Integration of Technology in Teaching Mathematics: Assessing the Influence of Digital Pedagogy on Learning Engagement and Achievement among Grade 8 Students

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ABSTRACT

The influence of adaptive learning technologies, as technology emerges today, plays a pivotal role in maximizing the potential of technology to enhance mathematics performance. This study aimed to explore teachers' technology integration and assess the impact of digital pedagogy on students' learning engagement and achievement in Grade 8 Mathematics. The study employed the evaluative and descriptive correlational research design to comprehensively investigate the impact of teachers' technology integration and digital pedagogy on students' learning engagement and achievement in Grade 8 Mathematics. A simple random sampling technique was used to determine the study's respondents, composed of 59 teachers and 348 students from selected secondary schools in Division of Sultan Kudarat. Appropriate statistical tools such as mean, standard deviation, Spearman's rho correlation, and Pearson's product-momentum correlation were utilized to analyze the data. Moreover, findings revealed that teachers' technology integration is very high, while teachers' digital pedagogy and students' engagement are high. Furthermore, students' achievement in Grade 8 mathematics is average. Likewise, teachers' technology integration and students' learning engagement are significantly correlated. Similarly, digital pedagogy and achievement in mathematics are found to be significantly correlated. This implies that with the proper utilization of technological tools, when teachers exhibit high digital pedagogy on the effective use of technological tools, the student's achievement in mathematics improves. Thus, teachers should continuously develop their skills in utilizing technology coupled with effective digital pedagogy to arouse students' learning engagement. When learners are engaged, their academic achievement improves.

Keywords: Technology Integration, Digital Pedagogy, Students' Learning Engagement, Achievement

INTRODUCTION

In recent years, technology integration into education has garnered attention and transformed conventional teaching methods. With the widespread availability of digital devices and interactive learning tools, educators have increasingly incorporated technology into various subjects, including mathematics. The integration of technology in teaching mathematics, often referred to as digital pedagogy, aims to enhance students' learning engagement and academic achievement.

Lectures, textbooks, and tedious problem-solving activities are frequently used in traditional mathematical education. This method has occasionally caused students to get disengaged and learn things poorly. Technology integration in mathematics instruction offers creative ways to involve students, advance conceptual comprehension, and deliver individualized learning experiences. Mathematics instruction can be

interactive and dynamic due to the emergence of numerous digital tools and platforms such as but not limited to Lumi, GeoGebra, Wolfram Alpha, Khan Academy, Jam board, Didax, and many more. Students have the capability to explore mathematical ideas in a concrete and interesting way, which makes learning more visible and participatory (Ke & Grabowski, 2019).

However, it is widely acknowledged that mathematics performance among Filipino students has been a concern over the years. Bautista, et al., (2013) examined the mathematics performance of Filipino students using data from TIMSS. Filipino students' performance of in mathematics was relatively low compared to other countries. Moreover, Southeast Asian Ministers of Education Organization (SEAMEO, 2016) highlighted the challenges faced by the Philippines in improving mathematics education. The report mentioned issues such as not enough teachers' training, lack or limited number of resources, and inadequate curriculum alignment with international standards.

According to recent educational assessments, students in the Division of Sultan Kudarat have exhibited concerning trends in mathematics literacy and performance. The National Achievement Test (NAT) results from the Department of Education (DepEd) reveal that a significant portion of students in the division are not achieving satisfactory levels of mathematics proficiency. These results are consistent with findings from the study conducted by Garcia (2020), which highlighted the prevalent struggles students face in comprehending mathematical concepts and solving complex problems.

Technology integration in math classes has been demonstrated to improve student learning achievements. Studies have found that using virtual aids in elementary mathematics improves students' conceptual understanding and problem-solving abilities (Moyer-Packenham et al., 2016), and the benefits of digital tools and platforms (Brown & Jones, 2019). However, there remains a significant research gap regarding the specific aspects of digital pedagogy that contribute to improved achievement in mathematics (Smith, 2018) and limited research focusing on the effectiveness of different instructional strategies, the influence of adaptive learning technologies in maximizing the potential of technology integration in secondary level mathematics education.

The lack of thorough study on the local and comprehensive consequences of integrating technology into mathematics instruction, with a specific emphasis on the impact of digital pedagogy on students' learning engagement, represents the research gap in Division of Sultan Kudarat. The advantages of technology integration into education are being highlighted by an increasing amount of research worldwide, but few studies particularly address this problem in Sultan Kudarat Division's local educational setting. This sparked the researcher's interest in figuring out how digital pedagogy affected the learning engagement and achievement of Grade 8 students.

METHODOLOGY

Research Design

This study employed the evaluative and descriptive correlational research design to comprehensively investigate the impact of teachers' technology integration and digital pedagogy on students' learning engagement and achievement in Grade 8 Mathematics. As defined by Borich and Jemekia (1981), evaluative research design aims to inform decision-makers concerning the effects of instruction, program, product, or procedure where data is obtained, analyzed, and synthesized to formulate relevant information. Likewise, it is a form of inquiry that emphasizes judgment (Kushner, 2016). Moreover, the descriptive design aims to describe individuals, events, and or conditions by treating and studying them as they are in nature. It seeks to represent only the variables and/or samples that define the characteristics of a population (Siedlecki, 2020). Adding on, the correlational design focuses on the prevalence of relationships among variables and forecasting data or events from timely data and knowledge. It also involves establishing a relationship between the two variables with the same population or between the same variables with different populations (Curtis et al., 2015).

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In this study, the evaluative research design was used to determine the effects of technology integration and digital pedagogy on mathematics teachers, particularly in Grade 8 Mathematics. More so, the descriptive part of the research design was utilized to determine the level of the four variables in this study: teachers' technology integration, digital pedagogy, students' learning engagement, and achievement in Grade 8 Mathematics. In connection, the correlational design of the study was used to determine the relationship among study variables, specifically the independent and dependent variables.

By employing the evaluative and descriptive correlational design, research will be able to provide a comprehensive overview of the current landscape of technology integration and digital pedagogy in mathematics education and its relationship with students' learning engagement and academic achievement. The findings would contribute valuable insights into the potential impact of digital pedagogy on fostering a more engaging and interactive learning environment for students in the realm of mathematics.

Research Locale

The study was conducted in the selected secondary schools of the Division of Sultan Kudarat, Province of Sultan Kudarat. In order to select the respondents' schools, the school must be categorized in to large school due to the presence of various educational practices, teaching methods, or resources that can contribute to the richness of the study. This diversity can help draw meaningful conclusions about the impact of technology integration and digital pedagogy on students' learning engagement.

Respondents of the Study

This study used the teachers, including the Grade 8 students from selected secondary schools in the Division of Sultan Kudarat, as the respondents. As emphasized by Patino and Ferreira (2018), in establishing high-quality research, it is essential to determine the main attributes of the target population that the researchers used to be part of the study and answer the study's research questions, which may include demographic, clinical, geographical characteristics, etc. Hence, in selecting the respondents of the study, the respondents must meet the following criteria set by the researcher:

1. The teacher-respondents must be a permanent teacher of Department of Education;

2. The teacher-respondent is teaching mathematics;

3. The students are officially enrolled in their respective school year 2024 – 2025, and

4. The students are in grade 8.

By meeting these inclusion criteria, the researcher ensures that all the data that can be derived from the respondents are valid.

Research Instrument

The researcher used a survey questionnaire to gather the data for this study. The research instrument is composed of four parts: Part I assessed the teachers' technology integration in teaching mathematics, Part II assessed the teachers' digital pedagogy in teaching mathematics, Part III assessed the student's learning engagement, and Part IV assessed the student's achievement in Grade 8 Mathematics.

Part I of the research instrument is adapted from Ravitz (2014) study. It consists of ten-item statements that measure teachers' technology integration in teaching mathematics. The respondents rated this research instrument using the Five-point Likert-type scale parameters adopted from Simpal and Pidor (2024), presented in the table below.

Table 1. Five-point Likert Type Scale Parameters

Scale	Verbal Responses	Interpretation
5	Strongly Agree (SA)	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is highly observed.
4	Agree (A)	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is observed.
3	Moderately Agree (MA)	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is moderately observed.
2	Disagree (D)	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is less observed.
1	Strongly Disagree (SD)	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is not observed.

In order to interpret the respondents' responses, the following mean range, presented in Table 2, was used to give meaning to their ratings.

Table 2. Five-point Likert Type Scale Interpretation

Mean Range	Descriptive Level	Interpretation
4.20 – 5.00	Very High	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is highly observed.
3.40 – 4.19	High	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is observed.
2.60 – 3.39	Moderately High	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is moderately observed.
1.80 – 2.59	Low	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is less observed.
1.00 – 1.79	Very Low	The item statement regarding teacher technology integration in teaching Grade 8 Mathematics is not observed.

Part II of the research instrument was adapted from Handal et al. (2013), which assesses the teacher's digital pedagogy. It consists of two indicators: digital content knowledge and digital teaching pedagogy. Each indicator consists of ten items that measure the digital pedagogy of mathematics teachers. To get the respondents' responses, a five-point Likert-type scale adopted from Simpal and Pidor (2024) was used to rate each item in the digital pedagogy questionnaire. The table below presents the rating scale.

Table 3. Five-point Likert Type Scale Parameters

Scale	Verbal Responses	Interpretation
5	Strongly Agree (SA)	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is highly demonstrated.
4	Agree (A)	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is demonstrated.
3	Moderately Agree (MA)	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is Moderately demonstrated.
2	Disagree (D)	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is less demonstrated.
1	Strongly Disagree (SD)	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is not demonstrated.

In order to interpret the respondents' responses, the following mean range, presented in Table 4, was used to give meaning to their ratings.

Table 4. Five-point Likert Type Scale Interpretation

Mean Range	Descriptive Level	Interpretation
4.20 – 5.00	Very High	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is highly demonstrated.
3.40 – 4.19	High	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is demonstrated.
2.60 – 3.39	Moderately High	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is Moderately demonstrated.
1.80 – 2.59	Low	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is less demonstrated.
1.00 – 1.79	Very Low	The item statement regarding the digital pedagogy of my mathematics teacher in Grade 8 is not demonstrated.

Part III of the research instrument is adapted from Duya (2020), which assessed the students' learning engagement in mathematics with technology integration. The survey questionnaire comprises four indicators: learner's motivation, learner's cognition, learner's interaction, and delivery of the lesson. Each indicator consists of five item statements to extract the necessary data from respondents about their engagement in Mathematics. The respondents rated the questionnaire using the Five-point Likert-type scale adopted from Simpal and Pidor (2024). The table below shows the rating scale.

Table 5. Five-point Likert Type Scale Parameters

Scale	Verbal Responses	Interpretation
5	Strongly Agree (SA)	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is highly observed.
4	Agree (A)	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is observed.
3	Moderately Agree (MA)	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is moderately observed.
2	Disagree (D)	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is less observed.
1	Strongly Disagree (SD)	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is not observed.

In order to interpret the respondents' responses, the following mean range, presented in Table 6, was used to give meaning to their ratings.

Table 6. Five-point Likert Type Scale Interpretation

Mean Range	Descriptive level	Interpretation
4.20 – 5.00	Very High	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is highly observed.
3.40 – 4.19	High	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is observed.
2.60 – 3.39	Moderately High	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is moderately observed.
1.80 – 2.59	Low	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is less observed.
1.00 – 1.79	Very Low	The item statement regarding the student's learning engagement with the technology integration in Grade 8 Mathematics is not observed.

Lastly, part IV of the research instrument pertains to students' achievement in Grade 8 Mathematics adopted from Ortiz composed of 40 items multiple choice questions. The research questionnaire aims to assess students' achievement in Grade 8 Mathematics and is composed of multiple-choice questions. The scoring system for this research questionnaire has a one-point equivalent score for each correct response from the respondents. Their score will be tabulated and used to interpret their academic achievement.

In order to give meaning to the scores of the students from the achievement test of Grade 8 mathematics, the following criteria adopted from the DepEd Memorandum No. 160, series of 2012 is used.

Table 7. Mastery/Achievement Level of the Students

MPS	Descriptive Equivalent
96% - 100%	Mastered
89% - 95%	Closely Approximate Mastery
66% - 85%	Moving Towards Mastery
35% - 65%	Average
15% - 34%	Low
5% - 14%	Very Low
0 - 4%	Absolutely No Mastery

To certify that the survey questionnaires are valid and reliable, the research instrument was subjected to validation by experts. Six master teachers and doctorate holders were asked to validate the research instrument. These master teachers with a doctorate serve as the expert validators of the survey questionnaires. Their comments, suggestions, and recommendations were integrated into the final version of the research instrument. The analysis of the validation results found that the research instrument is valid and within acceptable range of item level content validity index (I-CVI) and scale content validity index (S-CVI) following the methods of Yusoff (2019).

After the validation process, a pilot test was done to ensure the reliability of the research instrument. The study's respondents in the pilot test procedure were not be included in the actual respondents of the study. The reliability test, by determining its internal consistency, ensured that Cronbach's alpha of the survey questionnaire is within the accepted range. This ensures that the overall research instrument measures what it intends to measure before implementing the study.

In particular, for the technology integration variable, the overall Cronbach's Alpha is .950, interpreted as excellent. More so, variable two which pertains to digital pedagogy has an overall Cronbach's Alpha of .934, interpreted as excellent reliability. Likewise, the students' engagement obtained an overall Cronbach's Alpha of .936, interpreted as excellent.

This validity and reliability procedure aligns with the suggestion of Kimberlin and Winterstein (2008), who underscores that most of the variables of interest in social sciences are outcomes of an important abstract known as theoretical constructs. Thus, utilizing a valid and reliable instrument to measure the specific constructions is vital to research quality.

Data Gathering Procedure

To realize this study, the researcher underwent the following procedure: Upon the approval of the research study and permission from the graduate school, a transmittal letter was sent to the office of the schools division Superintendent for approval. Upon the approval of the division office, the permission letter was sent to the selected secondary school heads within the division to ask for approval to conduct the study by asking their teachers and students to answer the survey questionnaires. Upon the approval of the letter, the researcher was then conducting an orientation to the teacher and student respondents regarding the purpose of the study, followed by the implementation of a sampling technique to get the actual respondents of the study who will be given the survey questionnaire.

The survey questionnaire was disseminated to every recognized junior high school mathematics teacher and randomly selected students, accompanied by a letter elucidating the study's objectives and emphasizing the voluntary nature of participation. The research instrument consists of teachers' technology integration, digital pedagogy, and students' learning engagement and academic achievement in Grade 8 Mathematics. After which, the researcher retrieved the questionnaire after its completion. The researcher carefully examined each response to ensure completeness and consistency. Any incomplete or unclear answers would be clarified by reaching out to the respective respondents. Lastly, the collected data were tabulated, analyzed, and interpreted.

As emphasized by Mazhar et al. (2021), data gathering procedure involves following the step-by-step protocols in outlining the research plan focusing on the vital aspect of the data collection method that is to safeguard information and unswerving data collected for statistical analysis in making data-driven decision making. The figure in the next page illustrates the flow of data gathering procedure.

RESULTS AND DISCUSSION

Technology Integration in Mathematics

As shown in Table 8, the extent of technology integration in teaching mathematics is measured using a 10-item statements rated through a Five-point type Likert scale. As can be seen, the results obtained a mean range from 4.13 to 4.37 respectively. Likewise, the computations yielded an overall mean of 4.25 described as very high. This implies that the teacher technology integration in teaching grade 8 mathematics in the selected secondary schools in the Division of Sultan Kudarat is highly observed. Moreover, the overall standard deviation of .653 is less than 1 indicative of a minimal dispersion among the responses of the respondents.

In particular, the item "*shares and presents the lesson in Grade 8 Mathematics class like multimedia presentations using sound or video, presentation software, blogs, podcasts, etc.,*" obtained a highest mean of 4.37 (SD=.740) described as very high. This indicates that the technology integration of teachers on this aspect in teaching grade 8 mathematics is highly observed. More so, the item "*uses technology to interact directly with experts or local/global mathematics community members*" garnered a lowest mean of 4.13 (SD = .819) interpreted as high. This suggests that the technology integration of teachers in teaching grade 8 mathematics in terms of this aspect is observed.

Table 8. Extent of Technology Integration in Teaching Mathematics

Items	Mean	SD	Descriptive Level
1. Uses technology or internet for self-instruction in Grade 8 Mathematics classes like Khan Academy or other videos, tutorials, self-instructional websites, etc.	4.27	.784	Very High
2. Selects appropriate technology tools or resources for completing a task and learning Grade 8 Mathematics concepts.	4.32	.753	Very High
3. Uses technology to analyze information like databases, spreadsheets, graphic programs, etc.	4.25	.801	Very High
4. Shares and presents the lesson in Grade 8 Mathematics class like multimedia presentations using sound or video, presentation software, blogs, podcasts, etc.	4.37	.740	Very High
5. Uses technology to support teamwork or collaboration among students in Grade 8 Mathematics activity like shared workspaces, email exchanges, giving and receiving feedback, etc.	4.16	.723	High
6. Uses technology to interact directly with experts or local/global mathematics community members.	4.13	.819	High
7. Uses technology to keep track of students' work on extended tasks or assignments in Grade 8 Mathematics.	4.23	.703	Very High
8. Tries to develop student's skills in using technology as a tool for learning Grade 8 Mathematics concepts.	4.22	.811	Very High
9. Makes students learn to use technology in class as a tool for learning Grade 8 Mathematics concepts.	4.28	.720	Very High
10. Assess students' skills effectively in Grade 8 Mathematics activities using technology for learning.	4.27	.739	Very High
Overall Mean	**4.25**	**.653**	**Very High**

Legend: 4.20 – 5.00 = Very High; 3.40 – 4.19 = High; 2.60 – 3.39 = Moderately High;
1.80 – 2.59 = Low; 1.00 – 1.79 = Very Low

In connection, the results of the study suggest that teachers teaching grade 8 mathematics are indeed embedding technology to the learning process of teaching mathematics. Teachers are more likely to use technological tools to present their lessons which include the use of audio-video presentations like the Khan academy, tutorial videos, interactive self-instruction websites and podcasts to make the learning more meaningful to the learners. It is also observed that teachers are using shared workspaces like email exchanges to give feedbacks which promote collaboration among students, this includes the utilization of technology to assess and give feedbacks to the students. Adding on, teachers are also equipped with exposing students to the use of technological software for database like the use of spreadsheets and visual diagram to analyze and present information comprehensively which nurture students' mathematical skills.

The findings of the study aligned with the study of Larkin and Calder (2016) who underscores that an integration of technological tools like the spreadsheet, digital calculator, and software applications have been a long-standing legacy that mathematics teachers have been doing. In fact, Trgalová et al. (2018) mentioned that the long tradition of didactic approach in teaching evolved and expanded when technology has integrated in the teaching process. More so, Flood et al. (2020) emphasized that the use of technological advancements like the utilization of multimedia through audio-video presentation, videos, and other supplemental technological applications can facilitate the transfer of meaningful learning. Thus, the rapid advancement in technology today fundamentally altered how mathematics is taught and learned (Attard et al., 2020).

Teachers' Digital Pedagogy

As shown in Table 9, the extent of mathematics teachers' digital pedagogy comprises two indicators such as digital content knowledge and digital teaching pedagogy. Each indicator composed of 10-item statements used to measure the domains. Computations yielded a mean ranging from 3.92 to 4.09. The generated overall mean is 4.01 described as high. This implies that the mathematics teachers' digital pedagogy among educators in the Division of Sultan Kudarat is demonstrated. Moreover, the overall standard deviation is .502 which is less than 1 indicative of a minimal dispersion among the respondents' responses.

Table 9. Extent of Mathematics Teachers' Digital Pedagogy

Indicators	Mean	SD	Descriptive Level
1. Digital Content Knowledge	3.92	.571	High
2. Digital Teaching Pedagogy	4.09	.534	High
Overall Mean	**4.01**	**.502**	**High**

Legend: 4.20 – 5.00 = Very High; 3.40 – 4.19 = High; 2.60 – 3.39 = Moderately High;
1.80 – 2.59 = Low; 1.00 – 1.79 = Very Low

More so, the indicator "*digital teaching pedagogy*" garnered a highest mean rating score of 4.09 (SD = .534), described as high. This indicates that digital teaching pedagogy in teaching grade 8 mathematics among mathematics teachers is demonstrated. Adding on, the indicator *"digital content knowledge"* obtained the lowest mean rating score of 3.92 (SD = .571), interpreted as high. This suggests that digital content knowledge of mathematics teachers in teaching grade 8 mathematics is demonstrated.

Furthermore, the results of the study point out to the idea that teacher's digital pedagogy in mathematics is consistently demonstrated in their classroom teaching process, particularly in teaching grade 8 mathematics. The high level of digital pedagogy among teachers reciprocates to their ability to utilize technology to effectively deliver lesson and apply their content knowledge for effective use of technological tools inside the classroom. More so, teachers are flexible enough in utilizing different ways of teaching mathematics through the aid of technological tools like the use of simulator, animator, and online applications which models a more in-depth mathematical contents, that can be considered as contributing factor towards meaningful learning experiences among students.

The findings of the study are congruent with the study of Sinclar (2020) who underscores that technological content knowledge and technological pedagogical knowledge of the teachers on the utilization of various

educational technologies altered the mathematical context that is taught and influence teachers' instruction in mathematics. Attard et al. (2020) stressed that the nature of complexity in teaching mathematics as well as the methods needed to deliver it changes when the technology emerges in teaching mathematics. This is due to the contextual knowledge and awareness acquired by the teachers on how these technologies can be harnessed in teaching mathematics that leads to meaningful transfer of knowledge (Mishra, 2019).

Students' Engagement in Mathematics

As presented in table 10, the extent of students' engagement in mathematics comprises four indicators namely; learner's motivation, learner's cognition, learner's interaction, and delivery of the lesson. Each domain has 5-item statements used to measure the extent of students' engagement through the used of Five-point Likert type scale. As can be observed, the computed means are ranging from 4.02 to 4.16 respectively. The computations yielded an overall mean of 4.09 interpreted as high. This indicates that students' engagement in grade 8 mathematics is observed. Moreover, there is a minimal dispersion on the students' responses as manifested in the obtained overall standard deviation of .492.

Table 10. Extent of Students' Engagement in Mathematics

Indicators	Mean	SD	Descriptive Level
1. Learner's Motivation	4.16	.565	High
2. Learner's Cognition	4.02	.565	High
3. Learner's Interaction	4.12	.588	High
4. Delivery of the Lesson	4.05	.565	High
Overall Mean	**4.09**	**.492**	**High**

Legend: 4.20 – 5.00 = Very High; 3.40 – 4.19 = High; 2.60 – 3.39 = Moderately High;

1.80 – 2.59 = Low; 1.00 – 1.79 = Very Low

More so, by looking at the individual domain, the indicator *"leaner's motivation"* obtained the highest mean rating score of 4.16 (SD = .565), interpreted as high. This suggests that students' engagement in the aspect of learner's motivation in grade 8 mathematics is observed. In connection, the indicator "*learner's cognition*" got the lowest mean rating score of 4.02 (SD = .565), interpreted as high. This underscores that the students' engagement in the aspect of learner's cognition in learning grade 8 mathematics is observed.

This result suggests that there is enough evidence that students are engaged in learning mathematics particularly when technology integrated. The students are more motivated and interested to attend their mathematics lesson when technological tools are used to deliver it. The positive use of multimedia provides opportunities for students to explore the underlying mathematical concepts of a topic. Through technology integration, students are actively engaged in class discussion throughout the lesson, thus, making it more engaging while learning meaningfully in their mathematics class. Furthermore, students have a wide grasp of the mathematical concepts when technology is use for illustration like the graph, diagram, and models which make the discussion more interesting.

These findings are aligned with the study of Boaler (2016), who underscores that students do not inherently possess an interest in learning mathematics. Still, with the careful application of appropriate teaching strategies, they have the potential to become engaged in learning and show interest and motivation to learn. In connection, Yeh et al. (2019) emphasized that teaching innovation, such as using emerging technologies, triggers students' interests and abilities to engage with the learning process. In fact, Sidabutar (2016) mentioned that innovative teaching through the integration of technology elevates student engagement, which maximizes learning outcomes. Thus, using technology in mathematics classes improved student interest and engagement, which elevated their mathematics performance (Lavin et al., 215).

Students' Achievement

As presented in Table 11, the extent of students' achievement in Grade 8 mathematics is measured using a well-validated multiple choices questionnaire design to determine the achievement in mathematics which comprises 40-items multiple choices. In particular, as can be gleaned from the table, the mean percentage score is registered 64.76 (SD = 5.07), which interpreted as average. This means that the achievement of grade 8 students in mathematics is within the average level despite the integration of technology.

Table 11. Extent of Students' Achievement in Grade 8 Mathematics

Variable	Mean Percentage Score (MPS)	SD	Descriptive Level
Academic Achievement	64.76	5.07	Average

Legend:

96% - 100% = Mastered;

89% - 95% = Closely Approximate Mastery

66% - 85% = Moving Towards Mastery

35% - 65% = Average

15% - 34% = Low

5% - 14% = Very Low

0 - 4% = Absolutely No Mastery

The study's results suggest that despite the use of technology, the teacher might not fully optimize the utilization of technological tools to cater to students' needs in understanding mathematical concepts. Moreover, the technology used by the teachers does not match the students' actual learning needs, and this cannot be compensated using technology alone. Likewise, integrating technology alone does not guarantee a complete elevation of mathematical skills because teachers' teaching strategies still play a critical role in the learning process.

This finding is aligned with Okeke's (2016) study, which found that digital tools can be useful teaching aids to improve academic achievement, but despite their use, minimal effects have been observed. In fact, Yeh et al. (2019) notices that the substantial number of low achieving students in mathematics is due to the dominance of teacher-directed instruction in mathematics. Students' mathematics achievement has risen due to their diverse abilities and learning needs, thus making it challenging to use one single strategy only in teaching them in math class (Yep et al., 2019).

As highlighted by Cai et al. (2020), the used of interactive technological applications slightly increased students' achievement in mathematics which stimulate learning opportunities for students to learn. Mensahe and Nabie (2021) accentuated that technology improves the learning process inside the classroom. However, its effective use is a pattern that reflects teacher preparedness, continuous development, and attitudes toward using technology to improve academic achievement in mathematics classes.

Teachers' Technology Integration and Students' Learning Engagement

Table 12 presents the significant relationship between teachers' technology integration and students' learning engagement. A Spearman's rho correlation analysis is utilized to determine the significant relationship between the teachers' technology integration and students' learning engagement since the nature of the two data sets is not normally distributed, as obtained from the normality test done by the researcher.

Table 12. Significant Relationship between Teachers' Technology Integration and the Students' Learning Engagement

Variable	Students' Learning Engagement		Remarks
	r_s	*p*-value	
Technology Integration	.621**	.000	Significant

**. Correlation is significant at the 0.01 level (2-tailed).

Moreover, as can be gleaned from the table, the independent and dependent variables have significant correlations ($p<0.01$). In particular, a significant relationship exists between technology integration and students' learning engagement ($r_s = .621$, $p<0.01$). The strength of the correlation between the two variables is a positive moderate correlation, as revealed by its correlation coefficient of .621. This leads to the rejection of H_0 "*There is no significant relationship between the teachers' technology integration and the students' learning engagement."* This implies that as the extent of teachers' technology integration increases, the extent of students' learning engagement increases.

This finding is congruent with the study of Sheenah and Nillas (2010), who underscores that good technology integration has a significant impact on the learning engagement of the students, which necessitates for teachers to have continual development to sustain the positive use of technology inside the classroom. With an increase in the use of technology, students learning engagement and performance have a noticeable increase and are now gaining the spotlight in teaching mathematics inside the classroom (Ali, 2023). Recently, Mufron et al. (2024) reiterated that technology integration in learning mathematics significantly influences the increasing number of students' engagement in class activities inside the classroom. With technology, students can be more adept and creative in acquiring and learning knowledge by integrating technology.

Teachers' Technology Integration and Achievement in Mathematics

As shown in Table 13, the significant relationship between teachers' technology integration and achievement in Grade 8 mathematics was tested using a Spearman's rho correlation. The computation yielded non-significant results between the independent and dependent variables ($p>0.05$). In particular, there is no significant relationship between the teachers' technology integration and achievement in mathematics ($r_s = -.062$, $p>0.05$). This leads to the acceptance of H_0 "*There is no significant relationship between the teachers' technology integration and achievement in Grade 8 Mathematics.*" The results of the analysis suggest that the extent of teachers' technology integration does not directly affect students' mathematics achievement. This further suggests that students' mathematics achievement is not influenced by one single variable, such as technology inside the classroom, as it may be due to various factors like the teaching strategies used by the teacher.

Table 13. Significant Relationship between Teachers' Technology Integration and Achievement in Grade 8 Mathematics

Variable	Achievement		Remarks
	r_s	*p*-value	
Technology Integration	-.062	62.643	Not Significant

The study supports the study of Yep et al. (2019), who emphasized that students' mathematics achievement arises from their diverse abilities and skills, which do not necessarily connect to the technology used by the teachers during the teaching and learning process. In fact, Muslu and Erdun (2019) accentuated that many factors influence the students' mathematics achievement aside from the use of technology inside the classroom; such factors include institutional support, teacher beliefs, and available resources. In support, Briers and Murphy (2005) argued that teachers' technology integration does not directly correlate with the student's academic achievement, as they found that it has an almost negligible correlation based on the obtained correlation coefficient of less than 0.01.

Teachers Digital Pedagogy and Students' Learning Engagement

As presented in Table 14, the significant relationship between teachers' digital pedagogy and students' learning engagement in grade 8 mathematics was tested using Spearman's rho correlation. The analysis generated a non-significant result between the independent and dependent variables ($p>0.05$). In particular, there is no significant relationship between the teachers' digital pedagogy and students' learning engagement ($rs = .205$, $p>0.05$). This leads to the acceptance of H_0 "*There is no significant relationship between teachers' digital pedagogy and students' learning engagement*."

The result of the study indicates that there is not enough sample evidence to show that the extent of digital pedagogy and students' learning engagement are related. This means that student engagement is associated with other factors like teaching strategies, mathematical difficulties, and the effectiveness of technology integration.

Table 14. Significant Relationship between Teachers' Digital Pedagogy and Students Learning Engagement

Variable	Students' Learning Engagement		Remarks
	r_s	*p*-value	
Digital Pedagogy	.205	.120	Not Significant

The study's findings are congruent with the study of Perienen (2020), who underlined that the digital pedagogy of the teachers does not always reciprocate to increase students' learning engagement, especially teachers with a lack of training and knowledge on the effective use of technology. In fact, Rajabalee et al. (2020) emphasized that the influence of digital pedagogy on learning engagement exists only for those with high-performing students. Still, on the contrary, it seems to have an almost negligible relationship for low-performing learners. This can be attributed to students' diverse needs, which cannot be singled out only by integrating digital pedagogy in teaching Mathematics (Yep et al., 2019).

Teachers' Digital Pedagogy and Achievement in Grade 8 Mathematics

Table 15 shows the significant relationship between the teachers' digital pedagogy and Achievement in Grade 8 mathematics tested using Pearson's correlation. The computations yielded a significant relationship between the independent and dependent variables ($p<0.05$).

In particular, a significant relationship exists between the teachers' digital pedagogy and achievement in Grade 8 mathematics ($r = .166$, $p<0.01$). More so, there is a weak positive correlation between the independent and dependent variables, as manifested in the obtained correlation coefficient of .166. This leads to the rejection of H_0 *"There is no significant relationship between teachers' digital pedagogy and achievement in Grade 8 mathematics."* This means that as the extent of digital pedagogy increases, there is a slight increase in the extent of achievement in Grade 8 mathematics.

Table 15. Significant Relationship between Teachers' Digital Pedagogy and Achievement in Grade 8 Mathematics

Variable	Achievement in Grade 8 Mathematics		Remarks
	R	*p*-value	
Digital Pedagogy	.166**	.002	Significant

**. Correlation is significant at the 0.01 level (2-tailed).

Moreover, the result suggests further that the small influence of digital pedagogy on the achievement of students in grade 8 mathematics is due to the fact that not all students were able to comprehend mathematical concepts using technological applications. Some students do not meet their learning needs by simply using technological tools; there are students who learn best using hands-on experience.

This finding supports the study of Abildinova et al. (2024), who found that effective use of a digital pedagogical approach in integrating technology significantly influences the increase in academic achievement of students in math class. More so, Bozkus (2021) underscores that the digital pedagogy of teachers in the use of technological infrastructure significantly affected students' academic performance, which could provide practical benefits for students through the use of effective technological tools in teaching mathematics. On the other hand, Bertheussen and Myrland (2016) accentuated that teachers' digital pedagogy has a positive influence on the students' academic achievement, but this relationship is weak and does not contribute much to the increase in the student's achievement in mathematics.

CONCLUSION

Based on the results of the study, the following conclusions were drawn:

The teachers' very high mean rating score in technology integration is due to the fact that technological advancement alters mathematics teaching today; teachers are embracing the critical role of technology in mathematics education. Moreover, the high mean rating of teachers; digital pedagogy attributed to the teachers' commitment to attending professional development to acquire necessary skills in the use of technology resulted in a high mean rating score for students' learning engagement, which is indicative of the positive impact of technology. More so, the average mastery level of students' mathematics achievement is because students have diverse learning needs that cannot be addressed simultaneously by one approach, like technology integration and digital pedagogy. Thus, students are still challenged to understand the crucial role of technology today.

Furthermore, the technological tools used by the teachers in teaching grade 8 mathematics proved that they influenced students' participation in all activities, and this relationship has proven significant. Subsequently, with the proper utilization of technological tools when teachers exhibit high digital pedagogy on the effective use of technological tools, the student's achievement in mathematics improves, and this relationship is proven significant. Thus, teachers should continuously develop their skills in utilizing technology coupled with effective digital pedagogy to arouse students' learning engagement. When learners are engaged, their academic achievement improves.

Conflict of Interests

The authors declared no conflict of interest.

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