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Utilization of Gamification Strategy in Teaching Problem-Solving in Mathematics

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Abstract — This study explored the extent of gamification strategy in teaching problem-solving in mathematics in Bolinao Districts I and II, Schools Division of Pangasinan I, during S.Y. 2024-2025. Utilizing an ex post facto one-shot case study research design, 51 mathematics teachers served as respondents. The study revealed that most teachers were aged 31-40 (37.3%), predominantly female (52.9%), and married (56.9%), with 45.1% holding MA units and 35.3% having 6-10 years of teaching experience. The extent of gamification strategy usage was found to be "Slightly Extensive" with a weighted mean of 2.47. Significant differences in the utilization of gamification were observed based on age and years of teaching experience, while no significant relationships were found with other profile variables.
A learning development plan was proposed to enhance the use of gamification strategies, addressing identified gaps to improve students' problem-solving performance in mathematics. Recommendations included encouraging teachers to pursue further studies, engage in professional development, and collaborate with colleagues to optimize the benefits of gamification. Further research was recommended to explore the broader factors influencing the use of gamification in teaching problem-solving.

Keywords — gamification, problem-solving, planning and collaboration, monitoring, evaluation

I. Introduction

Problem-solving is particularly relevant in the context of learning Mathematics. Just as with any other subject, understanding mathematical content requires students to create their meaning (Wang et al., 2022).

Given these points, the role of problem-solving in education cannot be overstated. Teachers must focus on cultivating these skills, particularly within the mathematics curriculum, to prepare students for the complexities of the modern world. As Ismail et al. (2021) assert, the primary objective of teaching problem-solving in mathematics is to impart skills or processes and foster independent thinking and awareness of diverse approaches to problem resolution.

Based on the foregoing insights, the researcher believes that applying gamification strategy in mathematics can help enhance the problem-solving abilities of learners, remove their anxiety,

and increase their motivation towards the subject, thus improving their academic performance. With this belief, the researcher will seek to find out the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of the Districts of Bolinao I and II, Schools Division Office of Pangasinan I.

Statement of the Problem

This study aimed to determine the extent of utilization of gamification strategy in teaching problem solving by the mathematics teachers of Bolinao Districts I and II for the S.Y. 2024-2025.

Specifically, it sought to answer the following problems:

1. What is the profile of the respondents in terms of:

    a. age;

    b. sex;

    c. civil status;

    d. highest educational attainment;

    e. number of years teaching experience; and

    f. relevant trainings attended?

2. What is the extent of utilization of gamification strategy in teaching problem solving by the mathematics teachers along:

    a. planning and collaboration;

    b. monitoring; and

    c. evaluation?

3. Are there significant differences in the extent of utilization of gamification strategy in teaching problem solving by the mathematics teachers across their profile variables?

4. Are there significant relationships between the extent of utilization of gamification strategy in teaching problem solving by the mathematics teachers and their profile variables?

5. What learning development program for the mathematics teachers can be proposed to sustain/improve the extent of utilization of gamification strategy in teaching problem solving?

Literature Review

Gamification has emerged as a transformative approach in education since 2020, capturing the attention of teachers and researchers due to its ability to merge enjoyment with instruction and foster meaningful engagement among learners (Ahmad & Iksan, 2021; Zou, 2020). This instructional strategy involves the use of game elements—such as points, levels, rewards, and challenges—not merely for entertainment but to stimulate active learning.

Moreover, gamification has proven to be a powerful tool in integrating technology into instruction, aligning with the digital inclinations of today's learners. Web-based platforms that include gamified elements have demonstrated significant improvements in learning outcomes by making education more interactive, responsive, and tailored to individual student needs (Marisa et al., 2020; Wols et al., 2020; Panis et al., 2020). These environments promote learner autonomy, collaboration, and persistence—attributes critical for success in both academic and real-world settings.

As teachers design gamified instruction, understanding learner motivation and aligning game mechanics with educational goals are critical. Studies have shown that games can foster collaboration, critical thinking, media literacy, and systems thinking—all of which are considered vital 21st-century competencies (Blankman, 2022; Huang et al., 2020).

In conclusion, gamification, when effectively implemented, promotes deeper learning, enhances problem-solving capabilities, and nurtures essential 21st-century skills. Its success lies in thoughtful integration—beyond superficial rewards—to foster intrinsic motivation, real-world relevance, and sustained student engagement.

II. Methodology

Research Design

This study utilized an ex post facto one-shot case study research design. This design involves investigating phenomena that have already occurred without manipulating the study environment or conditions. This type of design is used to identify and analyze the relationships between variables as they naturally exist. The term "ex post facto" means "after the fact," indicating that the research looks backward to examine the conditions and outcomes that are already in place (Tippins, 2023).

This design was appropriate for this study as it allows examining existing conditions without manipulating variables. Specifically, it enables the researcher to study how mathematics teachers have incorporated gamification strategies into problem-solving instruction without altering their teaching methods or the educational environment. In this context, the study focused on a specific group of mathematics teachers to analyze how much they have incorporated

gamification strategies in their problem-solving instruction. Using an ex post facto one-shot case study design, the researcher gathered data on the current use of gamification strategies and evaluate their effectiveness based on teachers' perceptions and experiences.

Population and Locale of the Study

The respondents of the study were the public secondary school mathematics teachers from the Schools Division Office I Pangasinan, specifically Bolinao Districts I and II.

The researcher employed the complete enumeration technique, a type of purposive sampling technique for all population members (total population) with characteristics such as specific attributes/traits, experience, knowledge, skills, and exposure to an event or phenomenon procedure. Additionally, this technique gives all the members of the population equal opportunities and chances.

Data Gathering Tool

To gather information for this study, the researcher used a questionnaire checklist. This list of questions was organized and straightforward, making it easy for math teachers in Bolinao Districts I and II to share their thoughts and information.

The questionnaire checklist consisted of two (2) parts. Part I dealt with the profile of the respondent teachers, such as age, civil status, highest educational attainment, number of years of teaching experience, and relevant trainings attended.

Meanwhile, Part II included the extent to which the mathematics teachers of Bolinao Districts I and II utilize the gamification strategy in teaching problem-solving, along with planning and collaboration, monitoring, and evaluation.

The researcher utilized a 4-point Likert-type scale. Likert scales are odd-numbered scales, commonly 5-point scales, and 7-point scales. However, at times, there are situations when a respondent chooses the 'Neutral' option in a 5-point or 7-point Likert scale. Researchers have started using a 4-point scale called the force Likert scale in which there is no neutral option wherein the respondents are forced to form a judgment (Campilla & Castañaga, 2021). The 4-point Likert scale was utilized to extract a specific response from the respondents.

After creating the questionnaire checklist, it went to a thorough evaluation by a panel of experts. These experts utilized the Survey/Interview Validation Rubric for Expert Panel by Simon & White (2016), as cited in Campilla & Castañaga (2021).

This validation process aimed to ensure that each question is clear, relevant to the teachers' experiences, and easy to understand. This was crucial to ensure that teachers cannot answer the questionnaire and to guarantee the validity of the collected data.

Data Gathering Procedure

Upon refining and finalizing the questionnaire checklist, the researcher formally requested permission to conduct the study. This request was directed to the Office of the Schools Division Superintendent of Pangasinan I and the Public Schools District Supervisors of Bolinao I and II. Obtaining such a permit was crucial to secure official approval, ensuring that the study adheres to ethical guidelines and procedures established by educational authorities.

The researcher administered the questionnaire to the mathematics teachers upon obtaining the necessary approval. The distribution of the questionnaires was accompanied by a clear explanation of the study's purpose and significance, aiming to encourage active participation from the teachers. Once the teachers have completed the questionnaires, the researcher collected them, ensuring the accurate capture of all essential data.

The researcher analyzed and interpreted the collected data using the research instrument. This analysis involved organizing and summarizing the data employing suitable statistical methods and techniques. The results of this analysis were presented in a comprehensive report, incorporating tables to enhance the interpretation and understanding of the data.

Treatment of Data

Following the data collection using the questionnaire checklist, the researcher sorted, tallied, organized, and tabulated the data within an Excel Spreadsheet. This approach aimed to ensure the proper structuring of data, allowing for the identification and correction of any errors or inconsistencies. Then, the collected data was subjected to statistical treatment using appropriate tools.

To answer problem number 1 on the profile of the mathematics teachers in terms of age, sex, civil status, highest educational attainment, number of years of teaching experience, and relevant trainings attended, the researcher utilized frequency counts and percentages. Each profile variable was categorized and assigned a corresponding numerical value to facilitate computation.

To answer problem number 2 on the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II along planning and collaboration, monitoring, and evaluation, the weighted mean was utilized and interpreted as follows:

Point Value	Mean Scale Range	Descriptive Equivalent	Transmuted Rating
A	3.50-4.00	Always	Very Extensive (VE)
B	2.50-3.49	Often	Extensive (E)
C	1.50-2.49	Seldom	Slightly Extensive (SE)
D	1.00- 1.49	Never	Not Extensive (NE)

To answer Problem No. 3, the Analysis of Variance (ANOVA) and t-test were used to evaluate significant differences in the extent to which the mathematics teachers utilize the gamification strategy in teaching problem-solving across their profile variables.

To answer Problem No. 4, which concerns determining the relationship between the extent to which mathematics teachers utilize gamification strategies in teaching problem-solving and their profile variables, the Coded Pearson Product Correlation was used. The significance level was confirmed with a p-value (Probability Value) of 95% significance.

To answer Problem No. 5, a learning development plan was proposed to sustain/improve the extent to which mathematics teachers utilize the gamification strategy in teaching problem-solving.

III. Results and Discussion

Profile of the Respondents

The respondents' profile is to provide and describe the background information about them as subjects of the study specifically in terms of age, sex, civil status, highest educational attainment, number of years teaching experience, and relevant trainings attended.

Table 1 presents the data of the respondents.

Table 1: Profile of the respondents

Profile Variables	Variable Category	F	%
Age	21-30	13	25.5
	31-40	19	37.3
	41-50	13	25.5
	51-60	5	9.8
	61-above	1	2.0
Sex	Male	24	47.1
	Female	27	52.9
Civil Status	Single	22	43.1
	Married	29	56.9
Highest Educational Attainment	BSE/BEED	10	19.6
	BS with MA Units	23	45.1
	MA Degree Holder	15	29.4
	With Doctoral Units	2	3.9
	EdD/PhD	1	2.0
Number of Years Teaching Experience	5 years-below	13	25.5
	6-10 years	18	35.3
	11-15 years	5	9.8
	16-20 years	6	11.8
	21-25 years	9	17.6
Relevant Trainings Attended	5-below	12	23.5
	6-10	14	27.5
	11-15	11	21.6
	16-20	2	3.9
	21-25	12	23.5

Extent of Utilization of Gamification Strategy in Teaching Problem-Solving by the Mathematics Teachers

Table 2 reflects the summary of the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II.

Table 2: Summary of the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II

Indicators	OWM	TR
1. Planning and Collaboration	2.56	E
2. Monitoring	2.48	SE
3. Evaluation	2.36	SE
General Overall Weighted Mean	**2.47**	**SE**

Legend:

Statistical Range	Descriptive Equivalent	Transmuted Rating
4.50 – 5.00	Always	Very Extensive (VE)
3.50 – 4.49	Often	Extensive (E)
2.50 – 3.49	Sometimes	Slightly Extensive (SE)
1.50 – 2.49	Seldom	Not Extensive (NE)

It can be observed from the table that the summary of the extent of utilization of gamification strategies in teaching problem-solving by mathematics teachers in Bolinao Districts I and II reveals a general trend toward Extensive application across the three key indicators: planning and collaboration, monitoring, and evaluation.

In conclusion, while the mathematics teachers in Bolinao Districts I and II are employing gamification strategies to a moderate extent, particularly in planning and collaboration, the overall utilization remains an area with considerable potential for improvement. Focusing on enhancing monitoring and evaluation practices will enable teachers to better assess the effectiveness of gamified instruction, ultimately leading to improved problem-solving skills and student engagement in mathematics.

Summary of ANOVA Results for Mean Difference in the Extent of Utilization of Gamification Strategy in Teaching Problem Solving in Mathematics by the Respondent Mathematics Teachers across Profile Variables

Relative to the problems of this study which sought to determine the extent of utilization of gamification strategy in teaching problem-solving in mathematics by the respondent mathematics teachers, the Analysis of variance (ANOVA) and *t*-test was used and computed and is indicated by F-values with its corresponding level of significance.

Table 3 presents the differences of the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II across profile

variables age, highest educational attainment, number of years teaching experience and relevant trainings attended.

Table 3: Differences of the Extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II across profile variables age, highest educational attainment, number of years teaching experience and relevant trainings attended.

Profile Variables	Sources of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Age	Between Groups	16.541	4	4.135	3.441	.015
	Within Groups	55.273	46	1.202		
	Total	71.814	50			
Highest Educational Attainment	Between Groups	1.970	4	.492	.324	.860
	Within Groups	69.844	46	1.518		
	Total	71.814	50			
Number of Years Teaching Experience	Between Groups	18.230	4	4.558	3.913	.008
	Within Groups	53.584	46	1.165		
	Total	71.814	50			
Relevant Trainings	Between Groups	5.733	4	1.433	.998	.419
	Within Groups	66.082	46	1.437		
	Total	71.814	50			

Based on the summary table for ANOVA, the analysis of the extent of utilization of gamification strategies in teaching problem-solving by mathematics teachers in Bolinao Districts I and II across various profile variables reveals noteworthy findings. The mean differences in the extent of utilization of gamification strategy in teaching problem solving in mathematics were examined concerning profile variables such as age, highest educational attainment, number of years teaching experience, and relevant trainings attended.

Table 4 presents the differences of the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II across profile variables sex and civil status.

Table 4: Differences of the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II across profile variables sex and civil status

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sex	Equal variances assumed	2.179	.146	1.091	49	.280	.36620	.33558	-.30816	1.04057
	Equal variances not assumed			1.078	44.512	.287	.36620	.33963	-.31805	1.05046
Civil Status	Equal variances assumed	2.162	.148	.868	49	.389	.29498	.33968	-.38762	.97759
	Equal variances not assumed			.840	38.907	.406	.29498	.35109	-.41521	1.00518

It is shown on the table that the Levene's Test for Equality of Variances indicated no significant differences in variances for both sex and civil status, with p-values of 0.146 and 0.148, respectively, suggesting that the assumption of equal variances holds for the subsequent t-tests.

Relationship Between the Extent of Utilization of Gamification Strategy in Teaching Problem-Solving by the Mathematics Teachers

Table 5 presents the Pearson-*r* correlation between the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II and their profile variables.

Table 5: Pearson-*r* correlation between the extent of utilization of gamification strategy in teaching problem-solving by the mathematics teachers of Bolinao Districts I and II and their profile variables

Profile Variables	Pearson Correlation	Sig. (2-tailed)
Age	-0.005	0.973
Sex	-0.154	0.280
Civil Status	-0.123	0.389
Highest Educational Attainment	-0.124	0.385
Number of Years in Service	-0.195	0.170
Relevant Trainings Attended	-0.045	0.752

The results indicate that there are weak to very weak correlations between the profile variables and the extent of utilization of gamification strategies in teaching problem-solving among mathematics teachers in Bolinao Districts I and II. Specifically, the correlations for age, sex, civil status, highest educational attainment, number of years in service, and relevant trainings

attended all yield negligible values, suggesting that these profile variables may not significantly influence the extent of gamification strategy utilization.

Proposed Learning Development Plan for the Mathematics Teachers to Improve the Extent of Utilization of Gamification Strategy in Teaching Problem Solving

Relative to the problem of this study which determines a learning development program (LDP) to be proposed for mathematics teachers to improve their extent of utilization of gamification strategy in teaching problem solving, this portion discussed the components and framework of the proposed LDP.

This indicates the importance of a more structured and sustained effort to integrate gamification into teaching practices. Thus, the following learning development plan is hereby proposed.

Enhancing Teachers Utilization of Gamification Strategy in Teaching Problem-Solving in Mathematics in Bolinao Districts I and II

A. Background Information	
Name	PATRICK LESTER M. CARRANZA
Region/Division/District	Region I/SDO Pangasinan I/Bolinao Districts I and II
L & D Engagement/ Course	Teachers' Development Program
Key changes in my school/ classroom as a result as a result of this application	Improved student problem-solving skills, increased student engagement and confidence in mathematics, enhanced teacher effectiveness in facilitating learning.
Target Competency Improvement	To enhance the ability of mathematics teachers in Bolinao Districts I and II to effectively utilize gamification strategy in teaching problem-solving, leading to an improved student performance and engagement in mathematics.
Describe the Current Situation (Problem or opportunity) in your learning area that you need to address through your program.	Mathematics teachers in Bolinao Districts I and II face challenges in effectively utilizing gamification strategy in teaching problem-solving, leading to limited student engagement and lower performance in mathematics. There is a need to address this gap through targeted professional development programs.
Title of Application Project	Enhancing Problem-Solving Skills through Gamification Strategy in Mathematics
Project Objectives **SMART: Specific, Measurable, Attainable, Results- Oriented and Time Bound. It will be realistics for students to achieve and how will the students accomplish it. Helps ensure that the objectives are attainable within a certain time frame.**	implement strategies to enhance the utilization of gamification strategy in teaching problem-solving. increase in the use of gamification strategy by teachers and improvement in student problem-solving skills. Improved student performance in mathematics, as evidenced by assessment results.
Start Date	TBA
Length of Project	1 School Year
Expected Outputs	Increased utilization of gamification strategy by mathematics teachers. Improved student problem-solving skills and performance in mathematics.
Beneficiary/ies	Mathematics Teachers of Bolinao District I and II

B. Action Steps

ACTIONS	Responsible Person	Support Needed from	Target Date
Based on the results of the study, a learning development plan based on the needs assessment findings, focusing on effective implementation of metacognitive strategies in teaching problem-solving.	Researcher		TBA
Seek for Approval to the SDS thru the PSDSs of Bolinao Districts I and II for the implementation of such training.	Researcher	SDS, ASDS, CID Chief, SGOD Chief, EPS-Math, PSDSs	TBA
Implement the training program for mathematics teachers in Bolinao Districts I and II.	Researcher, Speakers	SDS, ASDS, CID Chief, SGOD Chief, EPS-Math, PSDSs, SHs	TBA
Provide ongoing support and mentoring to teachers as they implement gamification strategy in their classrooms.	EPS-Math, PSDSs, SHs	SDS, ASDS, CID Chief, SGOD Chief	TBA
Required Resources			
Provide specific details of the physical and human resources required to successfully implement action plan	Training materials, facilitators, classroom resources		
Provide the specific details of the budget resources required to successfully implement the action plan.	Funding for training materials, facilitator fees, and other associated costs		
Describe the risks that might impact on the success of the action plan.	insufficient support from school administration, limited resources for implementation.		

IV. Conclusion

Based on the findings of this study, several key conclusions were drawn. The mathematics teachers surveyed displayed a diverse demographic profile, with a majority falling within the 31–40 age range and a significant representation of female educators. Regarding the use of gamification strategies in teaching problem-solving skills in mathematics, the results indicate that while some elements of gamification are being incorporated, there remains considerable room for more innovative and engaging applications in the classroom. Additionally, the study revealed significant differences in the extent of gamification strategy utilization based on the teachers' age and teaching experience. This suggests that younger or less experienced teachers may adopt these strategies differently than their older or more seasoned peers. Conversely, the extent of gamification use was found to be unrelated to other profile variables. In response to the findings, a learning development plan has been proposed to enhance the use of gamification strategies in mathematics instruction. This plan is designed to address existing gaps and promote more effective teaching practices, ultimately improving students' problem-solving abilities in mathematics.

V. Recommendations

Based on the salient findings and conclusions of this study, several recommendations are proposed. Teachers are encouraged to pursue further studies in reputable institutions to enhance their knowledge and skills, particularly in utilizing innovative teaching strategies such as gamification in mathematics problem-solving instruction. Considering that age and teaching experience significantly influence the use of gamification strategies, mathematics teachers should actively seek professional development opportunities tailored to their level of experience. Younger and less experienced teachers, in particular, are advised to participate in specialized training programs to better understand and implement gamification techniques effectively in their classrooms. Additionally, mathematics teachers should consistently aim for excellence in the application of gamification strategies, as this can lead to more effective teaching and improved student performance in problem-solving. Collaboration among teachers is also encouraged, especially with colleagues who have successfully integrated gamification into their instruction, as sharing best practices can enhance teaching effectiveness. The implementation of the proposed learning development plan is recommended to further explore and maximize the benefits of gamification, ultimately leading to improved student engagement and problem-solving abilities. Lastly, further research should be conducted to investigate the various factors that influence the use of gamification strategies in teaching problem-solving.

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