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Role of Technology Acceptance by Student's in Enhancing Mathematics Achievement at the Middle School Level

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Abstract

This study investigates the role of technology acceptance among middle school students in enhancing mathematics achievement. Utilizing a descriptive survey design, data were collected from a sample of 250 students across various demographic variables, including gender, type of school, and locality. A self-developed Technology Acceptance Scale and academic performance records were used to assess student attitudes toward educational technology and their corresponding mathematics achievement. The findings revealed statistically significant differences in technology acceptance and mathematics performance across gender, locality, and type of school. Female students and those from government schools demonstrated higher technology acceptance, whereas private school students and those from rural areas showed better mathematics achievement. Moreover, a strong positive correlation (r = 0.78) was found between students' acceptance of technology and their mathematics performance. These results highlight the importance of fostering student-centered technology integration to improve learning outcomes in mathematics. The study offers important implications for educators and policymakers to enhance digital readiness and pedagogical practices in middle school education.

Keywords: *Technology Acceptance, Mathematics Achievement, Middle School Education, Gender Differences, Educational Technology.*

1. INTRODUCTION

In the 21st-century learning environment, the integration of technology into education has reshaped teaching and learning practices, especially in mathematics education. With the increasing digitization of classrooms, students' acceptance of educational technology has emerged as a crucial factor influencing academic outcomes **(Teo, 2011)**. Technology acceptance refers to the willingness of students to embrace and effectively utilize digital tools and platforms in their learning process. When students perceive technology as useful and easy to use, their engagement and motivation in subjects like mathematics can be significantly enhanced **(Davis, 1989; Venkatesh & Davis, 2000)**.

Mathematics, often regarded as a challenging subject among middle school learners, demands innovative instructional strategies to promote interest and understanding. Technology-supported learning environments can offer interactive and visual learning experiences that help students grasp abstract mathematical concepts more effectively **(Li & Ma, 2010)**. However, the effectiveness of such technologies largely depends on how students perceive and accept them in their learning process. Research has shown that students who positively accept educational technologies tend to demonstrate better academic performance and problem-solving skills **(Ifinedo, 2017)**.

Understanding the role of students' technology acceptance is particularly relevant at the middle school level, where foundational mathematical competencies are developed. This study aims to explore how students' attitudes and acceptance toward educational technology impact their achievement in mathematics. Such an investigation is essential to inform educators and policymakers about the significance of fostering a supportive and technology-friendly learning environment to enhance academic performance in mathematics.

2. TECHNOLOGY ACCEPTANCE BY STUDENTS

Technology acceptance by students refers to the degree to which learners are willing to embrace and effectively use digital tools and technologies in their educational environment. This concept is commonly studied using models like the Technology Acceptance Model (TAM), developed by **Davis (1989)**, which suggests that two main factors influence technology adoption: Perceived Usefulness (PU) – the extent to which a student believes that using a particular technology will improve their learning or academic performance, and Perceived Ease of Use (PEOU) – the extent to which a student believes that using the technology will be free of effort **(Davis, 1989)**.

2.1 Key Dimensions Of Technology Acceptance

- Attitude Toward Use – student's positive or negative feelings about using the technology **(Venkatesh & Davis, 2000)**.
- Behavioral Intention to Use – the likelihood that the student will use the technology in the future **(Teo, 2009)**.
- Actual Usage – how often and effectively the technology is used in practice **(Scherer et al., 2019)**.

2.2 Factors Influencing Student Technology Acceptance

Several factors influence students' willingness to adopt and use educational technology:

- Access to resources (devices, internet)
- Digital literacy **(Ng, 2012)**
- Teacher support and encouragement **(Scherer et al., 2019)**
- Relevance of technology to course content **(Teo, 2009)**
- Peer influence **(Venkatesh & Bala, 2008)**
- Self-efficacy in using technology **(Bandura, 1997; Tondeur et al., 2017)**

2.3 Importance In Education

Technology acceptance is crucial in enhancing student engagement, motivation, and academic success. When students perceive technology as useful and easy to use, it promotes autonomous and collaborative learning, supports personalized instruction, and contributes to higher academic performance, particularly in subjects like mathematics and science **(Li & Ma, 2010; Venkatesh et al., 2003)**.

2.4 Impacts Of Technology Acceptance On Learning Outcomes

There is strong empirical evidence that when students accept and effectively use educational technology, there is a positive impact on their learning outcomes. In a meta-analysis by

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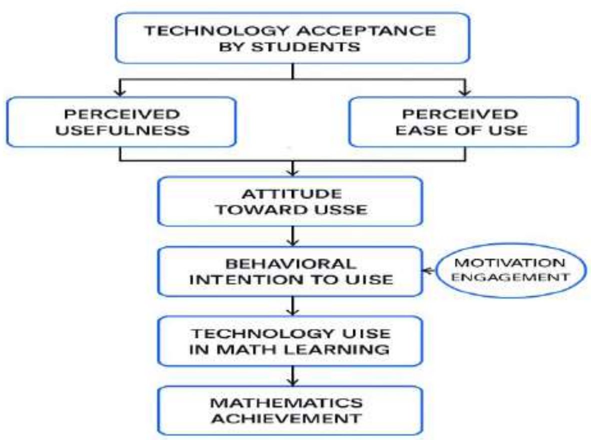
Li and Ma (2010), the use of computer-assisted learning tools in mathematics significantly improved student achievement. Furthermore, students who use educational technology regularly show enhanced problem-solving skills, increased motivation, and greater collaboration with peers (Cheung & Slavin, 2013).

In mathematics specifically, interactive apps, simulations, and online tutorials offer personalized learning experiences and immediate feedback, which contribute to a deeper understanding of complex concepts (Papadakis et al., 2018).

2.5 Technology Acceptance Model (TAM) Pathway to Mathematics Achievement in Middle School Students



3. REVIEW OF RELATED LITERATURE

The integration of technology into education has become a cornerstone of modern pedagogy, particularly in the teaching and learning of mathematics. Several studies have examined how students' acceptance of technology influences academic achievement, emphasizing cognitive engagement, interactivity, and learner autonomy (Teo, 2011).

3.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) developed by Davis (1989) is widely used to understand how users come to accept and use technology. According to TAM, two primary factors Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) influence an individual's attitude toward using technology, which subsequently affects their behavioral intention and actual use. In the context of education, PU and PEOU have been shown to predict students' engagement with learning technologies (Venkatesh & Bala, 2008).

3.2 Technology Acceptance and Student Performance

Multiple studies have demonstrated a positive correlation between students' technology acceptance and their academic performance. For instance, Park (2009) found that higher acceptance of e-learning tools significantly enhanced learning outcomes among university students. Similarly, Huang and Liaw (2018) observed that students with positive attitudes toward technology use in mathematics showed improved problem-solving skills and deeper conceptual understanding.

3.3 Student-Centered Technology Integration

Student-centered technology integration refers to the use of digital tools and platforms to support instruction that prioritizes student autonomy, engagement, and meaningful interaction. It encompasses strategies such as adaptive learning systems, gamified platforms, mobile-assisted learning, and collaborative online environments. Recent studies suggest that such integration can enhance student motivation, academic achievement, and critical thinking skills (Xie et al., 2023; Dhawan, 2023).

3.4 Middle School Context and Mathematics Achievement

Middle school students are at a formative stage where their attitudes toward learning, especially in subjects like mathematics, can significantly shape their future academic paths. Research by Ifinedo (2017) emphasized that students' technology self-efficacy and motivation are strongly linked with mathematics achievement, especially when digital tools are integrated effectively in classrooms.

3.5 Technology Integration in Mathematics Education

The use of technological tools such as graphing calculators, educational apps, and interactive whiteboards has been found to foster conceptual understanding and engagement (Pierce & Ball, 2009). Further, access to personalized learning platforms that adapt content to the student's pace has been shown to increase mathematics achievement in middle school learners **(Bakia et al., 2012)**.

3.6 Gaps in Literature

While existing studies affirm the role of technology acceptance in improving learning outcomes, there is limited research specifically targeting middle school students in the Indian educational context. Furthermore, few studies explore the combined impact of student technology acceptance alongside teacher technology adoption and student motivation in mathematics achievement.

4. NEED FOR THE STUDY

In the current digital era, the integration of technology into education has become a strategic priority for enhancing teaching and learning processes. While significant investments have been made to equip schools with technological infrastructure, student acceptance of technology remains a decisive factor in determining its educational effectiveness **(Davis, 1989; Teo, 2009)**. The mere availability of digital tools does not automatically translate to improved academic performance; instead, students' perceptions, attitudes, and willingness to use such tools play a pivotal role **(Venkatesh & Davis, 2000)**.

Middle school students represent a critical population for educational interventions, as this stage marks a transition in both cognitive development and academic responsibility. Mathematics is often perceived as a challenging subject during this phase, with students exhibiting varied levels of motivation and performance. Technology has the potential to transform mathematics education by offering interactive, personalized, and engaging learning experiences. However, the effectiveness of such interventions depends on the extent to which students accept and use these technologies in a meaningful way **(Li & Ma, 2010)**.

Despite its relevance, student technology acceptance remains underexplored in many school systems, especially in developing countries or under-resourced educational settings. While several studies have examined teachers' readiness and institutional capacity for technology adoption, student-centered perspectives are often overlooked. This creates a gap in understanding the actual impact of digital education initiatives on learners, particularly in the context of mathematics achievement at the middle school level.

Moreover, national education frameworks such as India's National Education Policy (NEP) 2020 emphasize digital learning as a key component of educational reform. To realize the full benefits of such policies, it is essential to understand how students perceive, interact with, and utilize educational technologies. Thus, investigating the factors that influence student technology acceptance is not only timely but also necessary for improving teaching strategies, informing policy decisions, and enhancing student outcomes.

Therefore, the present study seeks to explore the role of technology acceptance by students in enhancing mathematics achievement at the middle school level. By focusing on students' attitudes, intentions, and usage behaviors, the study aims to offer actionable insights for educators, curriculum developers, and policymakers who seek to optimize the use of technology in education.

Mathematics, often regarded as a challenging subject among middle school learners, demands innovative instructional strategies to promote interest and understanding. Technology-supported learning environments can offer interactive and visual learning experiences that help students grasp abstract mathematical concepts more effectively **(Li & Ma, 2010)**. However, the effectiveness of such technologies largely depends on how students perceive and accept them in their learning process. Research has shown that students who positively accept educational technologies tend to demonstrate better academic performance and problem-solving skills **(Ifinedo, 2017)**.

5. OBJECTIVE OF THE STUDY

- To find out whether there is a significant difference between male and female students in technology acceptance in enhancing mathematics achievement at the middle school level.
- To find out whether there is a significant difference between rural and urban students in technology acceptance in enhancing mathematics achievement at the middle school level.

- To find out whether there is a significant difference between private and government middle school students in technology acceptance in enhancing mathematics achievement.
- To examine the relationship between technology acceptance by students and their mathematics achievement at the middle school level.

6. HYPOTHESES

6.1 Null Hypotheses (H_0)

- $\mathbf{H_{01}}$: There is no statistically significant difference in technology acceptance scores between male and female middle school students with respect to mathematics achievement.
- $\mathbf{H_{02}}$: There is no statistically significant difference in technology acceptance scores between rural and urban middle school students with respect to mathematics achievement.
- $\mathbf{H_{03}}$: There is no statistically significant difference in technology acceptance scores between students attending private and government middle schools with respect to mathematics achievement.
- $\mathbf{H_{04}}$: There is no statistically significant relationship between students' technology acceptance and their mathematics achievement at the middle school level.

7. METHODOLOGY

7.1 Research Method

The study employed a survey method under the descriptive research design to investigate the role of students' technology acceptance in enhancing mathematics achievement at the middle school level.

7.2 Population and Sample

The population consisted of middle school students from both government and private schools. A total sample of 250 students was selected using the simple random sampling technique, ensuring representation from various demographic backgrounds, including gender (male/female), locality (rural/urban), and types of school (government/private).

This method was used to give every student an equal and fair chance of being chosen, without any bias. Simple random sampling helped ensure that the sample included a balanced mix of male and female students, as well as those from rural and urban areas and from both private and government schools. This approach made the sample more representative of the overall student population and helped improve the accuracy and fairness of the study's findings.

7.3 Tool description / Validity and Reliability

The self-constructed Technology Acceptance by Students Scale consisted of 20 items, based on four core dimensions of the Technology Acceptance Model (TAM) (Davis, 1989). Each dimension consists five questions, which included dimensions such as:

- Perceived Usefulness (PU)
- Perceived Ease of Use (PEOU)
- Attitude Toward Use (ATU)
- Behavioral Intention to Use (BIU)

Content validity was established through expert review by educational technologists and mathematics educators. To confirm construct validity, a pilot study was conducted with a subset of 30 students, and exploratory factor analysis (EFA) supported the factor structure aligned with TAM constructs.

The instrument demonstrated strong internal consistency: Cronbach's Alpha = 0.87.

Mathematics Achievement Test/School Records Academic performance in mathematics was recorded from the latest school examination scores or standardized test data.

7.4 Scoring procedures

Responses on the technology acceptance scale were recorded using a 5-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5).

7.5 Statistical techniques

Collected data were analyzed using appropriate statistical techniques, including:

- Descriptive statistics (mean, SD)
- Independent samples t-tests (for group comparisons like male vs. female, rural vs. urban, private vs. government)
- Pearson's correlation (to assess the relationship between technology acceptance and mathematics achievement)

8. DATA ANALYSIS

Table-1: Gender-wise Comparison of Students' Technology Acceptance and Mathematics Achievement

Variable	Gender	N	Mean	SD	t	Remark
Technology Acceptance by Students'	Male	120	52.90	8.75	5.536	S
	Female	130	58.80	8.10		
Mathematics Achievement	Male	120	54.50	7.80	3.141	S
	Female	130	57.50	7.30		

Table 1 presents a gender-based comparison of students' technology acceptance and mathematics achievement. The data shows that female students (N = 130) have a higher mean score (M = 58.80, SD = 8.10) in technology acceptance compared to male students (N = 120, M = 52.90, SD = 8.75). The independent samples t-test reveals a statistically significant difference between male and female students in technology acceptance, with a t-value of 5.536, indicating a significant result ($p < 0.05$). This suggests that female students are more accepting of technology in their learning processes than their male counterparts.

Similarly, in mathematics achievement, female students again scored higher (M = 57.50, SD = 7.30) than male students (M = 54.50, SD = 7.80). The t-test value of 3.141 also indicates a statistically significant difference ($p < 0.05$), implying that female students outperform male students in mathematics achievement as well. These findings highlight the gender disparities favouring female students in both technology-related attitudes and academic performance in mathematics.

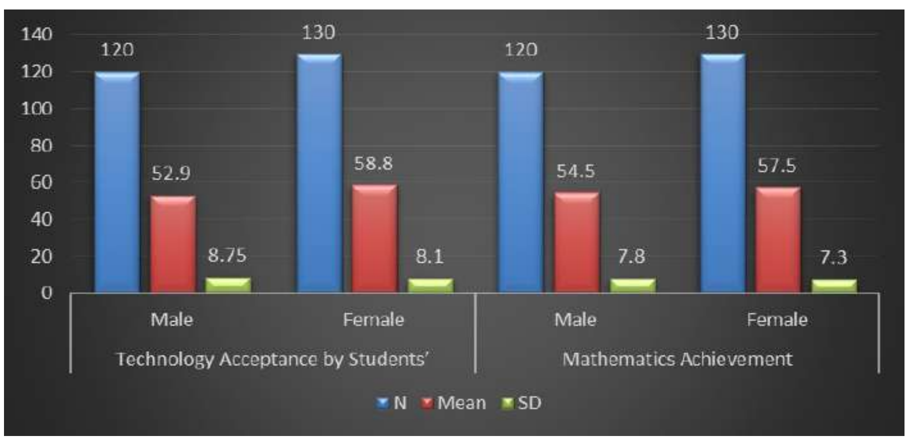


Fig-1.1: Gender-wise Comparison of Students' Technology Acceptance and Mathematics Achievement

Table-2: Locality-wise Comparison of Students' Technology Acceptance and Mathematics Achievement

Variable	Locality	N	Mean	SD	t	Remark
Technology Acceptance by Students'	Rural	115	53.90	6.80	2.717	S
	Urban	135	51.70	6.00		
Mathematics Achievement	Rural	115	57.20	7.80	4.775	S
	Urban	135	52.10	8.90		

Table 2 illustrates the comparison of technology acceptance and mathematics achievement between students from rural and urban areas. In terms of technology acceptance, rural students (N = 115) have a higher mean score (M = 53.90, SD = 6.80) than urban students (N = 135, M = 51.70, SD = 6.00). The t-test value of 2.717 indicates a statistically significant difference ($p < 0.05$), suggesting that rural students demonstrate greater acceptance of technology compared to their urban counterparts.

Regarding mathematics achievement, rural students also outperform urban students, with a mean score of 57.20 (SD = 7.80) versus 52.10 (SD = 8.90), respectively. The t-value of 4.775 confirms that this difference is statistically significant ($p < 0.05$). These results highlight that students from rural backgrounds, in this study, show not only higher engagement with technology but also superior performance in mathematics compared to students from urban settings. This finding could be attributed to differences in learning environments, educational interventions, or motivational factors present in rural schools.

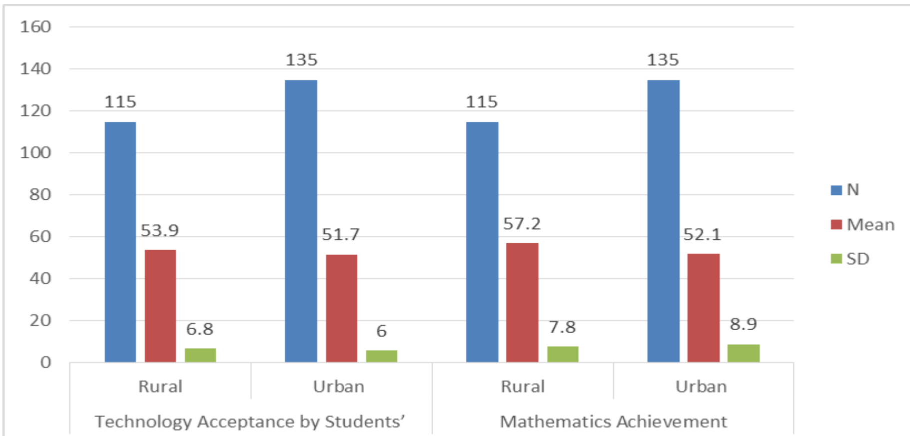


Fig-1.2: Locality-wise Comparison of Students' Technology Acceptance and Mathematics Achievement

Table-3: Type of school wise Comparison of Students' Technology Acceptance and Mathematics

Variable	Type of School	N	Mean	SD	t	Remark
Technology Acceptance by Students'	Private	110	52.80	6.80	3.8774	S
	Government	140	56.30	7.30		
Mathematics Achievement	Private	110	57.20	7.80	5.779	S
	Government	140	52.10	6.30		

Table 3 presents a comparison between private and government school students in terms of technology acceptance and mathematics achievement. Interestingly, government school students (N = 140) show higher technology acceptance (M = 56.30, SD = 7.30) compared to their private school counterparts (N = 110, M = 52.80, SD = 6.80). The independent samples t-test yields a statistically significant value of 3.8774 ($p < 0.05$), indicating that the observed difference is meaningful. This suggests that students in government schools are more receptive to adopting technology in their learning processes.

On the contrary, private school students outperform government school students in mathematics achievement, with a mean score of 57.20 (SD = 7.80) versus 52.10 (SD = 6.30), respectively. The t-test value of 5.779 confirms this difference is statistically significant ($p < 0.05$). These findings imply that although government school students are more open to using technology, private school students tend to achieve better academic outcomes in mathematics. This contrast may reflect variations in teaching quality, access to learning resources, instructional methods, or academic expectations between the two school types.

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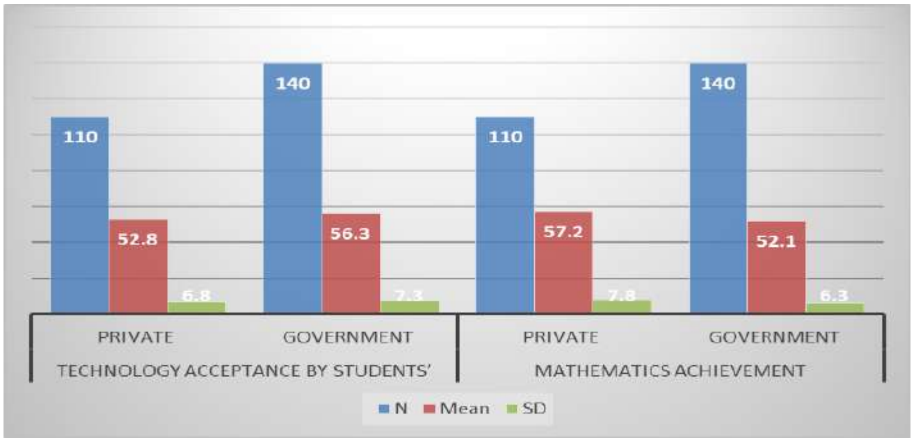

Fig-1.3: Type of school wise Comparison of Students' Technology Acceptance and Mathematics

Table-4: Correlation between Students' Technology Acceptance and Mathematics Achievement

Variable		**Technology Acceptance by Students'**	**Mathematics Achievement**
Technology Acceptance by Students'	Pearson Correlation	1	0.78
	Sig. (2-Tailed)		.000
	N	250	250
Mathematics Achievement	Pearson Correlation	0.78	1
	Sig. (2-Tailed)	.000	
	N	250	250

Table 4 shows the Pearson correlation analysis between students' technology acceptance and their mathematics achievement. The results indicate a strong positive correlation (r = 0.78) between the two variables, which is statistically significant at the 0.01 level (p = .000). This means that as students' acceptance of technology increases, their performance in mathematics also tends to improve.

The strength of the correlation suggests that technology acceptance plays a significant role in enhancing students' academic outcomes in mathematics. With a sample size of 250, the data provide robust evidence that fostering positive attitudes towards educational technology may be an effective strategy to boost mathematical achievement. This relationship underscores the importance of integrating technology meaningfully into the learning process to support student success in mathematics.

9. DISCUSSION

The present study contributes to the growing body of literature emphasizing the influence of technology acceptance on academic performance, particularly in mathematics education. The strong positive correlation (r = 0.78) observed in this study aligns with previous findings, supporting the idea that technology enhance learning outcomes **(Davis, 1989; Teo, 2011)**. Prior studies also show that students who positively engage with educational tools tend to perform better academically **(Alenezi et al., 2010; Liaw et al., 2007)**. Similarly, Cheung and Slavin (2013) found that educational technology applications contribute positively to K–12 mathematics performance.

Gender-wise analysis revealed that female students exhibited higher technology acceptance and performed better in mathematics than males, supporting **Ifinedo's (2017)** findings that female students often display stronger engagement with digital tools. This may be attributed to differences in motivation, learning styles, or classroom support mechanisms.

The rural-urban divide presents an interesting contradiction to conventional assumptions. Rural students not only accepted technology more but also performed better in mathematics, contrasting with some earlier studies **(e.g., Park, 2009)** which reported that urban students usually have better access and exposure to digital tools. This result may suggest that rural schools, particularly those involved in targeted digital interventions, can outperform expectations when infrastructure and support align effectively.

In terms of types of school, government school students showed greater acceptance of technology, possibly due to government-initiated digital literacy programs. However, private school students outperformed their peers in mathematics achievement. This finding echoes the concerns raised by **Venkatesh and Davis (2000)** that while technology availability and acceptance are necessary, they must be supported by effective instructional design and teaching quality to impact learning outcomes positively. This study complements prior works **(Scherer et al., 2019; Huang & Liaw, 2018)** and extends the TAM framework into a middle school context, offering evidence from an underrepresented educational demographic in India. However, contradictory findings in rural and school-type segments warrant deeper exploration into contextual variables such as teacher training, parental involvement, and school culture.

10. EDUCATIONAL IMPLICATIONS

The findings have significant implications for educators, policymakers, and curriculum developers. First, schools should invest not only in technological infrastructure but also in promoting students' positive attitudes toward using technology. Training programs should be designed to develop students' digital self-efficacy and interest, especially for male and urban students who scored lower in technology acceptance.

The results highlight the need for differentiated strategies tailored to school types. For government schools, continued reinforcement of digital adoption must be paired with improved academic support. For private schools, where performance is high but acceptance is lower, instructional technologies should be made more engaging and student-cantered. Finally, curriculum design must incorporate adaptive, interactive, and visually rich tools that align with students' learning needs in mathematics. Integrating personalized digital resources into mainstream pedagogy could significantly enhance conceptual understanding and engagement at the middle school level.

11. LOW-RESOURCE SCHOOL ENVIRONMENTS

11.1 Lack of Access to Devices and Internet

Students may be open to using technology for learning, but many low-resource schools don't have enough computers, tablets, or internet access. This makes it hard for students to actually use educational tools, even if they believe those tools could help them in math.

11.2 Widening the Learning Gap

While students in well-equipped schools' benefit from digital learning, students in poor schools fall further behind. Even if they accept and want to use technology, they may not get the same opportunities to improve their math skills.

11.3 Teachers Need More Support

Teachers in low-resource schools may not have training on how to use technology effectively in math class. If they don't know how to guide students with these tools, then students' positive attitudes toward technology may not lead to better learning.

11.4 Low-Tech Solutions Can Still Help

Even basic technology can be helpful:

- Offline math apps,
- Shared devices,
- Lessons through mobile phones or SMS.

These tools can still improve math learning if students accept and use them regularly.

11.5 Schools and Policymakers Can Do

- Provide affordable or shared technology,
- Train teachers on using digital tools,
- Use apps that work offline and match the local curriculum.

These steps can help make sure all students benefit from technology, not just those in well-funded schools.

12. CONCLUSION

This study underscores the critical role of technology acceptance in enhancing mathematics achievement among middle school students. Female students and those from government schools showed higher technology acceptance, while private and rural school students demonstrated better academic performance in mathematics. Importantly, the strong positive correlation between technology acceptance and mathematics achievement affirms the value of fostering student-friendly digital learning environments.

By applying the Technology Acceptance Model (TAM) in a middle school context, this research contributes meaningful insights into the digital transformation of education. Future efforts should focus on equitable access, effective teacher facilitation, and inclusive student engagement strategies to maximize the educational benefits of technology. Ultimately, empowering students with positive digital mindsets can play a pivotal role in closing performance gaps and promoting sustained academic growth in mathematics.

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