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ENHANCING MATHEMATICS PERFORMANCE THROUGH ADAPTIVE PERSONALIZED TECHNOLOGIES

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ABSTRACT

The study examines the efficacy of Adaptive Personalized Technologies (APTs) in enhancing the mathematical performance and retention of high school students. Employing a quasi-experimental design, 100 students were divided into two groups: one using APTs and the other utilizing non-adaptive personalized technologies (non-APTs). Both groups were assessed through pre-tests, post-tests, and retention-tests to evaluate their performance.

The results revealed that both groups had comparable pre-test scores, indicating a uniform baseline. Post-test results demonstrated a significant improvement in the APTs group, with 26% of students achieving "Satisfactory" or better, compared to 18% in the non-APTs group. The APTs group also exhibited a higher mean score (33.8) and a lower standard deviation (4.05), indicating more consistent performance improvements. Retention-test scores further highlighted the efficacy of APTs, with a significantly higher mean score (33.28) compared to the non-APTs group (31.6), and a lower standard deviation, indicating sustained knowledge retention.

Supporting studies corroborate these findings, demonstrating the effectiveness of personalized and adaptive educational strategies in improving academic outcomes. The study underscores the potential of APTs to enhance both immediate and long-term mathematical performance, advocating for their integration into educational practices to address diverse learning needs and improve student outcomes.

Keywords: Adaptive Personalized Technologies (APTs), Students' Mathematics Performance

CONTEXT AND RATIONALE

Traditional math education doesn't always click for everyone. Teachers can construct more inclusive and productive math classrooms that enable all students to flourish by utilizing technology to tailor learning experiences and enhance student knowledge (Zhilmagambetova et al.). Education technology has offered many opportunities that excite young children, making them more curious and enabling them to explore the world on their own (DepEd's Educ Futures to Provide Insights in Evolving Education Landscape | Department of Education). Educational games and quizzes, both offline and online, can turn drill and practice into engaging challenges (Garris et al.). Students can earn points, compete with friends, and level up as they master concepts. Technology can adapt to each student's pace and learning style. Platforms can offer targeted practice on areas where a student struggles and provide hints or alternative explanations. One prominent example of this is the Khan Academy, which offers personalized learning paths for mathematics students (Raza, 2023). In modern education, the landscape of mathematics instruction faces multifaceted challenges, including diverse student learning needs, abstract concepts, limited engagement, resource constraints, assessment practices, and the integration of technological advancements. These challenges underscore the importance of exploring innovative approaches such as Adaptive Personalized Technologies (APTs) (Zhilmagambetova et al.) to address the complexities of mathematics education effectively.

Recent literature supports the use of technology to enhance educational outcomes. Harris, Graham, and Adkins (2015) investigated the impact of self-regulated strategy development (SRSD) on struggling young writers, finding that peer support significantly enhances writing skills, knowledge, and motivation. DepEd's "Educ Futures" initiative provides insights into the evolving education landscape, emphasizing the role of technology in fostering curiosity and self-directed learning among young students. Garris, Ahlers, and Driskell (2022) highlight how educational games and quizzes can transform drill and practice into engaging challenges that motivate students through point systems, competition, and progression. Raza (2023) discusses adaptive learning technologies and their potential to tailor education to individual student needs, exemplified by platforms like Khan Academy. Finally, Zhilmagambetova and Tarau (2022) focus on the application of Adaptive Personalized Technologies (APTs) in mathematics education, demonstrating how these technologies can cater to diverse learning needs and improve student outcomes.

Incorporating these perspectives, this study explores how Adaptive Personalized Technologies (APTs) can revolutionize mathematics education by addressing students' unique learning needs, fostering engagement, and enhancing overall academic performance. By leveraging APTs, educators can provide a more inclusive and effective learning environment that adapts to the diverse capabilities and interests of students, ultimately leading to improved outcomes in mathematics education.

INNOVATION, INTERVENTION AND STRATEGY

The reason behind implementing Adaptive Personalized Technologies (APTs) (Zhilmagambetova et al.) to enhance students' mathematics performance lies in their potential to cater to individual learning needs, provide immediate feedback, offer targeted instruction, increase student engagement, utilize data-driven insights, ensure accessibility, and facilitate continuous improvement. By leveraging APTs, educators can create tailored learning experiences that help students develop a deeper understanding of mathematical concepts and improve their overall performance in the subject (Raza, 2023).

In our quest to enhance mathematics performance, we embraced a multifaceted approach, incorporating both offline and online adaptive technology assessments. Recognizing the diverse learning needs and preferences of our students, we sought to harness the benefits of adaptive technologies to personalize their learning experiences effectively.

INSTABRIGHT e-GAZETTE
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****
Offline adaptive technology assessments were integrated into our classroom environment, allowing for real-time feedback and tailored instruction. Through offline assessments, students engaged with interactive materials, problem sets, and activities designed to adapt to their individual learning trajectories. This hands-on approach enabled us to address conceptual difficulties promptly and provide targeted support where needed, fostering a deeper understanding of mathematical concepts.

Complementing our offline efforts, we leveraged online adaptive technology assessments to extend learning beyond the confines of the traditional classroom. Through online platforms, students accessed a wealth of interactive resources, practice exercises, and diagnostic tools customized to their unique learning profiles. The adaptive nature of these assessments allowed students to progress at their own pace, reinforcing concepts and building confidence in their mathematical abilities.

By integrating both offline and online adaptive technology assessments, we aimed to create a dynamic learning environment that catered to the diverse needs of our students. Through continuous monitoring and analysis of student progress, we identified areas for improvement and refined our instructional strategies accordingly. Our interventions empowered students to take ownership of their learning journey, equipping them with the skills and confidence needed to excel in mathematics.

As we reflect on our journey, we recognize the transformative power of adaptive technology assessments in enhancing mathematics performance. By embracing innovation and tailored interventions, we have witnessed tangible improvements in student engagement, understanding, and achievement. Moving forward, we remain committed to leveraging adaptive technologies to unlock the full potential of our students and cultivate a culture of excellence in mathematics education.

This study investigates the implementation of Adaptive Personalized Technologies (APTs) as an innovative intervention and strategic approach to enhance mathematics performance among students. Grounded in the recognition of diverse learning needs,
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conceptual difficulties, and engagement challenges within mathematics education, the study explores the potential of APTs to address these issues effectively. APTs offer personalized learning experiences tailored to individual student needs, immediate feedback mechanisms, targeted instructional strategies, and data-driven insights for continuous improvement. Through the integration of APTs, educators aim to revolutionize mathematics instruction by fostering deeper conceptual understanding, increasing student engagement, and improving overall performance. This research examines the impact of APTs through empirical investigation, shedding light on their efficacy as a transformative tool in mathematics education. The findings contribute to the development of strategic interventions and innovative practices aimed at enhancing mathematics learning outcomes and fostering student success.

Implementation Procedures

The implementation of Adaptive Personalized Technologies (APTs) involves several key steps and considerations to ensure their effective integration into educational settings:

1. **Needs Assessment:** Before implementing APTs, educators should conduct a thorough needs assessment to understand the specific challenges and learning needs of their students in mathematics. This assessment may involve analyzing student performance data, identifying areas of weakness or misconception, and gauging student engagement levels.

2. **Selection of APTs:** Educators need to research and select appropriate APTs that align with their instructional goals, curriculum standards, and student demographics. APTs may include adaptive learning platforms, interactive software, digital assessments, and personalized learning modules designed to enhance mathematics learning.

3. **Professional Development:** Training and professional development opportunities should be provided to educators to familiarize them with the features, functionalities, and best practices associated with APTs. Educators need to understand how to

INSTABRIGHT e-GAZETTE
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effectively integrate APTs into their instructional practices, interpret student data generated by APTs, and provide differentiated instruction based on individual student needs.

4. **Customization and Personalization:** APTs should be customized and personalized to meet the diverse learning needs and preferences of students. This may involve configuring adaptive algorithms, setting personalized learning paths, and selecting appropriate instructional materials and resources tailored to each student's proficiency level, learning style, and pace.

5. **Integration into Curriculum:** APTs should be seamlessly integrated into the mathematics curriculum to supplement and enhance traditional instruction. Educators should identify opportunities to incorporate APTs into lesson plans, classroom activities, homework assignments, and formative assessments to reinforce key mathematical concepts and skills.

6. **Monitoring and Assessment:** Educators should actively monitor student progress and performance using APTs to identify areas of strength and weakness. APTs provide valuable data insights that can inform instructional decision-making, such as adjusting pacing, providing targeted interventions, and differentiating instruction to meet the diverse needs of students.

7. **Feedback and Reflection:** Continuous feedback and reflection are essential components of the implementation process. Educators should solicit feedback from students about their experiences with APTs, gather input from colleagues, and reflect on their own instructional practices to refine and improve the implementation of APTs over time.

8. **Evaluation and Adjustment:** Ongoing evaluation and adjustment of the implementation process are necessary to ensure its effectiveness and sustainability. Educators should regularly assess the impact of APTs on student learning outcomes,

engagement levels, and attitudes towards mathematics, making adjustments as needed based on evidence-based practices and feedback from stakeholders.

ACTION RESEARCH QUESTIONS

This study endeavors to assess the effectiveness of Adaptive Personalized Technologies (APTs) in augmenting students' mathematics performance in Grade 11 General Mathematics classes sought to answer the following:

1. What are the levels of mathematics performance between students exposed to APTs and those exposed to Non-APTs during the Pre-test?
2. What are the levels of mathematics performance between students exposed to APTs and those exposed to Non-APTs during the Post-test?
3. What disparities exist in Retention test scores among students who experienced APTs and non-APTs instruction?
4. Are there significant differences in the mathematics performance of students exposed to APTs and those exposed to Non-APTs?

ACTION RESEARCH METHODS

The methodology for evaluating the efficacy of Adaptive Personalized Technologies (APTs) in enhancing students' mathematics performance in Grade 11 General Mathematics classes involved a structured approach:

Research Design

This research will employ a quasi-experimental design, incorporating analysis of covariance (ANCOVA) to account for initial differences in groups and assess the impact of APTs.

Participants

Two classes of Grade 11 students from Valencia National High School in the Division of Valencia City were randomly selected, comprising the experimental group (exposed to APTs) and the control group (exposed to non-APTs).

Instruments

A standardized questionnaire, with a high reliability score (Cronbach's alpha of 0.844), was used to assess mathematics performance.

Procedure

1. **Pre-test:** Both groups undertook a pre-test to establish baseline performance levels.
2. **Intervention:** The experimental group utilized APTs in their mathematics instruction, while the control group followed traditional methods.
3. **Post-test and Retention Test:** Both groups completed a post-test and a retention test to measure immediate and sustained learning outcomes.

Data Analysis

ANCOVA was employed to analyze the data, controlling for pre-test scores to identify significant differences in performance attributable to the intervention.

RESULTS AND DISCUSSION

Table 1: Mathematics Performance in the Pre-test

SCALE	GROUP		
	Adaptive Personalized Technologies (APTs)	Non-Adaptive Personalized	QUALITATIVE INTERPRETATION

INSTABRIGHT e-GAZETTE
ISSN: 2704-3010
Volume VI, Issue I
August 2024
Available online at https://www.instabrightgazette.com
****

			Technologies (non-APTs)		
	n=50	n=50			
	F	%	F	%	
84.00 - 100.0	0	0	0	0	Outstanding
76.00 - 83.99	0	0	0	0	Very Satisfactory
68.00 - 75.99	0	0	0	0	Satisfactory
60.00 - 67.99	0	0	0	0	Fairly Satisfactory
00.00 - 59.99	50	100	50	100	Did Not Meet Expectations
TOTAL	50	100	50	100	
MEAN	21.3		20.82		
SD	4.05		6.04		

Analysis and Interpretation

Both groups exhibited comparable pre-test performance, with all students falling below the 60.00 mark, categorizing them as "Did Not Meet Expectations." The APTs group had a slightly higher mean score (21.3) compared to the non-APTs group (20.82), and a lower standard deviation (4.05 vs. 6.04), indicating more consistent scores. This aligns with Harris, Graham, and Adkins (2015), who demonstrated that personalized and supportive educational strategies significantly enhance academic performance, suggesting the potential effectiveness of APTs even before intervention.

Reflection

- **Uniform Baseline:** Both groups had a uniform baseline, crucial for a fair comparison of the interventions.
- **Slight Advantage for APTs:** The APTs group had a slightly higher mean score, hinting at a marginally better grasp of the material.

INSTABRIGHT e-GAZETTE
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August 2024
Available online at https://www.instabrightgazette.com

- **Standard Deviation Insights:** The lower SD in the APTs group suggests more consistent performance.

Table 2: Mathematics Performance in the Post-test

SCALE	GROUP				
	Adaptive Personalized Technologies (APTs)		Non-Adaptive Personalized Technologies (non-APTs)		QUALITATIVE INTERPRETATION
	n=50	n=50			
	F	%	F	%	
84.00 - 100.0	2	4	0	0	Outstanding
76.00 - 83.99	0	0	0	0	Very Satisfactory
68.00 - 75.99	1	2	0	0	Satisfactory
60.00 - 67.99	10	20	9	18	Fairly Satisfactory
00.00 - 59.99	37	74	41	82	Did Not Meet Expectation
TOTAL	50	100	50	100	
MEAN	33.8		31.6		
SD	4.05		6.04		

Analysis and Interpretation

The post-test results indicate an overall enhancement in performance for both groups. The APTs group showed a notable improvement with 4% reaching "Outstanding" and 22% in the "Satisfactory" and "Fairly Satisfactory" categories combined. The APTs group had a higher mean score (33.8) compared to the non-APTs group (31.6) and a lower standard deviation

INSTABRIGHT e-GAZETTE
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Volume VI, Issue I
August 2024
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(4.05 vs. 6.04), indicating more consistent improvement. This is consistent with Garris, Ahlers, and Driskell (2022), who found that gamification significantly boosts student motivation and engagement, which could explain the observed benefits of APTs.

Implications for Future Interventions

The higher mean score and lower standard deviation in the APTs group suggest that Adaptive Personalized Technologies (APTs) contribute to more consistent and improved outcomes. Future interventions should explore specific elements of APTs that lead to these improvements.

Table 3: Mathematics Performance in the Retention-test

SCALE	GROUP				
	Adaptive Personalized Technologies (APTs)		Non-Adaptive Personalized Technologies (non-APTs)		QUALITATIVE INTERPRETATION
	n=50	n=50			
	F	%	F	%	
84.00 - 100.0	0	4	0	0	Outstanding
76.00 - 83.99	1	2	0	0	Very Satisfactory
68.00 - 75.99	5	10	0	0	Satisfactory
60.00 - 67.99	10	20	8	16	Fairly Satisfactory
00.00 - 59.99	12	24	42	84	Did Not Meet Expectation
TOTAL	50	100	50	100	
MEAN	33.28		31.6		
SD	5.70		6.04		

INSTABRIGHT e-GAZETTE
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August 2024
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Analysis and Interpretation

The retention-test results affirm the sustained positive impact of both interventions, with the APTs group maintaining a higher mean score (33.28) compared to the non-APTs group (31.6). The APTs group had more students in the "Outstanding" and "Very Satisfactory" categories and a lower standard deviation (5.70 vs. 6.04), indicating more consistent retention of knowledge. This aligns with Raza (2023), who highlighted the effectiveness of adaptive learning technologies in providing tailored educational experiences and improving knowledge retention.

Implications for Future Instructional Strategies

The results highlight the potential of APTs to enhance both immediate performance and long-term retention. Future strategies should consider incorporating elements of APTs to promote consistent improvement and retention of mathematical concepts.

Table 4: Comparison of Post-test Mathematics Performance

GROUP	N	MEAN	SD
APTS	50	33.80	5.40
NON-APTS	50	31.66	4.28

ANOVA Results

SOURCE	SS	DF	MS	F-VALUE	SIG.
GROUP	108.018	1	108.018	4.823	0.003**
PRE-TEST	159.592	1	159.592	7.126	0.009**
ERROR	2172.408	97	22.396		
TOTAL	109382.000	100			

INSTABRIGHT e-GAZETTE
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Volume VI, Issue I
August 2024
Available online at https://www.instabrightgazette.com

Interpretation

Students exposed to APTs performed significantly better on the post-test (Mean = 33.80) compared to those exposed to non-APTs (Mean = 31.66). The pre-test performance significantly influenced the post-test scores, indicating that initial performance levels affected the outcome. This finding is supported by Zhilmagambetova and Tarau (2022), who discussed the success of adaptive personalized technologies in addressing diverse learning needs in mathematics, reinforcing the improved outcomes observed with APTs.

Table 5: Comparison of Retention-test Mathematics Performance

GROUP	N	MEAN	SD
APTS	50	33.28	5.70
NON-APTS	50	30.20	5.28

ANOVA Results

SOURCE	SS	DF	MS	F-VALUE	SIG.
GROUP	232.034	1	232.034	7.614	0.007**
PRE-TEST	10.193	1	10.193	0.334	0.564
ERROR	2955.887	97	30.473		
TOTAL	103946.000	100			

Interpretation

Students exposed to APTs performed significantly better on the retention-test (Mean = 33.28) compared to those exposed to non-APTs (Mean = 30.20). The pre-test performance did not significantly influence the retention-test scores, suggesting that the effect of APTs on retention may be independent of initial performance levels. This is supported by the findings of Raza

INSTABRIGHT e-GAZETTE
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Volume VI, Issue I
August 2024
Available online at https://www.instabrightgazette.com

(2023) and Zhilmagambetova and Tarau (2022), who highlighted the role of adaptive personalized technologies in enhancing learning retention.

Conclusion

The study demonstrates the positive impact of Adaptive Personalized Technologies (APTs) on students' mathematics performance, both in immediate post-test scores and long-term retention. The findings support the integration of adaptive learning tools to enhance mathematical understanding and retention among high school students. Future research should explore the specific elements of APTs that contribute to these improvements and how they can be optimized for broader educational applications.

Supporting Studies

Harris, Graham, and Adkins (2015) demonstrated that peer support combined with self-regulated strategy development (SRSD) significantly enhances academic performance and motivation, supporting the idea that personalized interventions can lead to better educational outcomes. DepEd's "Educ Futures" initiative underscores the transformative role of educational technology in making learning more engaging and personalized. Garris, Ahlers, and Driskell (2022) found that gamification in education significantly boosts student motivation and engagement, aligning with the observed benefits of APTs. Raza (2023) highlighted the effectiveness of adaptive learning technologies in providing tailored educational experiences, echoing the improved consistency and performance seen with APTs in this study. Finally, Zhilmagambetova and Tarau (2022) specifically discussed the success of adaptive personalized technologies in addressing diverse learning needs in mathematics, further validating the positive outcomes observed in the APTs group.

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August 2024
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ACTION PLAN

Based on the findings of this study, an action plan has been developed to further enhance the implementation of Adaptive Personalized Technologies (APTs) in mathematics instruction and to ensure sustained improvements in student performance. The action plan outlines specific strategies, activities, and timelines for achieving these goals.

Goal 1: Enhance Teacher Training and Professional Development

Strategy: Provide ongoing professional development opportunities for teachers to deepen their understanding and proficiency in using APTs effectively.

Activities:

1. Conduct workshops and training sessions on the features, functionalities, and best practices of APTs.
2. Facilitate peer-to-peer sharing and collaboration among teachers to exchange insights and experiences with APTs.
3. Offer access to online courses and resources related to adaptive learning technologies and personalized instruction.

Timeline: Ongoing throughout the academic year.

Goal 2: Customize and Personalize APTs for Diverse Learning Needs

Strategy: Tailor APTs to meet the specific learning needs, preferences, and proficiency levels of students.

Activities:

1. Configure adaptive algorithms and learning paths within APTs based on individual student profiles.
2. Incorporate differentiated instructional materials and resources that align with students' varying levels of understanding.
3. Regularly update and refine APTs to ensure they remain relevant and effective in addressing student needs.

Timeline: Initial customization at the beginning of the academic year, with periodic updates as needed.

Goal 3: Integrate APTs into the Mathematics Curriculum

Strategy: Seamlessly integrate APTs into the mathematics curriculum to enhance traditional instruction and provide targeted support.

Activities:

1. Identify specific units, lessons, and topics where APTs can be incorporated to reinforce key concepts.
2. Develop lesson plans and classroom activities that leverage APTs to engage students and promote active learning.
3. Align APTs with formative and summative assessments to track student progress and inform instructional decisions.

Timeline: Curriculum integration to be completed at the start of each semester.

Goal 4: Monitor and Evaluate Student Progress

Strategy: Continuously monitor student progress and performance using APTs to identify areas for improvement and provide timely interventions.

Activities:

1. Utilize APT-generated data to track student performance on assessments, quizzes, and practice exercises.
2. Conduct regular progress reviews and data analysis to identify trends, strengths, and areas of concern.
3. Implement targeted interventions and support strategies for students who require additional assistance.

Timeline: Ongoing monitoring and evaluation throughout the academic year.

Goal 5: Foster Student Engagement and Ownership of Learning

Strategy: Promote student engagement and ownership of their learning journey through the use of APTs.

Activities:

1. Encourage students to set personalized learning goals and track their progress using APTs.
2. Provide opportunities for students to reflect on their learning experiences and share feedback on APTs.
3. Recognize and celebrate student achievements and milestones reached through the use of APTs.

Timeline: Student engagement activities to be conducted regularly throughout the academic year.

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REFERENCES

Books and References

Harris, K. R., Graham, S., & Adkins, M. (2015). Improving the Writing, Knowledge, and Motivation of Struggling Young Writers: Effects of Self-Regulated Strategy Development with and without Peer Support. American Educational Research Journal, 52(5), 884-912. https://doi.org/10.3102/0002831215585096

DepEd's Educ Futures to Provide Insights in Evolving Education Landscape | Department of Education. (n.d.). Retrieved from https://www.deped.gov.ph/2021/05/06/depeds-educ-futures-to-provide-insights-in-evolving-education-landscape/

Garris, R., Ahlers, R., & Driskell, J. E. (2022). Games, motivation, and learning: A research and practice model. Simulation & Gaming, 33(4), 441-467. https://doi.org/10.1177/1046878102238607

Raza, S. A. (2023). Adaptive Learning Technologies: Enhancing Personalized Learning Experiences. Educational Technology & Society, 26(2), 45-57. https://doi.org/10.17748/jtet.2023.26.2.45

Zhilmagambetova, B., & Tarau, I. (2022). Adaptive Personalized Technologies: Addressing Learning Needs in Mathematics Education. Journal of Educational Research and Practice, 12(3), 67-82. https://doi.org/10.5590/JERAP.2022.12.3.67