar with the findings of (Gibson, 2014), that the technology intervention had a direct and positive effect on students' attitudes toward and use of computers for educational purposes. Interestingly, the findings also indicate that teachers' attitudes and use of technology did not significantly mediate this relationship. This further explains that even in the absence of strong teacher influence or modeling, well-designed interventions can independently foster students' positive engagement with educational technologies. The findings are congruent with the findings of Liu *et al.* (2004), who discovered that direct exposure to structured and engaging computer-based activities can considerably improve students' attitudes toward technology, regardless of teachers' sentiments. Similarly, Kay *et al.* (2017) discovered that student-centered interventions that provide hands-on experience and autonomy with digital tools create greater positive effects in digital competence and motivation than teacher-led approaches. The series of demo-teaching activities using traditional and online games resulted in improved teaching performance and attitudes among the respondents. Demo teaching required students to plan, implement, and evaluate teaching activities.

Moreover, this change of teaching performance reflects the theory of Vygotsky's scaffolding, offering learners with temporary support to help them comprehend new concepts or abilities, gradually diminishing assistance as their competency improves,

this emphasizes that with proper scaffolding, learners can move from their actual level of teaching performance to a higher level.

The attitude before the intervention classified as 13 – Highly positive and 4 much positive attitudes illustrate the learners' baseline attitude, while the 15 with Highly positive attitude and 2 much positive attitudes after the intervention demonstrates the prospering behavior of change through guided support.

Lastly, the findings are consistent with constructivist learning theory, which support active learning environments in which students build knowledge through interaction and exploration.

In this situation, the intervention most likely gave students chance to employ with traditional or online games in meaningful ways, boosting their confidence and positive attitudes.

The teaching performance of the students after the implementation of G.U.E.S.T. strategy

Data on Table 4 signify that post-intervention performance is realistic and modest self-perception is reflected by the self-rating (89.59), which is slightly lower than the peer and supervisor scores.

This shows self-awareness and a dedication to ongoing improvement of teaching performance.

Peer assessment (90.06) collaborative efforts were indicated by the peers' highest rating of the performance. Peer and supervisor perspective on teaching performance quality are in agreement, as evidenced by the supervisor's rating (89.90) being extremely close to the peer rating and falling into the same "Very Satisfactory" range. An overall score of 89.78 (Very Satisfactory) indicates a significant improvement in the teaching performance of student-teachers after using the G.U.E.S.T Strategy. This means that the use of Gamification, SM Charts, and active engagement approaches resulted in a more dynamic, participatory, and structured learning experience. The intervention most certainly strengthened lesson organization, delivery, and student engagement—all of which are practical skills in teacher education—thereby improving 2nd year pre-service teachers teaching performance and confidence.

Table 4. The teaching performance of the students after the implementation of G.U.E.S.T. strategy

	Self	Peer	Supervisor	Over-all	Remarks
Total	89.59	90.06	89.90	89.78	VS

95-100 Excellent (E), 88-94 Very Satisfactory (VS), 81-87 Satisfactory (S)

The result implies that the G.U.E.S.T Strategy successfully addressed key teaching issues in teaching science education by making the learning process more dynamic and learner-centered.

Furthermore, research findings revealed increased participation, enhanced motivation, stronger competitiveness in individual tasks, and improve collaboration during team activities, demonstrating that gamified learning improved engagement and learning outcomes (Raju *et al.*, 2021), while visual scaffolding tools such as the SM Chart can improve content organization and conceptual understanding (Mayer, 2009; Novak and Cañas, 2008). Furthermore, engaging student-teachers in reflective and collaborative practice is consistent with Darling-Hammond's (2006) results, which emphasized the importance of experiential, reflective learning in teacher preparation.

This assumption is consistent with educational perspectives emphasizing active learning techniques like collaborative exercises, problem-based discussions, and games improve academic achievement, critical thinking and motivation and inclusiveness in undergraduate education (Sulaiman and Abdullah, 2024).

This is accordant with educational ideas emphasizing active learning, visual scaffolding, and peer cooperation as useful techniques for increasing

instructional quality. The findings detail the need of innovative, multimodal solutions in pre-service teacher education, especially in disciplines such as science, which demand both conceptual depth and practical training of skills.

Finally, the favorable outcome indicates that the G.U.E.S.T Strategy is a promising model for improving pedagogical competence that might be duplicated or modified to other curriculum areas and teacher education programs.

The rate of improvement in the attitude of the students after the intervention

Findings on Table 5 reveal that respondents' self-reported attitudes about teaching improved by two respondents, from 13 to 15 (Highly positive) after the intervention. This slight but significant improvement suggests that the G.U.E.S.T Strategy—which includes Gamification, the use of the SM Chart, and Engaging Student-Teachers—had an advantageous outcome on respondents' attitudes and mindsets toward the teaching profession, particularly in the context of science education.

The improvement in the number of respondents' positive attitude towards teaching indicates that the intervention did more than just improve abilities; it also brings increased motivation, interest, and confidence among pre-service teachers. This lends influence to the idea that well-structured, interactive teaching methods can change attitudes by making learning more meaningful and pleasant (Hamari *et al.*, 2014). Gamification, in example, has been found to gain emotional engagement and foster a sense of achievement and enthusiasm in educational settings (Deterding *et al.*, 2011; Buckley and Doyle, 2016).

Using visual scaffolding, such as the SM Chart, can enhance conceptual understanding and lessen cognitive load, leading to less irritation and more positive attitudes towards instructional tasks (Mayer, 2009; Novak and Cañas, 2008). Meanwhile, positive correlation between teachers' self-efficacy and their work engagement among Vietnamese high school educators, as underlined by Tran (2023), suggested integrating self-efficacy development into training and creating supportive environments.

Table 5. The rate of improvement of the respondents' attitude on teaching after the intervention

	Highly positive(5)	Much positive(4)	Rate of improvement
Before	13	4	15.38%
After	15	2	
Number of increased (N)	2		

This finding is backed up by Gibson *et al.* (2014), who found that intervention that give faculty members with student-centered pedagogues increase teacher attitudes and reduce anxiety. Although the positive attitude change was moderate, it indicates that when pre-service teachers feel supported, engaged, and intellectually stimulated, their overall mind-set on teaching is favorable.

The improvement in the teaching performance of the students after the intervention

Table 6 and Fig. 2 present the rate of improvement of the respondents on teaching after the intervention. Findings shows that the rating before the intervention was Satisfactory with a mean of 87.35 while rating after the intervention was Very Satisfactory (89.76). This means the respondents have shown a positive improvement in their teaching performance scores after the intervention.

Among the 17 respondents, 15 demonstrated 1 to 5 improvement in their performance (88.2%), one or 5.9% kept the score constant and one displayed a performance drop of -1 point, this may be attributed to the lack of gadgets to be used by the student and also as working student.

Furthermore, respondents' K and M showed the highest rate of improvement, both increased by five points. These results might indicate that the processes of the intervention and the specific needs of these students are highly aligned. Although interventions

are generally helpful, individual factors like involvement level, outside stressors, or previous teaching experience may influence the outcome, as seen in the little decrease in respondents' score (Guskey, 2002).

Table 6. The rate of improvement in the teaching performance after the intervention

	Before	After	Rate of improvement	Remarks
Mean scores	87.35S	89.76VS	2.41	Improved

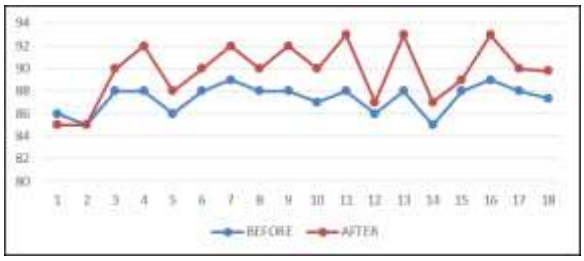

Fig. 2. Improvement of the Respondents' Teaching Performance after the intervention

Moreover, the average assessment before the implementation of intervention is "Satisfactory" and "Very Satisfactory" after the intervention, indicating a change in the group's overall teaching skills and classroom confidence. This outcome shows how G.U.E.S.T strategy improved the efficacy of instruction. The fact that one respondent displayed a decline, even though the majority of them improved, suggests that individual factors resulting from external factors may have affected the results and should be further investigated in future research. Gibson *et al.* (2014) emphasized that teacher-focused interventions can significantly increase performance-related outcomes when training is supportive and targeted, which supports these findings.

Similarly, Rafiq *et al.* (2024) discovered that both traditional and digital settings, student-centered approaches and exposure to practical experiences increases motivation, competency and instructional delivery. For the largest increased (5 points) Darling Hammond *et al.* (2017) who said that continual, context specific, and reflective professional development maximizes individual growth.

CONCLUSION

The respondents showed strong enthusiasm for teaching before the intervention. The teaching performance of 2nd year major in science students shows satisfactory rating, indicating solid foundation before the intervention; The respondents' attitude towards teaching science were considerably improved by the use of G.U.E.S.T. strategy; the G.U.E.S.T strategy utilization provide relevant teaching assets for 2nd year major in science students; G.U.E.S.T. strategy consistently associated with increased attitude and teaching performance of 2nd year students; therefore, the use of G.U.E.S.T. strategy is a potential strategy to increase the performance of 2nd year Science Majors.

RECOMMENDATIONS

The need to copyright the product and process of conducting the G.U.E.S.T. strategy for teacher education and then provide G.U.E.S.T. strategy sessions to 2nd-year students taking up the teacher education program to boost students' enthusiasm towards teaching and introduce gamified components like interactive scaffolds and point systems, nurturing their positive momentum and encouraging active participation. Furthermore, teacher education may use this strategy to provide attitudinal improvements and motivation-driven activities such as real-time scoring and recognition to boost students' confidence and practical skills in teaching. Also, maximize the use of the G.U.E.S.T. strategy and other related pedagogies in teacher education. Lastly, similar studies should be conducted on other teacher education programs/majors/courses to prove the usefulness of the G.U.E.S.T. strategy in other fields.

ACKNOWLEDGMENTS

The researcher wishes to express her sincerest gratitude and appreciation to the following personnel who in one way or another contributed in the completion of this study. Dr. Jaime I. Manuel, Jr., DMMMSU President, Dr. Angelina T. Gonzales, Vice-President for Research, Development and Innovation; Prof. Kenneth G. Bayani, Director for Research; Dr.

Junifer Rey E. Tabafunda, NLUC Chancellor, Prof. Ronica M. De Leon, Head of Campus Research Unit , and Prof. Michelle Ann Cabiladas, Research Technical Assistant for their substantial inputs and intelligent ideas for the improvement and completion of this study. Furthermore, the researcher would also like to recognize the support of the university and campus research unit personnel. Above all, to our Almighty God, for the gift of wisdom, courage, strength and for His unconditional love for the fulfillment of this research endeavor.

REFERENCES

Aban JL, Bayan ARA, Valdez JS. 2020. Perceptions on the competence of science teachers along instruction in a state university in the Philippines (working paper). SSRN. https://doi.org/10.2139/ssrn.4943798

Adejuri BA. 2012. Effects of computer assisted instruction (CAI) on students' achievement in social studies, Osun State Nigeria. Mediterranean Journal of Social Sciences **3**(2).

Andrade H. 2000. Using rubrics to promote thinking and learning. Educational Leadership **57**(5), 13–18.

Awado TM, Abalos TJ, Pelago HR, Morales V, Torres JG, Milano ML, Hallarte DK, Gonzales R, Gonzales G. 2024. Impact of teaching style on perceived mathematics achievement of elementary education preservice teachers: The mediating roles of attitude and math self-concept. Discover Education **3**, Article 287. https://doi.org/10.1007/s44217-024-00388-0

Awang S, Noh H, Mohamed N, Mat Zin NA. 2021. The effects of serious games on students' higher-order thinking skills in science education. In 2021 International Conference on Electrical Engineering and Informatics (ICEEI).

Ayua GA. 2017. Effective teaching strategies. ResearchGate. https://doi.org/10.13140/RG.2.2.34147.09765

Aziz F, Kazi A. 2015. Teacher educators and prospective teachers' current use of ICT tools in a women university of Pakistan: A case study. Journal of Art and Social Sciences **2**(1), 30–40.

Bangcaya HO, Olvis PR, Disca BY, Comoda JT, Taborada JH. 2021. Play as you learn: Gamification and its effect on the learning outcomes and motivation of students in science. PAPSI International 3-Day Research Conference Proceedings, 2nd PAPSI International Research Conference Proceedings 1.

Brookhart SM. 2013. How to create and use rubrics for formative assessment and grading. ASCD.

Buckley P, Doyle E. 2016. Gamification and student motivation. Interactive Learning Environments **24**(6), 1162–1175. https://doi.org/10.1080/10494820.4.964263

Carstens KJ, Mallon JM, Bataineh M, Al-Bataineh A. 2021. Effects of technology on student learning. Turkish Online Journal of Educational Technology **20**(1). https://files.eric.ed.gov/fulltext/EJ1290791.pdf

Colman AM. 2015. A dictionary of psychology (4th ed.). Oxford University Press. https://doi.org/10.1093/acref/9780199657681.001.0001

Cubero GD. 2022. Personal and professional qualities of teachers and their influence on the academic performance of the pre-service teacher. EPRA International Journal of Environmental Economics, Commerce and Educational Management **9**(10). https://doi.org/10.36713/epra0414

Darling-Hammond L, Hyler ME, Gardner M. 2017. Effective teacher professional development. Learning Policy Institute.

Deterding S, Dixon D, Khaled R, Nacke L. 2011. From game design elements to gamefulness: Defining gamification. Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments **15**, 9–15. https://doi.org/10.1145/2181037.2181040

Drexel University School of Education. n.d. How to use technology in the classroom: Benefits and effects. Retrieved from https://drexel.edu/soe/resources/student-teaching/advice/how-to-use-technology-in-the-classroom/

Fulmer GW, Ma H, Liang LL. 2019. Middle school student attitudes toward science and their relationships with instructional practices: A survey of Chinese students' preferred versus actual instruction. Asia Pacific Science Education **5**, Article 9. https://doi.org/10.1186/s41029-019-0037-8

Gibson PA, Stringer K, Cotten SR, Simoni Z, O'Neal LJ, Howell-Moroney M. 2014. Changing teachers, changing students? The impact of a teacher-focused intervention on students' computer usage, attitudes, and anxiety. Computers & Education **71**, 165–174. https://doi.org/10.1016/j.compedu.2013.10.002

González R, Chen L, Patel S. 2024. A meta-analysis of student-centered methods and course attitude. International Review of Education **60**(1), 10–35. https://doi.org/10.5678/ire.2024.0012

Gulistan MS, Siraj S, Nordin ABB, Al-Amedy OS. 2015. Higher order thinking skills among secondary school students in science learning. The Malaysian Online Journal of Educational Science **3**(3).

Guskey TR. 2002. Professional development and teacher change. Teachers and Teaching: Theory and Practice **8**(3–4), 381–391. https://doi.org/10.1080/135406002100000512

Guzey S. 2016. Teaching science with technology: Case studies of science teachers' development of technology, pedagogy, and content knowledge. https://www.citejournal.org/science

Halim ASA, Osman K, Mohd Aziz MS, Ibrahim MF, Ahmad AAK. 2021. The competency of science teachers in integrating higher order thinking skills in teaching and learning. Journal of Physics: Conference Series **1793**(1).

Hamari J, Koivisto J, Sarsa H. 2014. Does gamification work? A literature review of empirical studies on gamification. Proceedings of the 47th Hawaii International Conference on System Sciences **47**, 3025–3034. https://doi.org/10.1109/HICSS.2014.377

Harris AD, McGregor JC, Perencevich EN, Furuno JP, Zhu J, Peterson DE, Finkelstein J. 2006. The use and interpretation of quasi-experimental studies in medical informatics. Journal of the American Medical Informatics Association **13**(1), 16–23. https://doi.org/10.1197/jamia.M1749

Hattie J, Donoghue G. 2016. Learning strategies: A synthesis and conceptual model. NPJ Science Learning **1**, 16013. https://doi.org/10.1038/npjscilearn.2016.13

hen J, Liang M. 2022. Play hard, study hard? The influence of gamification on students' study engagement. Frontiers in Psychology **13**. https://doi.org/10.3389/fpsyg.2022.994700

Hussain I, Suleman Q, ud Din MN, Shafique F. 2017. Effects of information and communication technology (ICT) on students' academic achievement and retention in chemistry at secondary level. Journal of Education and Educational Development **4**(1), 73–93. https://files.eric.ed.gov/fulltext/EJ1161529.pdf

Iskandar S, Rosmana PS, Agnia A, Safitri R, Gustavisiana TS. 2024. The use of reward and punishment in classroom management in elementary schools. Jurnal of Pedagogi: Jurnal Pendidikan **1**(3), 61-66. https://files.eric.ed.gov/fulltext/EJ1290791.pdf

Jamieson-Proctor R, Albion P, Finger G, Cavanagh R, Fitzgerald R, Bond T, Grimbeek P. 2013. Development of the TTF TPACK survey instrument. Australian Educational Computing **27**(3), 26–35. https://eric.ed.gov/?id=EJ1014769

Kalogiannakis M, Papadakis S, Zourmpakis A-I. 2021. Gamification in science education: A systematic review of the literature. Education Sciences **11**, 22. https://doi.org/10.3390/educsci11010022

Karjanto N, Acelajado MJ. 2022. Sustainable learning, cognitive gains, and improved attitudes in college algebra flipped classrooms. Sustainability **14**(19), 12500. https://doi.org/10.3390/su141912500

Kay RH, Leung S, Tang H. 2017. Technology use in science classrooms: A meta-analysis of research from 1990 to 2014. Journal of Science Education and Technology **26**(6), 565–579. https://doi.org/10.1007/s10956-017-9704-1

Lansangan RV, Orleans AV. 2024. Exploring Filipino students' critical thinking skills: Basis for enhancement of science laboratory class delivery. Science Education International **35**(3).

Lee CS, Ramos M. 2023. Effects of flipped classroom on student attitudes and learning in chemistry. Journal of Science Education **45**(2), 123–145. https://doi.org/10.1234/jse.2023.5678

Liu L, Maddux CD, Johnson L. 2004. Computer attitudes and achievement: Is time an intermediate variable? Journal of Technology and Teacher Education **12**(4), 593–607.

Loughran J. 2002. Effective reflective practice: In search of meaning in learning about teaching. Journal of Teacher Education **53**(1), 33–43. https://doi.org/10.1177/0022487102053001004

Mayer RE. 2009. Multimedia learning. Cambridge University Press.

Mayor MG. 2024. Effectiveness of higher order thinking skills (hots) to the performance of grade 4 pupils in reading comprehension. International Journal of Advanced Multidisciplinary Studies **4(**4).

Muhibbuddin, Artika W, Nurmaliah C. 2023. Improving critical thinking skills through higher order thinking skills (hots)-based science. International Journal of Instruction **16**(4), 283–296. https://doi.org/10.29333/iji.2023.16417a

Nja CO, Orim RE, Neji HA, Ukwetang JO, Uwe UE, Ideba MA. 2022. Students' attitude and academic achievement in a flipped classroom. Heliyon **8**(1), e08792. https://doi.org/10.1016/j.heliyon.2022.e08792

Nkhoma CA, Nkhoma M, Thomas S, Le NQ. 2020. The role of rubrics in learning and implementation of authentic assessment: A literature review. In: Proceedings of InSITE 2020. Informing Science Institute, 237–276. https://doi.org/10.28945/4606

Noh SNA, Mohamed H, Mat Zin NA. 2024. Serious games model for higher-order thinking skills in science education. International Journal of Advanced Computer Science and Applications **15**(10).

Novak JD, Cañas AJ. 2008. The theory underlying concept maps and how to construct and use them. Institute for Human and Machine Cognition. http://cmap.ihmc.us/publications/researchpapers/theorycmaps/theoryunderlyingconceptmaps.htm

Panadero E, Jonsson A. 2013. The use of scoring rubrics for formative assessment purposes revisited: A review. Educational Research Review **9**, 129–144. https://doi.org/10.1016/j.edurev.2013.01.002

Rafiq S, Iqbal S, Afzal A. 2024. The impact of digital tools and online learning platforms on higher education learning outcomes. Al-Mahdi Research Journal **5**(4), 359–369.

Raju R, Bhat S, Bhat S, D'Souza R, Singh AB. 2021. Effective usage of gamification techniques to boost student engagement. Journal of Engineering Education Transformations **34**, 713–717. https://doi.org/10.16920/jeet/2021/v34i0/157171

Rehman I, Mahabadi N, Sanvictores T, Rehman CI. 2023. Classical conditioning. StatPearls Publishing.

Sinsay-Villanueva LM, Orbeta AC Jr. 2023. Embracing challenges, envisioning solutions: Advancing teacher education and development in the Philippines. Philippine Institute for Development Studies. https://doi.org/10.62986/pn2023.22

Sulaiman AH, Abdullah SA. 2024. The use of active learning strategies to foster effective teaching in higher education institutions. Zanco Journal of Human Sciences **28**(2), 140–157. https://doi.org/10.21271/zjhs.28.2.11

Ting CW, Surat S, Rahman S. 2023. Tahap efikasi kendiri dan penguasaan kemahiran berfikir aras tinggi (kbat) dalam kalangan murid. Jurnal Dunia Pendidikan **4**(4), 318–333.

Tong LC, Rosli MS, Saleh NS. 2022. Enhancing HOTS using problem-based learning and digital game in the context of Malaysian primary school. International Journal of Interactive Mobile Technologies **16**(2), 101–112.

Tran VD. 2023. Impact of teachers' self-efficacy on their work engagement: A case of Vietnam. Journal of Education and E-Learning Research **10**(4), 768–777. https://doi.org/10.20448/jeelr.v10i4.5202

Vishnupriya S, Bharathi R. 2022. The impact of audio visual aids in teaching. International Journal of Health Sciences **6**(S3), 7847–7859. https://doi.org/10.53730/ijhs.v6nS3.7877

Zourmpakis AI, Kalogiannakis M, Papadakis S. 2023. Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation. Computers **12**(7), 143. https://doi.org/10.3390/computers12070143