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Cultural Immersion Activities And Socio-cultural Awareness Of Junior High School Students In Congressional District 1, Division Of Batangas Province

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Abstract

This study assessed the socio-cultural awareness of Junior High School students in Congressional District 1, Division of Batangas Province, through the lens of cultural immersion activities during the 2025–2026 school year. The research aimed to determine the extent of implementation of cultural immersion activities - covering exposure, interaction, reflection, collaboration, and advocacy, the level of student socio-cultural awareness across three dimensions - cultural appreciation, social values, and behavioral practice, and the relationship between these two variables.

Using a descriptive-correlational research design, data were gathered from a stratified random sample of 141 Araling Panlipunan teachers using a validated researcher-made Likert-type questionnaire. To validate the quantitative results, Focus Group Discussion (FGD) was conducted virtually via Google Meet with a purposive sample of 10 teachers who were not part of the questionnaire. Statistical analysis was performed using weighted mean, Pearson r, and ranking.

The findings revealed that teachers reported a moderate extent of implementation for cultural immersion activities (CM=3.44), led by advocacy-based initiatives. Similarly, students possessed a moderate level of socio-cultural awareness (CM=3.45), with behavioral practice emerging as the highest-rated dimension. A very strong positive correlation (r=0.864, p <0.05) was established between the extent of implementation of cultural immersion activities and the level of student socio-cultural awareness, leading to the rejection of the null hypothesis.

However, qualitative data surfaced critical barriers to implementation of cultural immersion activities, most notably safety concerns, budgetary constraints, and heavy teaching workloads. The study concluded that intensified implementation of immersion activities directly enhances student socio-cultural awareness. To bridge identified gaps, the researcher proposed Project SALIN-LAHI, a strategic set of enhancement activities designed to institutionalize cultural immersion activities and sustain student socio-cultural awareness.

Keywords: *Cultural Immersion Activities, Socio-Cultural Awareness, Enhancement Activities*

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Introduction

Mathematics education plays a critical role in developing learners' analytical thinking and problem-solving abilities. Despite curriculum reforms emphasizing critical thinking, challenges such as poor comprehension, lack of strategic approaches, and limited metacognitive skills persist. Many students struggle with higher-order thinking skills, particularly in applying mathematical concepts in real-world contexts. This issue is evident in both classroom performance and international assessments, where Filipino learners consistently perform below global benchmarks.

Traditional teaching approaches, often centered on procedural knowledge, may not adequately address diverse learner needs. As a result, there is a growing need for innovative and technology-driven instructional strategies that promote conceptual understanding, engagement, and independent problem-solving.

With the emergence of artificial intelligence (AI) in education, new opportunities have arisen to enhance teaching and learning processes. AI-powered systems—such as chatbots, AI-based problem generators, adaptive learning tools, and intelligent tutoring systems—offer personalized instruction, immediate feedback, and step-by-step guidance that can improve students' problem-solving abilities. Research also suggests that AI enhances student motivation and engagement by making learning interactive and responsive. However, challenges such as limited teacher training, infrastructure constraints, and ethical concerns remain barriers to effective implementation. Research also suggests that AI enhances student motivation and engagement by making learning interactive and responsive. However, challenges such as limited teacher training, infrastructure constraints, and ethical concerns remain barriers to effective implementation.

Despite the potential of AI in education, there is limited empirical evidence in the local context examining its relationship with students' mathematics problem-solving skills. This study addresses this gap by focusing on teacher perspectives in Lipa City. Thus, this study investigated the relationship between students' Mathematics problem solving skills and AI-enhanced strategies of teachers among Senior High Schools in SDO Lipa City for the School Year 2025–2026. Specifically, it sought to answer the following questions:

1. What is the level of Mathematics problem-solving skills of the students, as assessed by the teacher-respondents, in the following lessons:
    1.1 Functions and their Graphs;
    1.2 Business Mathematics;
    1.3 Systems of Linear Equations and Inequalities;
    1.4 Exponential and Logarithmic Functions; and
    1.5 Mathematics of Logic?

2. What is the extent of the utilization of the following AI-enhanced strategies in teaching problem-solving as assessed by the respondents relative to:

2.1 chatbots or AI tutors;
2.2 AI-based problem generators;
2.3 virtual or augmented reality simulations;
2.4 AI-powered Adaptive learning tools; and
2.5 Intelligent Tutoring Systems (ITS)?

3. Is there a significant relationship between the assessments on the level of Mathematics problem-solving skills and on the extent of utilization of AI-enhanced strategies?

4. What challenges do teachers encounter when using AI-enhanced strategies in Mathematics?

5. What AI-based instructional activities can be proposed?

Methodology

Research Design

This study employed a descriptive–correlational research design to obtain a clear understanding of the relationship between the variables under investigation. The descriptive component was used to describe the level of students' Mathematics problem-solving skills and the extent of teachers' utilization of AI-enhanced strategies, while the correlational component was used to determine whether a significant relationship exists between these variables based on teacher-respondents' assessments.

This design ensured that the study provided objective, numerical evidence regarding both the level of AI-enhanced strategy utilization and students' Mathematics problem-solving skills, as well as the strength and direction of their relationship. The findings served as a basis for understanding how AI-enhanced instructional strategies are associated with Mathematics learning outcomes in General Mathematics, supporting evidence-based instructional planning and intervention.

Participants

The respondents were 105 Senior High School Mathematics teachers from selected schools in the Schools Division Office (SDO) of Lipa City. These teachers were considered the primary respondents because they are directly responsible for observing, monitoring, and evaluating students' engagement and problem-solving performance in their classes.

Stratified random sampling was employed. The teacher population were first grouped into strata according to school size and school location. This sampling procedure ensured that teachers from different types and locations of schools were adequately represented in the study, allowing for a more balanced and generalizable set of findings.

Research Instrument

The research utilized two primary instruments: a Teacher Survey Questionnaire and Teacher Interviews. These tools were developed to collect quantitative data relevant to the objectives of the study and to ensure consistency in responses.

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The Teacher Survey Questionnaire was designed to gather quantitative data on the relationship between AI-enhanced strategies and the Mathematics problem-solving skills of Senior High School students in Lipa City. It consisted of several sections including respondents' profile, level of students' Mathematics problem solving skills and extent of utilization of AI-enhanced strategies. Responses were collected using a four-point Likert scale, ranging from 1 (Low/Least Utilized/Strongly Disagree) to 4 (High/Highly Utilized//Strongly Agree).

To complement the quantitative results, semi-structured interviews was conducted with selected teacher-respondents. The Teacher Interview Guide was used to gather insights focusing on research question which explored the challenges teachers encounter in integrating AI-enhanced strategies in Mathematics instruction. The Teacher Interview Guide contained open-ended questions designed to elicit detailed responses regarding teachers' challenges and experiences with AI-enhanced strategies.

Data Collection Procedure

The data gathering process consisted of several systematic steps to ensure ethical compliance, validity, and accuracy of the information collected. The researcher first secured the necessary permissions from the Department of Education (DepEd) and the principals of the participating schools within the Schools Division of Lipa City. Upon approval, the researcher coordinated with school administrators or designated coordinators through official communication channels to facilitate the distribution of the research instrument.

Each teacher-respondent was presented with a digital informed consent form at the beginning of the survey, outlining the objectives of the research, the voluntary nature of participation, and the assurance of confidentiality and anonymity. After securing consent, the Survey Questionnaire was administered online through Google Forms. This method allowed respondents to answer the questionnaire at their most convenient time and pace, promoting thoughtful and accurate responses. The collected data were tallied, tabulated, and statistically treated according to the frequency and distribution of responses. Statistical tools appropriate to the study were applied to interpret the quantitative data accurately.

The researcher also conducted interviews with selected teacher-respondents using a set of open-ended questions. These interviews allowed the participants to express their insights and experiences regarding the use of AI-enhanced strategies, including aspects such as accessibility of tools, instructional barriers, student engagement, and recommendations for effective integration. Responses were recorded manually and summarized to extract meaningful themes and perspectives.

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Data Analysis

The statistical treatment of data involved both quantitative and qualitative analyses to comprehensively address the research objectives. For the quantitative data analysis, descriptive and inferential statistics such as frequencies, percentages, means, and Pearson correlation were utilized to summarize the data collected from the teacher survey. This included teachers' assessments on the level of students' Mathematics problem-solving skills and the extent of utilization of AI-enhanced strategies in General Mathematics instruction.

In terms of qualitative data analysis, the analysis was used to determine the qualitative data through the interview transcripts gathered from selected teacher-respondents.

Results

1. Level of Mathematics Problem-Solving Skills of Senior High School students in Mathematics Lessons

This section presents the level of Mathematics problem-solving skills of Senior High School students in selected Mathematics topics. The assessment focuses on five major areas of Mathematics instruction, namely: Functions and Graphs, Business Mathematics, Systems of Linear Equations and Inequalities, Exponential and Logarithmic Functions, and Mathematics of Logic. The data reflect teachers' perceptions of their students' abilities to analyze, interpret, and solve mathematical problems across these areas. The results are summarized using weighted means, verbal interpretations, and ranks to determine the extent to which students demonstrate problem-solving competence.

Table 1
Level of Mathematics Problem-Solving Skills in Functions and Graphs

Indicators	WM	VI	Rank
1. Identify independent and dependent variables correctly.	3.15	AA	2
2. Determine the domain and range of a function.	3.07	AA	7.5
3. Distinguish one-to-one from many-to-one functions.	3.09	AA	5.5
4. Represent functions through tables, equations, or graphs.	3.10	AA	4
5. Interpret key features of a graph (intercepts, slope, turning points).	3.18	AA	1
6. Translate verbal problems into algebraic or graphical form.	3.12	AA	3
7. Apply function operations (addition, subtraction, multiplication, division).	3.07	AA	7.5
8. Analyze inverse and composite functions.	3.09	AA	5.5
9. Solve real-world problems involving functional relationships.	2.48	BA	10
10. Justify reasoning and check solutions using graphs or tables.	2.91	AA	9
Composite Mean	**3.02**	**AA**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Low (L) 1.50-2.49 = Below Average (BA) 2.50-3.49 = Above Average (AA) 3.50-4.00 = High (H)

The data in Table 1 revealed that the overall level of Mathematics problem-solving skills of students in Functions and Graphs obtained a composite mean of 3.02, interpreted as Above Average. This overall mean indicated that, in general, students demonstrate a satisfactory level of competence in solving problems related to functions and graphs suggesting that learners possess adequate understanding and skills that enables them to perform expected tasks.

Among the indicators, the highest-ranked skill was interpreting key features of a graph obtaining a weighted mean of 3.18, classified as Above Average. On the other hand, the lowest-ranked indicator was solving real-world problems involving functional relationships posting a weighted mean of 2.48, categorized as Below Average. The findings indicated that students possess adequate conceptual understanding of functions and graphs but require further support in applying these concepts to real-life problem-solving situations.

Table 2
Level of Mathematics Problem-Solving Skills in Business Mathematics

Indicators	WM	VI	Rank
1. Compute profit, loss, and discount accurately.	3.09	AA	4
2. Solve problems on simple and compound interest.	3.15	AA	2
3. Interpret word problems involving percentage and ratio.	3.20	AA	1
4. Apply the concept of annuities and present value.	3.11	AA	3
5. Perform correct computations in installment and commission problems.	2.47	BA	10
6. Analyze financial data to make business-related decisions.	3.06	AA	5.5
7. Estimate and verify accuracy of financial results.	3.00	AA	7
8. Demonstrate reasoning in comparing financial alternatives.	2.91	AA	8
9. Relate business math concepts to everyday financial transactions.	2.49	BA	9
10. Explain the importance of accuracy and ethics in computation.	3.06	AA	5.5
Composite Mean	**2.95**	**AA**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Low (L) 1.50-2.49 = Below Average (BA) 2.50-3.49 = Above Average (AA) 3.50-4.00 = High (H)

The results in Table 2 showed that the overall level of students' problem-solving skills in Business Mathematics obtained a composite mean of 2.95, which is verbally interpreted as Above Average, suggesting that students generally demonstrate a satisfactory level of competence in business-related mathematical concepts

The highest-ranked indicators revealed that interpreting word problems involving percentage and ratio obtained a weighted mean of 3.20, classified as Above Average. However, the lowest-ranked indicators were performing correct computations in installment and commission problems posting a weighted mean of 2.47, categorized as Below Average. In general, the findings imply that while students demonstrate a reasonable understanding of business Mathematics concepts, their practical application in everyday financial decision-making still needs improvement.

Table 3
Level of Mathematics Problem-Solving Skills in Systems of Linear Equations and Inequalities

Indicators	WM	VI	Rank
1. Recognize consistent, inconsistent, and dependent systems.	3.01	AA	6
2. Apply the substitution method correctly.	3.02	AA	5
3. Apply the elimination method efficiently.	3.16	AA	1
4. Graph systems accurately to find points of intersection.	3.05	AA	4
5. Interpret solutions in real-world contexts.	2.44	BA	10
6. Express inequalities graphically on a coordinate plane.	2.86	AA	7.5
7. Test ordered pairs to verify solutions of inequalities.	3.11	AA	2
8. Reason out the most efficient method for solving a given system.	3.10	AA	3
9. Use systems of equations to model and solve word problems.	2.48	BA	9
10. Justify correctness of their answers using logical arguments.	2.86	AA	7.5
Composite Mean	**2.91**	**AA**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Low (L) 1.50-2.49 = Below Average (BA) 2.50-3.49 = Above Average (AA) 3.50-4.00 = High (H)

The data in Table 3 indicated that the overall level of students' Mathematics problem-solving skills in Systems of Linear Equations and Inequalities obtained a composite mean of 2.91, interpreted as Above Average.

The highest-ranked indicators showed that applying the elimination method efficiently obtained a weighted mean of 3.16, classified as Above Average. Conversely, the lowest-ranked indicators revealed that interpreting solutions in real-world contexts obtained a weighted mean of 2.44, categorized as Below Average. These results implied that students face difficulties in applying mathematical concepts to real-life situations and in representing them graphically, highlighting the need for greater emphasis on contextual and visual learning experiences.

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Table 4
Level of Mathematics Problem-Solving Skills in Exponential and Logarithmic Functions

Indicators	WM	VI	Rank
1. Identify exponential and logarithmic equations correctly.	3.03	AA	6
2. Convert exponential equations into logarithmic form and vice versa.	3.03	AA	6
3. Apply the laws of exponents and logarithms in problem solving.	3.10	AA	3
4. Solve exponential growth and decay problems accurately.	3.03	AA	6
5. Interpret the behavior of exponential and logarithmic graphs.	3.15	AA	2
6. Determine transformations of exponential and logarithmic functions.	2.87	AA	9
7. Apply real-life problems involving population, interest, or decay.	2.46	BA	10
8. Analyze how base changes affect the graph of the function.	2.97	AA	8
9. Check and verify computed results using properties of logarithms.	3.08	AA	4
10. Communicate reasoning in solving exponential/logarithmic equations.	3.16	AA	1
Composite Mean	**2.99**	**AA**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Low (L) 1.50-2.49 = Below Average (BA) 2.50-3.49 = Above Average (AA) 3.50-4.00 = High (H)

The results in Table 4 showed that the overall level of students' problem-solving skills in Exponential and Logarithmic Functions obtained a composite mean of 2.99, interpreted as Above Average. This result implied that students generally exhibit a competent understanding of the concepts and are able to apply relevant strategies in solving problems involving exponential and logarithmic functions.

The highest-ranked indicator was communicating reasoning in solving exponential and logarithmic equations obtained the highest weighted mean of 3.16. In contrast, the lowest-ranked indicator was applying real-life problems involving population, interest, or decay recorded the lowest weighted mean of 2.46. Overall, the findings suggested that students demonstrate satisfactory understanding of exponential and logarithmic concepts but need further reinforcement in practical application.

Table 5
Level of Mathematics Problem-Solving Skills in Mathematics of Logic

Indicators	WM	VI	Rank
1. Identify propositions, symbols, and logical connectives accurately.	3.10	AA	4
2. Construct truth tables for simple and compound statements.	3.07	AA	5

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3. Determine the truth value of compound statements.	3.03	AA	6
4. Apply the laws of logic (e.g., De Morgan's, distributive).	2.48	BA	9
5. Translate verbal statements into symbolic form correctly.	3.22	AA	3
6. Distinguish valid from invalid arguments.	2.95	AA	7.5
7. Use logical reasoning in everyday decision-making situations.	2.33	BA	10
8. Identify fallacies in reasoning or argumentation.	3.23	AA	2
9. Explain logical solutions clearly in written or oral form.	2.95	AA	7.5
10. Evaluate statements to determine consistency and equivalence.	3.27	AA	1
Composite Mean	**2.96**	**AA**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Low (L) 1.50-2.49 = Below Average (BA) 2.50-3.49 = Above Average (AA) 3.50-4.00 = High (H)

The findings in Table 5 showed that the overall level of students' Mathematics problem-solving skills in Mathematics of Logic obtained a composite mean of 2.96, interpreted as Above Average.

The highest-ranked indicator was evaluating statements to determine consistency and equivalence, with a weighted mean of 3.27. However, the lowest-ranked indicator was using logical reasoning in everyday decision-making situations, which obtained a weighted mean of 2.33. The results indicated that students have an adequate understanding of logical principles but require further opportunities to apply logical reasoning in real-life decision-making scenarios.

The overall level of Mathematics problem-solving skills of Senior High School students, based on Tables 1 to 5, obtained a grand mean of 2.97, which was verbally interpreted as Above Average. This indicated that students generally demonstrate adequate competence in solving mathematical problems across different areas, including functions and graphs, business Mathematics, systems of equations, exponential and logarithmic functions, and Mathematics of logic.

The findings suggested that while students possess a satisfactory understanding of mathematical concepts and procedures, there are still areas that require improvement, particularly in applying these concepts to real-life situations. This indicated that learners have developed a solid foundation in procedural knowledge and conceptual understanding but their ability to transfer and apply these skills in practical problem-solving contexts is still limited. Overall, the results implied that students have developed foundational problem-solving skills but would benefit from more contextualized and application-based learning experiences to further enhance their mathematical proficiency.

2. Utilization of AI-Enhanced Strategies in teaching Problem-Solving

This section presents the extent of utilization of AI-enhanced strategies in teaching Mathematics problem-solving. The data reflect teachers' perceptions regarding their use of various AI-based instructional tools and technologies in classroom instruction. These strategies include chatbots or AI tutors, AI-based problem generators, virtual or augmented reality simulations, AI-powered adaptive learning tools, and intelligent tutoring systems. The responses were analyzed using weighted means, verbal interpretations, and rankings to determine the level of utilization of these AI technologies in teaching practices.

Table 6
Teachers' Utilization of Chatbots or AI Tutors

Indicators	WM	VI	Rank
1. Use AI chatbots to answer students' real-time Mathematics questions.	3.27	MU	5
2. Use chatbots as supplementary tools for homework or practice exercises.	3.25	MU	6
3. Allow students to use AI tutors for step-by-step guidance in problem-solving.	3.13	MU	9
4. Use AI chatbots to explain difficult mathematical concepts.	3.38	MU	2
5. Integrate chatbots for student feedback or performance assessment.	3.35	MU	3
6. Assign chatbot-based activities to enhance classroom participation.	3.14	MU	8
7. Monitor students' learning progress through chatbot interactions.	3.03	MU	10
8. Use chatbots to provide enrichment tasks for advanced learners.	3.41	MU	1
9. Utilize chatbots to assist in remedial instruction for struggling students.	3.30	MU	4
10. Use AI tutors to reinforce independent learning and critical thinking.	3.15	MU	7
Composite Mean	**3.24**	**MU**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Least Utilized (LU) 1.50-2.49 = Slightly Utilized (SU) 2.50-3.49 = Moderately Utilized (MU) 3.50-4.00 = Highly Utilized (HU)

The data in Table 6 showed that the utilization of chatbots or AI tutors in teaching Mathematics problem-solving obtained a composite mean of 3.24, which is verbally interpreted as Moderately Utilized. This indicated that teachers integrate chatbot technologies in their instructional practices to some extent, particularly as supplementary learning tools that assist students in understanding mathematical concepts.

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Among the indicators, the highest-ranked practice was using chatbots to provide enrichment tasks for advanced learners ranked first which obtained a weighted mean of 3.41. However, the lowest-ranked indicator was monitoring students' learning progress through chatbot interactions, with a weighted mean of 3.03. The results suggested that while chatbots are increasingly being used to support Mathematics instruction, their potential for comprehensive instructional monitoring and learning analytics remains underutilized. This also highlighted the need for more structured integration strategies to maximize their benefits in learning.

Table 7
Teachers' Utilization of AI-based Problem Generators

Indicators	WM	VI	Rank
1. Use AI-based platforms that generate customized Math problems	3.23	MU	3
2. Utilize AI-generated problems that adjust to students' ability levels	3.20	MU	4
3. Use AI tools to create multiple versions of quizzes and worksheets	3.40	MU	1
4. Provide AI-generated practice exercises for mastery of skills	3.09	MU	6
5. Use AI tools to produce differentiated tasks for diverse learners	3.02	MU	10
6. Assess student understanding using automatically generated problems	3.04	MU	9
7. Encourage students to use AI-based problem generators for self-practice	3.30	MU	2
8. Review the quality of AI-generated problems before assigning them	3.07	MU	7.5
9. Integrate AI-generated questions in quizzes and examinations	3.07	MU	7.5
10. Rely on AI-based generators to save time in creating problem sets	3.16	MU	5
Composite Mean	**3.16**	**MU**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Least Utilized (LU) 1.50-2.49 = Slightly Utilized (SU) 2.50-3.49 = Moderately Utilized (MU) 3.50-4.00 = Highly Utilized (HU)

The results in Table 7 indicated that the utilization of AI-based problem generators obtained a composite mean of 3.16, which is verbally interpreted as Moderately Utilized. This finding suggested that teachers use AI-generated problem sets in their instruction, although the integration of such tools is still developing within classroom practices.

The highest-ranked indicator was using AI tools to create multiple versions of quizzes and worksheets, which obtained a weighted mean of 3.40. On the other hand, the lowest-ranked

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indicator was using AI tools to produce differentiated tasks for diverse learners, which obtained a weighted mean of 3.02. Overall, the results indicated that AI-based problem generators are primarily used to support assessment preparation and practice exercises rather than personalized learning strategies.

Table 8
Teachers' Utilization of Virtual or Augmented Reality Simulations

Indicators	WM	VI	Rank
1. Use virtual or AR tools to visualize complex mathematical concepts	2.99	MU	9
2. Integrate simulations to demonstrate real-life mathematical applications	3.25	MU	1.5
3. Allow students to explore mathematical models in virtual environments	3.03	MU	7
4. Use VR/AR to illustrate geometric shapes, graphs, and data sets	3.17	MU	4
5. Utilize AR-based applications to enhance student engagement	3.08	MU	6
6. Assign VR simulations as part of interactive class activities	3.22	MU	3
7. Encourage students to interpret results from VR/AR mathematical models	3.11	MU	5
8. Use VR or AR tools to demonstrate mathematical relationships visually	3.01	MU	8
9. Integrate virtual simulations to strengthen problem-solving understanding	2.97	MU	10
10. Use AR features in mobile applications to supplement class instruction	3.25	MU	1.5
Composite Mean	**3.11**	**MU**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Least Utilized (LU) 1.50-2.49 = Slightly Utilized (SU) 2.50-3.49 = Moderately Utilized (MU) 3.50-4.00 = Highly Utilized (HU)

The data in Table 8 revealed that the utilization of virtual or augmented reality simulations obtained a composite mean of 3.11, which is verbally interpreted as Moderately Utilized. This suggested that teachers occasionally integrate VR or AR technologies in Mathematics instruction, particularly for visualizing abstract mathematical concepts.

The highest-ranked indicators were integrating simulations to demonstrate real-life mathematical applications and using AR features in mobile applications to supplement instruction, both obtaining a weighted mean of 3.25. In contrast, the lowest-ranked indicators indicated that integrating virtual simulations to strengthen problem-solving understanding posted a weighted mean of 2.97, interpreted as Moderately Utilized. This result suggested that although VR and AR tools are used for visualization and engagement, they may not yet be fully integrated

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into structured problem-solving activities. Teachers are less inclined to apply VR and AR technologies for deeper conceptual understanding and higher-order thinking tasks, pointing to a need for further support in maximizing these tools for more complex and analytical learning objectives.

Table 9

Teachers' Utilization of AI-powered Adaptive Learning Tools

Indicators	WM	VI	Rank
1. Use AI platforms that adapt to each student's learning pace	3.12	MU	4.5
2. Utilize adaptive tools to recommend personalized learning materials	3.04	MU	7
3. Assign activities from adaptive systems that adjust difficulty levels	3.29	MU	1
4. Monitor student performance using AI-generated analytics	3.15	MU	3
5. Use AI feedback to modify my teaching strategies	3.12	MU	4.5
6. Integrate AI dashboards to track students' mastery of competencies	3.03	MU	8
7. Encourage students to use adaptive tools for additional practice	3.27	MU	2
8. Use adaptive platforms to assign remediation tasks.	2.97	MU	9
9. Rely on adaptive learning tools to support differentiated instruction.	3.11	MU	6
10. Use AI-based recommendations to enhance learning outcomes.	2.92	MU	10
Composite Mean	**3.10**	**MU**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Least Utilized (LU) 1.50-2.49 = Slightly Utilized (SU) 2.50-3.49 = Moderately Utilized (MU) 3.50-4.00 = Highly Utilized (HU)

The results in Table 9 showed that the utilization of AI-powered adaptive learning tools obtained a composite mean of 3.10, which is interpreted as Moderately Utilized. This indicated that adaptive learning technologies are incorporated into Mathematics instruction to some extent, particularly in activities that adjust to students' learning pace.

The highest-ranked indicator was assigning activities from adaptive systems that adjust difficulty levels, which obtained a weighted mean of 3.29. Conversely, the lowest-ranked indicator was using AI-based recommendations to enhance learning outcomes with a weighted mean of 2.92. This implied that teachers may not yet fully rely on AI-generated insights or analytics to guide their instructional decisions. Overall, the results suggest that while adaptive learning tools are used to facilitate individualized practice, their potential for data-driven instructional planning has not been fully maximized.

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Table 10
Teachers' Utilization of Intelligent Tutoring Systems (ITS)

Indicators	WM	VI	Rank
1. Use intelligent tutoring systems that provide instant corrective feedback.	3.07	MU	8
2. Integrate ITS to guide students step-by-step through problem-solving.	3.23	MU	2.5
3. Allow students to use ITS to review and master mathematical topics.	3.04	MU	9
4. Rely on ITS to monitor student progress and performance trends.	3.02	MU	10
5. Use ITS reports to identify students who need additional support.	3.16	MU	5.5
6. Utilize ITS to assess learning outcomes more efficiently.	3.16	MU	5.5
7. Encourage students to interact with ITS for self-directed learning.	3.15	MU	7
8. Use ITS-generated feedback to improve my instructional strategies.	3.23	MU	2.5
9. Integrate ITS into classroom activities for guided practice.	3.22	MU	4
10. Use ITS to provide targeted review lessons for specific competencies.	3.27	MU	1
Composite Mean	**3.15**	**MU**	

Legend: WM – Weighted Mean VI – Verbal Interpretation
1.00-1.49 = Least Utilized (LU) 1.50-2.49 = Slightly Utilized (SU) 2.50-3.49 = Moderately Utilized (MU) 3.50-4.00 = Highly Utilized (HU)

The findings in Table 10 revealed that the utilization of intelligent tutoring systems obtained a composite mean of 3.15, which is interpreted as Moderately Utilized. This indicated that ITS technologies are integrated into Mathematics instruction to support guided practice and individualized learning, although their use remains moderate in classroom settings.

The highest-ranked indicator was using ITS to provide targeted review lessons for specific competencies, with a weighted mean of 3.27. Meanwhile, the lowest-ranked indicator was relying on ITS to monitor student progress and performance trends with a weighted mean of 3.02. This implied that while ITS platforms provide analytical tools, teachers may not yet fully utilize these features for comprehensive learning analytics such as continuous monitoring, independent student practice, and immediate feedback. Overall, the results indicated that intelligent tutoring systems serve primarily as instructional aids rather than as full learning management tools in Mathematics classrooms.

The overall extent of utilization of AI-enhanced strategies in teaching Mathematics problem-solving, based on Tables 6 to 10, obtained a grand mean of 3.15, which was verbally

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interpreted as Moderately Utilized. This indicated that teachers are integrating AI-based tools such as chatbots, problem generators, virtual simulations, adaptive learning systems, and intelligent tutoring systems into their instructional practices to a considerable extent. These tools are being used to support lesson delivery, enhance student engagement, and provide additional learning resources that supplement traditional teaching strategies.

The findings revealed that while AI technologies are being used to support teaching and learning processes, their full potential has not yet been maximized. Teachers tend to use these tools primarily for supplementary instruction, practice, and engagement rather than for advanced applications such as data-driven decision-making and comprehensive learning analytics. Overall, the results suggested that AI-enhanced strategies are present in Mathematics instruction, but further training, support, and infrastructure are needed to achieve more effective and extensive utilization.

3. Relationship between the Assessments on the Level of Mathematics Problem-Solving Skills and the extent of the Utilization of AI-Enhanced Strategies

This section examines the relationship between the level of Mathematics problem-solving skills of students and the extent of utilization of AI-enhanced strategies in teaching Mathematics. The analysis determines whether the integration of AI technologies in instruction significantly influences the development of students' mathematical problem-solving abilities.

Table 11
Relationship between the Level of Mathematics Problem-Solving Skills on Functions and Graphs and the Utilization of AI-Enhanced Strategies

	r-value	p-value	Interpretation	Decision	Verbal Interpretation
Chatbots or AI tutors	0.762	0.000	Very Strong Positive Relationship	Reject	Highly Significant
AI-based problem generators	0.761	0.000	Very Strong Positive Relationship	Reject	Highly Significant
Virtual or augmented reality simulations	0.747	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-powered Adaptive learning tools	0.747	0.000	Strong Positive Relationship	Reject	Highly Significant
Intelligent Tutoring Systems (ITS)	0.729	0.000	Strong Positive Relationship	Reject	Highly Significant

Coefficient of correlation (r): ±1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), ±.51 to .75 (Strong relationship), ±.26-.50 (Moderate Relationship, ±.11 to .25 (Weak relationship), ±.01 to .10 (Very weak relationship), .00 (No relationship

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The results showed that all AI-enhanced strategies have highly significant relationships with students' problem-solving skills, as indicated by p-values of 0.000. The correlation coefficients range from 0.729 to 0.762, indicating a strong positive relationship.

Among the AI-enhanced strategies, Chatbots or AI tutors (r=0.762) and AI-based problem generators (r=0.761) yielded the highest correlation coefficients, both interpreted as having a very strong positive relationship. On the other hand, Virtual or augmented reality simulations (r=0.747) and AI-powered adaptive learning tools (r=0.747) demonstrated a strong positive relationship, indicating that while they are slightly less correlated than the top indicators, they still play a substantial role in enhancing students' understanding and application of mathematical concepts.

This implied that students who frequently use AI tools tend to demonstrate better performance in understanding and solving problems related to functions and graphs. The strong relationship may be attributed to the ability of AI tools to provide step-by-step guidance, immediate feedback, and multiple problem variations, which are essential in mastering graphical interpretation and functional relationships. These tools enhance conceptual clarity and allow students to explore patterns and relationships visually and interactively.

Table 12
Relationship between the Level of Mathematics Problem-Solving Skills on Business Mathematics and the Utilization of AI-Enhanced Strategies

	r-value	p-value	Interpretation	Decision	Verbal Interpretation
Chatbots or AI tutors	0.718	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-based problem generators	0.720	0.000	Strong Positive Relationship	Reject	Highly Significant
Virtual or augmented reality simulations	0.728	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-powered Adaptive learning tools	0.715	0.000	Strong Positive Relationship	Reject	Highly Significant
Intelligent Tutoring Systems (ITS)	0.717	0.000	Strong Positive Relationship	Reject	Highly Significant

Coefficient of correlation (r): ±1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), ±.51 to .75 (Strong relationship), ±.26-.50 (Moderate Relationship, ±.11 to .25 (Weak relationship), ±.01 to .10 (Very weak relationship), .00 (No relationship)

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The findings showed that all variables have highly significant relationships with p-values of 0.000, and correlation coefficients ranging from 0.715 to 0.728. The highest correlation was observed in Virtual or augmented reality simulations (r=0.728), suggesting that immersive and interactive environments are particularly effective in enhancing students' understanding of business-related mathematical concepts. Meanwhile, Chatbots or AI tutors (r=0.718) and Intelligent Tutoring Systems (ITS) (r=0.717) also demonstrated strong positive relationships, indicating that guided instruction, feedback, and personalized assistance contribute significantly to students' problem-solving abilities.

This indicated that AI-enhanced strategies significantly contribute to students' ability to apply Mathematics in practical situations. The relatively consistent correlation values suggest that all AI tools are beneficial, particularly in contextualizing abstract mathematical concepts into real-world applications. VR and AR simulations likely enhance experiential learning by immersing students in realistic business scenarios, making mathematical concepts more meaningful and easier to understand.

Table 13
Relationship between the Level of Mathematics Problem-Solving Skills on Systems of Linear Equations and Inequalities and the Utilization of AI-Enhanced Strategies

	r-value	p-value	Interpretation	Decision	Verbal Interpretation
Chatbots or AI tutors	0.722	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-based problem generators	0.735	0.000	Strong Positive Relationship	Reject	Highly Significant
Virtual or augmented reality simulations	0.732	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-powered Adaptive learning tools	0.777	0.000	Very Strong Positive Relationship	Reject	Highly Significant
Intelligent Tutoring Systems (ITS)	0.743	0.000	Strong Positive Relationship	Reject	Highly Significant

Coefficient of correlation (r): ±1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), ±.51 to .75 (Strong relationship), ±.26-.50 (Moderate Relationship, ±.11 to .25 (Weak relationship), ±.01 to .10 (Very weak relationship), .00 (No relationship)

All variables showed highly significant relationships with p-values of 0.000, and r-values ranging from 0.722 to 0.777. Among the AI-enhanced strategies, AI-powered adaptive learning tools registered the highest correlation coefficient (r=0.777), interpreted as a very strong positive relationship. Chatbots or AI tutors (r=0.722) showed the lowest correlation among the variables, although still interpreted as a strong positive relationship.

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This suggested that adaptive AI systems were particularly effective in improving students' ability to solve systems of equations and inequalities and enhancing students' ability to solve complex algebraic problems. These topics require sequential reasoning and accuracy, which are enhanced by AI tools that adjust difficulty levels and provide targeted feedback. The strong correlations indicate that personalized learning experiences significantly improve students' algebraic problem-solving skills.

Table 14
Relationship between the Level of Mathematics Problem-Solving Skills on Exponential and Logarithmic Functions and the Utilization of AI-Enhanced Strategies

	r-value	p-value	Interpretation	Decision	Verbal Interpretation
Chatbots or AI tutors	0.745	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-based problem generators	0.768	0.000	Very Strong Positive Relationship	Reject	Highly Significant
Virtual or augmented reality simulations	0.738	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-powered Adaptive learning tools	0.810	0.000	Very Strong Positive Relationship	Reject	Highly Significant
Intelligent Tutoring Systems (ITS)	0.715	0.000	Strong Positive Relationship	Reject	Highly Significant

Coefficient of correlation (r): ±1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), ±.51 to .75 (Strong relationship), ±.26-.50 (Moderate Relationship, ±.11 to .25 (Weak relationship), ±.01 to .10 (Very weak relationship), .00 (No relationship)

The results indicated highly significant relationships, with p-values of 0.000 and r-values ranging from 0.715 to 0.810. Among the strategies, AI-powered adaptive learning tools obtained the highest correlation coefficient (r=0.810), interpreted as a very strong positive relationship. On the other hand, chatbots or AI tutors (r=0.745), virtual or augmented reality simulations (r=0.738), and intelligent tutoring systems (ITS) (r=0.715) all demonstrated strong positive relationships. Although slightly lower than the top variables, these tools still play a significant role in supporting students' understanding and problem-solving abilities.

This suggested that adaptive AI tools are highly effective in teaching exponential and logarithmic concepts, which often require deep conceptual understanding. The ability of AI to provide personalized instruction and real-time feedback helps students overcome difficulties and misconceptions in these topics.

Table 15
Relationship between the Level of Mathematics Problem-Solving Skills on Mathematics of Logic and the Utilization of AI-Enhanced Strategies

	r-value	p-value	Interpretation	Decision	Verbal Interpretation
Chatbots or AI tutors	0.698	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-based problem generators	0.689	0.000	Strong Positive Relationship	Reject	Highly Significant
Virtual or augmented reality simulations	0.729	0.000	Strong Positive Relationship	Reject	Highly Significant
AI-powered Adaptive learning tools	0.776	0.000	Very Strong Positive Relationship	Reject	Highly Significant
Intelligent Tutoring Systems (ITS)	0.770	0.000	Very Strong Positive Relationship	Reject	Highly Significant

Coefficient of correlation (r): ±1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), ±.51 to .75 (Strong relationship), ±.26-.50 (Moderate Relationship, ±.11 to .25 (Weak relationship), ±.01 to .10 (Very weak relationship), .00 (No relationship)

All AI-enhanced strategies showed highly significant relationships with p-values of 0.000, and r-values ranging from 0.689 to 0.776. Among the strategies, AI-powered adaptive learning tools (r = 0.776) and Intelligent Tutoring Systems (ITS) (r = 0.770) emerged as the top contributors, both described as having a very strong positive relationship. On the other hand, chatbots or AI tutors (r = 0.698) and AI-based problem generators (r = 0.689), while still showing strong positive relationships, ranked comparatively lower.

This indicated that AI tools that provide guided reasoning and structured feedback are particularly effective in enhancing logical thinking. Mathematics of Logic requires higher-order thinking skills, which are supported by AI systems that encourage reflection, reasoning, and step-by-step problem-solving.

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Table 16
Relationship between the Over-all Level of Mathematics Problem-Solving Skills and the Utilization of AI-Enhanced Strategies

	r-value	p-value	Interpretation	Decision	Verbal Interpretation
Level of Mathematics Problem Solving Skills and Utilization on AI-Enhanced Strategies	0.934	0.000	Very Strong Positive Relationship	Reject	Highly Significant

Coefficient of correlation (r): ±1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), ±.51 to .75 (Strong relationship), ±.26-.50 (Moderate Relationship, ±.11 to .25 (Weak relationship), ±.01 to .10 (Very weak relationship), .00 (No relationship)

The r-value of 0.934 indicated a very strong positive correlation between Mathematics problem-solving skills and the utilization of AI-enhanced strategies. This means that as the use of AI-enhanced strategies increases, the level of students' Mathematics problem-solving skills also tends to increase.

These findings suggested that the integration of AI-enhanced strategies plays an important role in improving students' ability to analyze, interpret, and solve mathematical problems. AI-supported learning tools may provide interactive problem-solving environments, personalized feedback, and adaptive learning experiences that help students develop deeper mathematical understanding and more effective problem-solving strategies.

Overall, the results highlighted that greater utilization of AI-enhanced strategies is strongly associated with higher levels of Mathematics problem-solving skills, emphasizing the potential value of incorporating AI-based technologies into Mathematics instruction to enhance student engagement and cognitive development.

4. Challenges teachers encounter in using AI-Enhanced Strategies in Mathematics

This section presents the challenges encountered by teachers in using AI-enhanced strategies in Mathematics instruction. As artificial intelligence becomes increasingly integrated into educational practices, teachers may face various technological, instructional, and institutional barriers that affect the effective implementation of these tools. These challenges may include issues related to infrastructure, teacher preparedness, compatibility of AI applications, and student readiness to engage in technology-supported learning environments. The data in this table summarize the respondents' level of agreement regarding different difficulties associated with integrating AI-based technologies into Mathematics teaching. The results provide insight into the key obstacles that may influence the successful adoption and sustainability of AI-enhanced strategies in the classroom.

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Table 17
Challenges encountered in using AI-Enhanced Strategies in Mathematics

Indicators	WM	VI	R
1. Limited access to reliable internet connection and digital devices in school.	3.51	SA	4
2. Lack sufficient training or orientation in the use of AI-enhanced tools.	3.52	SA	3
3. Inadequate institutional policies or support systems for AI integration.	2.80	A	13
4. Technical issues such as software errors or slow system performance.	2.73	A	15
5. Preparing AI-integrated lessons requires more time than traditional approaches.	3.53	SA	1.5
6. AI applications are not compatible with available school devices.	2.66	A	19
7. Students have varying levels of digital literacy that affect AI-based learning activities.	3.53	SA	1.5
8. AI tools sometimes provide inaccurate or irrelevant information.	2.91	A	9
9. Concerns about data privacy and the ethical use of AI in the classroom.	2.79	A	14
10. Difficulty aligning AI-generated content with curriculum standards.	3.41	SA	5
11. Some students become overly dependent on AI assistance and neglect manual problem-solving.	2.70	A	17
12. Limited technical support is available when AI systems malfunction.	2.58	A	20
13. Challenging in evaluating the accuracy of AI-generated assessments.	2.72	A	16
14. Integrating AI tools into existing lesson plans disrupts the regular pacing of instruction.	2.87	A	10
15. Budget constraints hinder the procurement of paid AI applications or subscriptions.	2.84	A	11
16. Some AI tools are in English only, making localization and student comprehension difficult.	3.36	SA	6
17. Students show reduced interpersonal interaction when using AI-based learning systems.	2.95	A	7
18. Collecting and analyzing AI-generated data requires additional teacher workload.	2.93	A	8
19. AI tools occasionally fail to match the specific learning needs of diverse learners.	2.81	A	12
20. Uncertainty about the long-term reliability and sustainability of AI technologies in teaching.	2.69	A	18
Grand Mean	**2.99**	**A**	

Legend: WM – Weighted Mean VI – Verbal Interpretation R – Rank
1.00-1.49 =Strongly Agree (SA) 1.50-2.49 =Agree (A) 2.50-3.49 = Disagree (D)
3.50-4.00 = Strongly Disagree (SD)

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The results showed that the challenges encountered in using AI-enhanced strategies obtained a grand mean of 2.99, which is verbally interpreted as Agree. This denoted that teacher generally experience a considerable level of difficulty in integrating AI into their instruction, indicating that while AI is being utilized, several barriers still affect its smooth and effective implementation in the teaching and learning process.

The most significant challenges include preparing AI-integrated lessons which require more time than traditional approaches and students having varying levels of digital literacy, both ranked 1.5 with weighted means of 3.53. These findings suggested that the integration of AI technologies demands additional preparation and instructional adjustments from teachers. Moreover, differences in students' technological skills may affect their ability to effectively participate in AI-based learning activities. These findings highlighted that time constraints, differences in students' technological readiness, and insufficient teacher preparation are major concerns that influence the successful adoption of AI in the classroom.

These findings were strongly supported by the responses noted by one teacher-interviewee "AI-based lessons require more preparation because I need to check the accuracy of generated outputs and make sure they match my lesson objectives." Another teacher similarly stated, "It takes longer to prepare activities since AI tools still need teacher adjustment before being used in class." These statements reinforce the result that time-intensive preparation is one of the most significant barriers in AI integration.

In addition, another respondent emphasized that "some students are still not digitally skilled enough to fully participate in AI-assisted activities" and ""not all students are familiar with using AI tools, so some of them struggle to follow the activities properly", confirming the challenge posed by varying levels of digital literacy among learners.

Other notable challenges limited access to reliable internet connections and difficulty aligning AI-generated content with curriculum standards. These issues highlighted the need for institutional support, professional development programs, and improved technological infrastructure.

This is reinforced by a teacher's statement that "Unstable internet connection often interrupts our AI-based activities, especially during simulations and online exercises." Another added, "Sometimes only a few students can fully participate because not everyone has access to devices or stable connectivity." These responses clearly illustrate how infrastructure limitations directly affect classroom implementation and student participation.

Similarly, lack of sufficient training or orientation in AI tools was supported by teachers expressed need for professional development. One respondent stated, "I am still not fully confident using AI tools because we were not properly trained on how to integrate them into lesson planning." Another teacher emphasized, "We need more seminars and hands-on training to maximize the use of AI in teaching Mathematics." These statements highlight the gap between technology availability and teacher readiness.

In contrast, the lowest-ranked challenges include limited technical support being available when AI systems malfunction with a weighted mean of 2.58, some students becoming overly dependent on AI assistance and neglecting manual problem-solving with 2.70, and

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technical issues such as software errors or slow system performance with 2.73. These results indicate that although these concerns are present, they are less pressing compared to other challenges, implying that teachers are relatively less affected by system-related issues and dependency concerns than by instructional and capacity-related barriers.

One teacher shared, "When AI tools fail, we usually try to fix the problem ourselves because technical support is not always immediately available." Another stated, "Some students tend to rely too much on AI answers instead of trying to solve problems on their own." However, teachers also noted that these issues are manageable and less disruptive compared to preparation and training challenges.

Overall, the findings indicated that while AI technologies offer significant instructional benefits, several practical challenges must be addressed to ensure their effective and sustainable integration in Mathematics education.

5. Proposed AI-based Instructional Activities

The proposed AI-based instructional activities were crafted based on the study's findings. Based on the findings of the quantitative and qualitative analyses, a set of AI-based instructional activities is proposed to enhance the teaching of Mathematics problem-solving among Senior High School students. The proposed activities aim to address the needs identified in the study, particularly in improving students' problem-solving skills, increasing engagement in Mathematics lessons, and utilizing AI technologies effectively while minimizing the challenges encountered by teachers.

The quantitative findings revealed that AI-enhanced strategies such as chatbots, AI-generated problem sets, adaptive learning systems, and intelligent tutoring platforms are moderately utilized in Mathematics instruction. These tools were found to support guided practice, individualized learning, and immediate feedback. Meanwhile, qualitative responses from teachers highlighted that AI tools increase student engagement, provide step-by-step explanations, and help visualize complex mathematical concepts.

Considering these findings, the proposed AI-based instructional activities are designed to promote balanced integration of artificial intelligence and traditional teaching approaches. The activities encourage active participation, critical thinking, and responsible use of AI tools while still allowing teachers to guide the learning process.

1. AI-Guided Problem-Solving Sessions

In this activity, students use AI-powered tutoring systems or chatbots to receive step-by-step guidance while solving mathematical problems. The teacher first introduces the problem-solving task and explains the objectives of the lesson. Students then interact with AI tutors to analyze the problem, identify known information, and explore possible solution strategies.

The AI system provides hints, explanations, and corrective feedback when students encounter difficulties. After completing the activity, students discuss their solutions with their classmates and reflect on the strategies they used. This activity supports the qualitative finding

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that AI tutors help students understand mathematical procedures through guided practice. It also promotes independent learning while allowing teachers to monitor student progress.

2. AI-Generated Problem Exploration

Teachers can use AI-based problem generators to create multiple variations of mathematical problems related to the lesson topic. Students work individually or in groups to solve these problems, which gradually increase in difficulty.

Through this activity, students are exposed to different types of problem-solving situations, allowing them to practice analytical thinking and apply mathematical concepts in various contexts. AI-generated questions also enable teachers to provide differentiated tasks for students with different ability levels. This instructional strategy addresses the quantitative finding that AI-based problem generators are useful for producing varied assessments and practice exercises while saving preparation time for teachers.

3. AI Visualization and Simulation Activity

In this activity, teachers use AI-supported visualization tools, simulations, or interactive graphing platforms to demonstrate abstract mathematical concepts such as functions, equations, and relationships between variables.

Students explore these visual representations and analyze how changes in variables affect graphs or mathematical models. The teacher facilitates discussion by asking students to interpret patterns and explain their observations. The activity aligns with the qualitative theme of visualization of mathematical concepts, where teachers reported that graphs, simulations, and visual explanations help students understand difficult mathematical ideas more effectively.

4. AI-Supported Collaborative Learning Task

Students are divided into small groups and assigned complex problem-solving tasks that require collaboration. Each group may use AI tools to generate additional information or verify their solutions. However, students must explain their reasoning and justify their answers before consulting the AI system.

This strategy ensures that AI tools function as supportive resources rather than replacements for student thinking. It also encourages discussion, peer learning, and critical reasoning skills. The activity addresses the qualitative concern regarding student overdependence on AI by promoting balanced integration of technology and collaborative learning.

5. AI Feedback and Reflection Activity

After completing problem-solving tasks, students receive feedback from AI platforms regarding the accuracy of their answers and the steps they followed. The teacher then guides students in reflecting on their mistakes and identifying areas for improvement.

Students may also analyze AI-generated reports showing their performance trends and learning progress. This reflection process helps learners develop metacognitive skills and become more aware of their strengths and weaknesses in Mathematics. This activity corresponds to the qualitative theme of immediate feedback and personalized learning, where teachers emphasized that AI systems help students recognize errors and improve their understanding.

Discussion

The results revealed that the overall level of Mathematics problem-solving skills of Senior High School students in the selected General Mathematics topics was above average as attested by the grand mean of 2.97. This indicates that students generally demonstrate adequate competence in solving mathematical problems across various domains, including Functions and Graphs, Business Mathematics, Systems of Linear Equations and Inequalities, Exponential and Logarithmic Functions, and Mathematics of Logic. Among these areas, students showed relative strength in understanding concepts and performing procedural tasks such as interpreting graphs, solving equations, and applying mathematical rules.

However, the findings also revealed that students encountered difficulties in applying mathematical concepts to real-life situations and contextualized problem-solving tasks. Indicators related to real-world applications consistently obtained lower mean scores compared to conceptual and procedural indicators. This suggests that while students possess foundational knowledge and skills, their ability to transfer learning to practical contexts remains limited. The results imply that students have developed a satisfactory level of mathematical problem-solving skills but require further enhancement in higher-order thinking skills, particularly in applying concepts to authentic and real-world problems.

The findings also indicated that AI-enhanced strategies are moderately utilized in teaching Mathematics problem-solving among Senior High School teachers based on the grad mean of 3.15. This indicates that teachers integrate AI-based instructional tools—such as chatbots or AI tutors, AI-based problem generators, virtual or augmented reality simulations, AI-powered adaptive learning systems, and intelligent tutoring systems—into their teaching practices to a considerable extent.

The findings revealed that AI tools are commonly utilized to support instructional delivery, provide practice exercises, facilitate student engagement, and offer immediate feedback. Teachers particularly recognize the value of AI in enhancing independent learning, generating varied problem sets, and visualizing mathematical concepts.

The qualitative responses from teacher-respondents highlighted that AI technologies help facilitate immediate feedback, individualized learning paths, and interactive learning experiences, which are essential in improving students' engagement and problem-solving abilities in Mathematics. However, the results also indicated that the utilization of AI technologies remains at a moderate level, suggesting that their full potential is not yet fully maximized. Teachers tend to use AI tools as supplementary resources rather than as integral components of instruction, particularly in areas such as learning analytics, performance monitoring, and data-driven instructional decision-making.

The findings suggested that while AI-enhanced strategies are already present in Mathematics instruction, there is still a need for improved teacher training, technological infrastructure, and institutional support to promote more effective and comprehensive integration of AI tools in the teaching and learning process.

The statistical analysis revealed a very strong positive relationship between the level of Mathematics problem-solving skills and the utilization of AI-enhanced strategies. The computed correlation coefficient ($r = 0.934$) with a p-value of 0.000 indicated that the relationship between the two variables was highly significant. This result implies that increased use of AI-enhanced strategies is associated with improved Mathematics problem-solving skills among students. Consequently, the null hypothesis stating that there is no significant relationship between the two variables was rejected.

The study also revealed that teachers agreed that they encounter challenges in using AI-Enhanced Strategies as attested by the grand mean of 2.99. Among the most significant challenges were the additional time required to prepare AI-integrated lessons, differences in students' digital literacy levels, limited access to reliable internet connectivity and digital devices, and insufficient training in the use of AI-based tools. These challenges highlight the need for improved infrastructure, teacher professional development, and institutional support to ensure the effective implementation of AI-enhanced strategies in schools.

Considering the positive relationship between AI-enhanced strategies and Mathematics problem-solving skills, as well as the challenges encountered by teachers, the study proposed AI-based instructional activities designed to guide teachers in effectively integrating artificial intelligence tools into Mathematics instruction. Activities such as AI-Guided Problem-Solving Sessions, AI-Generated Problem Exploration, AI Visualization and Simulation Activity, AI-Supported Collaborative Learning Task, and AI Feedback and Reflection Activity aims to enhance conceptual understanding, promote critical thinking, and strengthen students' ability to solve mathematical problems in both academic and real-life contexts.

Conclusions

1. The Mathematics problem-solving skills of Senior High School students in General Mathematics are generally above average, indicating that students possess an adequate level of conceptual understanding and procedural competence in solving mathematical problems.

2. Assessment showed that Mathematics teachers moderately utilize AI-enhanced strategies in teaching Mathematics problem-solving, reflecting the growing integration of digital and AI-supported tools in contemporary classroom instruction. AI-enhanced strategies, particularly intelligent tutoring systems and adaptive learning tools, provide opportunities for personalized instruction, immediate feedback, and guided practice, which may enhance students' engagement and understanding of mathematical concepts.

3. The study confirms that a very strong and statistically significant relationship exists between the utilization of AI-enhanced strategies and students' Mathematics problem-solving skills.

4. The effective integration of AI in Mathematics education is influenced by several technological and pedagogical challenges, including insufficient training, infrastructure limitations, and varying levels of digital literacy among students.

5. The development of AI-based instructional activities serves as a practical and relevant approach to improving Mathematics instruction in Senior High School. The proposed instructional activities provide structured opportunities for teachers to integrate artificial

intelligence tools in facilitating problem-solving tasks, personalized learning, and interactive classroom experiences.

Recommendations

1. Mathematics teachers may be encouraged to integrate AI-enhanced strategies into their instructional practices to support the development of students' problem-solving skills. They may also incorporate contextualized and real-world problem-solving activities to strengthen students' ability to apply mathematical concepts.

2. School administrators may provide adequate technological infrastructure, including reliable internet connectivity, digital devices, and access to AI-based learning platforms. They may also encourage collaborative professional learning communities where teachers can share effective practices in integrating AI technologies in Mathematics instruction.

3. The Department of Education may design and implement professional development programs and training workshops focused on artificial intelligence integration in education.

4. Curriculum planners and developers may consider integrating AI-supported instructional activities and technology-based problem-solving tasks into the Mathematics curriculum to promote innovative, learner-centered, and technology-integrated teaching approaches.

5. Educational Technology Developers of AI-based educational platforms may collaborate with educators to design AI tools that align with curriculum standards and support effective Mathematics teaching and learning.

6. Future researchers may conduct further studies exploring the use of AI-enhanced strategies in other subject areas or educational levels. They may also examine students' perceptions, attitudes, and actual academic performance in relation to AI-based learning environments to provide a more comprehensive understanding of the impact of artificial intelligence in education.

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