COVER PAGE AND DECLARATION

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EDUC580: Educational Research:

THE IMPACT OF TECHNOLOGY ON MIDDLE SCHOOL STUDENTS' ENTHUSIASM FOR LEARNING SCIENCE

1. INTRODUCTION

The research uses a mixed approach to determine technological effects on middle school students' interest in science education. Pre-intervention and post-intervention surveys harvested quantitative information, but qualitative evidence resulted from observation techniques student interviews, and teacher and student feedback. Components of this study measured parental insights about the subject to receive validation from an outside perspective. Statistical analysis coupled with thematic coding and trend analysis evaluated the obtained data. This survey analyses the demand for technology-based learning among students and parental perceptions. However, educators should incorporate technology-aided interaction systems and personalized systems to strengthen learners' curiosity in science education.

2. ABSTRACT

The research uses a mixed approach to determine technological effects on middle school students' interest in science education. Pre-intervention and post-intervention surveys harvested quantitative information but qualitative evidence resulted from observation techniques, student interviews and feedback from both teachers and students. Components of this study measured parental insights about the subject to receive validation from an outside perspective. Statistical analysis coupled with thematic coding and trend analysis evaluated the obtained data. This survey analyses the demand for technology-based learning among students and parental perceptions. However, educators should incorporate technology-aided interaction systems and personalized systems to strengthen learners' curiosity in science education.

Keywords: *Technology-based learning, Science education, Middle school students, Parental perceptions, Mixed-method research*

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3. RATIONALE OF THE STUDY

Technology has revolutionized the traditional blackboard teaching in the classroom. It is mainly prevalent for subjects such as science where the passion and curiosity is imperative for making the students understand abstract concepts (Farooq, Zaidi and Shah, 2024). This research study seeks to assess how technology affects middle school students' motivation towards science learning, in observation of the fact that today's learners are digital immigrants, who respond well to creative and hands-on instructional methods. With a growing presence of technology in the educational landscape, it is essential to study the influence of such tools on student motivation and engagement in scientific inquiry.

An observational study conducted by Tanti et al. (2021) depicts a correlation between the positive attitude of students to their performance in school and their interest in studying subjects such as science after school. This study tries to assess how the use of technology relates to student motivation so that teaching methods and curricula can be adapted. Students have different attitudes to science and these differences can be analyzed in order to plan effective use of teaching technology, including interactive simulations, educational games, and other online resources (Korkmaz, Cetin-Dindar and Oner, 2023). Additionally, this addresses inequalities in access to technology by most students. There are some students who have access to these technologies at home or at school and these students will enjoy learning more than those who do not have it. This study seeks to address these gaps in order to foster equity in education so that all learners can benefit from technology-based learning.

Going beyond the focus of how technology might affect the students' interest, the study will also look into the efficacy of specific teaching approaches employed for English as a Second Language (ESL) students (Griskell, Gámez and Lesaux, 2019). In any middle school, students belong to different language communities, and as a result, they can be motivated by different strategies used by their teachers. The intention of this research is to find effective ESL strategies that need to be incorporated in science classrooms to serve as motivation for the learners irrespective of their background.

In addition, the research intends to investigate parents' reactions about how students are able to respond to the new techniques to teaching. As we know, parents determine children's attitudes towards learning. Their opinion regarding the education field of their children can

contribute greatly on how their children will relate to learning when they are in school. This component of the study will demonstrate how schools and families should cooperate for learners to benefit from effective schooling.

The final objective is to identify the best practices related to implementing action research within school-based contexts. Action research helps educators become reflective practitioners through reflection on practices and data-driven decision making to ultimately improve student outcomes (D, 2019). This will add to further discussion on topics of educational innovation and improvement because of its contribution of identifying effective methods of integrating technology into science curricula.

4. RESEARCH QUESTION AND RESEARCH OBJECTIVES

a. Research Question

How does the integration of technology in the classroom impact middle school students' enthusiasm for learning science?

b. Research Objectives

b.1 To assess the effect of integrating technology on student enthusiasm for learning

The objective is to determine the impact that the use of certain technologies on the students' motivation towards science education. This research will seek to identify the attachments towards scientific phenomena which will be used to assess the motivation levels, Apparently, technology integration can motivate or demotivate students.

b.2 To evaluate the impact of teaching styles (ESL strategies) on student motivation

The objective analyzes the effectiveness of other forms of science teaching methods like English as a Second Language (ESL) strategies on the students' motivation. The main aim of this is to identify effective strategies that can be used in the classrooms to enhance comprehension and motivation among learners with varying abilities.

b.3 To determine the challenges students face when adapting to new instructional methods

This objective assesses the problems of middle-level students that arise from the adoption of different approaches to teaching that employ technology. These students face a number of unique learning challenges which educators can help ease to take full advantage of their potential.

b.4 To explore parental perceptions of students' enthusiasm and motivation in response to new teaching methods

This particular objective estimates the way parents perceive their children's interest and motivation towards the use of different teaching methods such as traditional and technology aided instruction. The research by obtaining parents' opinion is trying to show the wider context of student motivation and learning and find out what influences their learning experience.

b.5 To identify best practices for implementing action research in school-based settings

This objective deals with the effectiveness of practitioners while performing action research in educational contexts. In this regard, the research aims to identify good practices that would enable teachers to use instructional practices with technology aimed at engaging students and achieving better results.

5. LITERATURE REVIEW

Technology plays a more important role in education, particularly in science, since it increases student interest and involvement. This literature review explores existing research on the impact of technology on the level of enthusiasm that middle school students have in learning science. It zeroes in on different technological tools, strategies for efficient teaching, and how parental perceptions influence motivation among students. It aims to reveal ways of more effective and captivating science learning environments using technology that helps ignite the desire for scientific inquiry among students through examination of the aforementioned aspects.

a. The Role of Technology in Enhancing Student Engagement

Technology is serving as an effective aid for increasing the engagement of students towards learning. According to Zou, Xie and Wang (2022), technology involves immediate feedback as well as support for collaboration. It offers an interactive nature of learning that varies according to all learning style. For instance, educational games with interactive simulations enhanced the motivation significantly as abstract science concepts are then made more tangibly (Lahlali et al., 2023). These tools allow a student to do experiments and experience

scientific phenomena, which in turn brings about a safer and controlled experience that enhances comprehension and retention.

The multimedia resources, for instance videos, animations, and virtual labs, can make scientific concepts more relatable to the reality of students' lives, thus contextualizing the concept (Yakob et al., 2020). The addition of such resources to the curriculum helps in creating a learning experience that is rich, appealing, and capable of inspiring enthusiasm for science among students. This approach promotes active participation and inquiry-based learning, culminating in a better academic performance and a lifetime interest in the scientific exploration. The use of technology and its applications holds much promise in reshaping science education and ensuring enhanced student involvement in the near future.

b. Teaching Strategies and their Impact on Student Motivation

Technology can effectively contribute to enhancing student enthusiasm depending on the teaching strategies used by teachers. Diverse studies have shown that using differentiated instruction, where the teaching methods adopted are in accordance to the needs of an individual largely impacts students' motivation (Gobiberia, 2021). For example, using ESL strategies will provide non-native speakers a better way of comprehending scientific content. It has been proven that when teachers apply diverse instructional approaches that include technology, students tend to be motivated and enthusiastic about their learning experiences (Aljehani, 2024).

Besides this, technological help in learning allows the students to form social camaraderie, which further builds the motivation scale. Social constructivist theory, emphasized by Saleem et al. (2021), stated that learning is socially constructed, and while the students work together using technology, they can share knowledge and assist each other with the process of learning. This method not only brings out excitement but also builds the thought process critical for scientific inquiry. By using multiple approaches in teaching by using technology, the dynamic learning environment will be maximized and students will be more engaged and motivated to learn science.

c. Challenges in Adapting to New Instructional Methods

Despite the advantageous effects of integration in the use of technology in science education, several factors may be a barrier to its effective implementation. Students frequently encounter problems in adapting to a new method of instruction that involves the use of technology (Prayudha, 2023). For example, students who are unfamiliar with the tools used may easily

get frustrated and lose interest. Further, some students may resist changes from the mainstream teaching method owing to unfamiliar approaches requiring them to acquire new skills.

In addition to this, uneven access to technology can lead to significant inequalities for students. According to Pettalongi et al. (2024), students from lower income backgrounds may be limited in digital resources at home, which leads to their lesser ability to embrace technology-enhanced learning opportunities. This disparity can lead to differences in interest in science among various demographic groups because those who have more access to technology are likely to benefit from its integration in the classroom. Therefore, these challenges need to be addressed so that all students can meaningfully interact with and benefit from technology-enhanced science education, which will promote a more equitable learning environment.

d. Parental Perceptions and their Influence on Student Motivation

Parental beliefs significantly influence the attitude of students towards learning, determining motivation and participation in the process. Studies have shown that parents' perceptions about education values and active participation in children's learning determine student motivation (Peixoto et al., 2023). Parents are likely to encourage and support home use when their view of technology is to improve educational quality and quantity.

Additionally, parents' participation in learning activities with their children like helping with homework or reviewing school projects is linked to positive effects on student's interest in learning (Cheung et al., 2022). The presence of a home environment that respects education and allows technological involvement further helps students appreciate learning. In addition, an engaged parent in a child's life may foster interest and drive towards the subject, like science.

Recognition of the important role they play by parents can dramatically enhance the child's interest in learning. Increased discussion about their schoolwork at home and education technology can significantly enhance student motivation and a far greater interest in scientific exploration. It is vital that strong support be fostered between parents to cultivate a favorable attitude toward learning among students.

e. Best Practices for Implementing Technology in Science Education

To maximize the positive impact of technology on middle school students' enthusiasm for learning science, educators should adopt several best practices. First, providing professional

development opportunities for teachers is essential to equip them with the necessary skills and knowledge for effective technology integration (Avci et al., 2019). Training programs should focus on instructional strategies that leverage technology while promoting student engagement.

Secondly, a collaborative classroom environment should be developed. The teachers should promote group work and discussions that utilize technological tools, encouraging students to collaborate and communicate with each other (Daher et al., 2022). This is not only enhancing social interaction but also enables students to learn from each other, which will increase their interest in science.

There should also be constant assessment of how effectively technology is implemented. There should be regular feedback from the students concerning their experiences in using technological tools and the necessary adjustment done on the analysis of the responses. Such a cycle would ensure that technologies involve and entertain them, therefore growing their interest towards science. By implementing these best practices, educators can create a dynamic learning environment that harnesses the potential of technology to inspire and motivate middle school students in their scientific pursuits.

6. METHODOLOGY

6.1. Description of participants of the study

The participants of the study are eighth-grade middle school students who enrolled in the course of science. The participants were selected carefully to ensure a diverse and representative sample of middle school students, parents and teachers who are directly involved in the process of learning. The study focuses on the evaluations of technology integrations and their impact on the enthusiasm of students for learning science. The survey has considered multiple factors such as teaching style, adaptation challenges and the perceptions of parents in school-based action research. The sample size of 30 students was selected to ensure a manageable and diverse representation of the student response. The process of selection of the specific group was done based on the need for consistency in teaching conditions and the ability to measure the changes over time. The main purpose of the sampling approach is to ensure that the students who engaged with technology-based learning tools were included in the process also the process has included the students based on their academic performance and personal interest in science. The diversity in the process of sampling allows for a more comprehensive understanding of different learners regarding technological interventions (Pellas, 2023). The study focuses on the students within the age group which is crucial to managing the cognitive and academic development of the students

towards science that can shape their future educational choices. The selection process of the participants is developed based on the accessibility of the students in the school to integrate technology into their curriculum which can ensure that the students are able to access the learning tools for their study.

6.2. Demographic Characteristics

The students came from diverse socio-economic backgrounds and represented a mix of urban and suburban environments in school. The students had varying degrees of proficiency and technological literacy and were comfortable using technology for learning. However, some students had limited exposure to technology which makes the study relevant to how the integration of technology affects the students with different starting points. The sixth and eighth-grade students were included to evaluate the impact of ESL strategies on the motivation of students. The process of selection allows for the comparison between younger students who are adopting middle school learning and older students who have more exposure to technology and traditional teaching methods. Apart from the students, the study has also included parents and teachers as secondary participants, parents of the selected students were involved to provide insights about their perception regarding children's enthusiasm and motivations in response to the new teaching process. The involvement of the parents is crucial to encourage and influence the students (Yulianti et al., 2022). Additionally, the teachers are also engaged in the study to provide reflective summaries regarding the effectiveness of the process and shed light on the best practice of technology in science education. The data collection from the student group formed the core findings of the study as they experienced direct technology-driven learning and collected data from the parents can help the study to validate the response of the students and provide a more holistic view of the impact of technology beyond the classroom setting. Furthermore, the feedback of the teacher is also crucial to identifying effective strategies regarding the integration of technology and the understanding of potential challenges with the implementation of technology in middle school education.

6.3. Description of intervention (treatment) and data collection tools

In this study, the intervention is applied regarding the integration of technology-based instructional methods in the science curriculum of middle school. The study includes the use of interactive simulations, educational games such as animations and videos and digital collaboration tools to manage multimedia learning resources. The primary objective of the

study intervention is to assess the extension of technology tools to enhance student engagement and enthusiasm for learning experiences in science. The study employs multi-data collection tools to collect quantitative and qualitative data to evaluate the effects of the intervention. The objectives re-determine how the use of technology can enhance student enthusiasm for science and the intervention was conducted over the period to observe and measure changes in student engagement during and after implementation. The intervention incorporates interactive tools and technology-driven activities into the classroom of science to modify educational videos and animations. In the science classroom students are enabled to participate in hands-on virtual experiments which allows them to manipulate the variables and observe the outcomes properly. The intervention is to personalise learning modules and provide targeted feedback. The intervention aims to participate students in hands-on virtual experiments to manipulate the variables and observe the outcome. Science-based games and reward-based learning systems can help to make the lesson more engaging (Moses et al., 2025). In the group of students, online discussion and shared documents helps to manage real-time collaboration tools. The Personalised learning modules are adopted to manage the learning paces of the students with targeted feedback. The intervention of this approach follows a structured process to ensure consistency and measure the impact accurately. Before the implementation of the innovative technology in the classrooms a survey was conducted to analyse the initial level of enthusiasm among the students. Teachers also observe the classroom to record the participation levels. After the implementation of the technology students are engaged with the technological tools in their science curriculum, the lessons follow the structure of six weeks where in the first 1-2 weeks analyse the initial use of gamified quizzes and the implementation of virtual labs. In 5-6 weeks follow the discussion and reflect on feedback regarding the learning experience to analyse the experience of AR and VR.

Post post-intervention survey was administered to analyse the changes in enthusiasm. Teachers conduct final observations and collect numerical and narrative data from the students regarding their enthusiasm for learning science to evaluate noticeable shifts in students' motivations. The survey includes Likert scale questions to quantify the levels of motivation and open-ended questions to capture the qualitative feedback regarding the experience of students. The observational checklists were used throughout the interventions to enhance student engagement and participation during the technology-enhanced lessons. The observation helps to capture the spontaneous reactions and interactions that cannot reflected in the survey response (Karunarathna et al., 2024). Structured interviews and

focused group discussions were conducted with the students to gain in-depth insights into the learning experience. Parietal perceptions are gathered through short surveys that are distributed at the end of the interventions. Lastly, the reflection of the teacher and the journal entries are collected to document the instructional strategies for the future integration of technology in science education.

6.4. A detailed and descriptive data collection procedure

The data collection process followed a systematic approach to ensure complete and accurate documentation regarding the student responses and intervention effectiveness.

6.5. Pre-Intervention Phase

Students performed a survey at the start aimed to identify their baseline excitement and drive toward science education. Initial classroom monitoring by teachers served as a baseline to measure student engagement when technology was not integrated. The brief survey sent to parents assessed their views about their children's current science motivation levels.

6.6. Implementation of Intervention

Students dedicated six weeks to participate in technologically enriched science lessons. Every day teachers employed interactive simulations together with virtual labs as well as multimedia resources in their daily lessons. Students gained scientific knowledge by collaborating with others through online educational activities and educational games. The teachers observe the logs to analyze the notable changes in student participation and their learning behaviors.

6.7. Data Collection During Intervention

The midpoint surveys documented the first reactions of students toward integrating technology into their learning. The students shared their experiences along with their difficulties through informal classroom conversations along interview sessions. Teachers document the instructional adjustments in reflective journal entries along with student responses.

6.8. Post-Intervention Phase

The participants evaluated their levels of engagement along with their excitement toward the new technology-based instructional approach on the final assessments. Data from observations enabled researchers to recognize behavioral patterns and student participatory actions (Cents-Boonstra et al., 2021). Interviews and focus group surveys provide qualitative insights regarding the overall experience of students. Further assessment included surveys that asked parents to share their observations at home so researchers could equate these findings with classroom observations. The compiled reflections from teachers formed the

basis to derive effective practices with recommendations regarding technology usage in science education.

The data collection process of the study is designed to capture a comprehensive picture of the impact of technology on science learning. By employing multiple methods such as surveys, observations, feedback forms and interviews the study has ensured a well-rounded data-driven approach. Pre and post-intervention provide a detailed and evidence-based evaluation of the role of technology in middle school science education. Qualitative insights provide detailed and evidence-based evaluation where the structured data collection approach ensures the findings are both reliable and meaningful to enhance student motivations and learning outcomes.

7. DATA ANALYSIS AND PRESENTATION OF RESULTS OF FINDINGS

7.1 Results

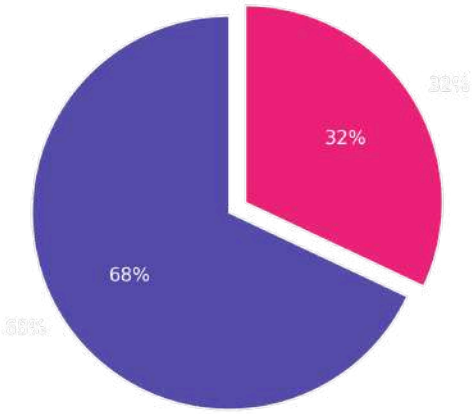


Figure 1: Gender

In this survey, 68% of the participants were female, while 32% were male, making it possible to determine the representation of gender in the assessment of technology on the subject of interest in science.

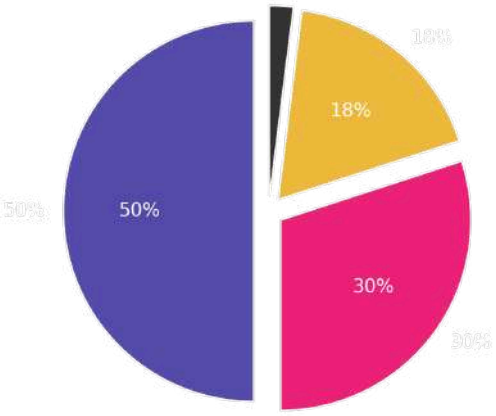


Figure 2: Age group

In regard to age, 50% of participants are 12 to 13 years old, 30% are 10 to 11 years old, 18% are 14 to 15 years old, and the rest of the participants are 16 years old and above to make sure we gather data across middle school grades.

Theme 1: The significance of digital tools simulations and virtual labs in creating science more interesting

Technology and gadgets such as simulation and virtual labs underline the interest of middle school students in science through games and visualization of various issues (Shambare & Jita, 2025). These technologies allow students to see the practical things that traditional approaches don't allow for visualizing and explaining, making it easier to understand the processes.

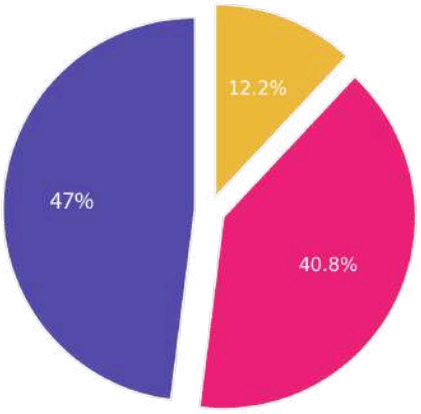


Figure 3: Learning science

This pictorial diagram shows how the use of technology enhances the level of interest that middle school students have in science. Here, the areas are leveled with 47 % indicating high interest, 40.8% moderate interest, and 12.2% low interest. This indicates the importance of digitalization in education

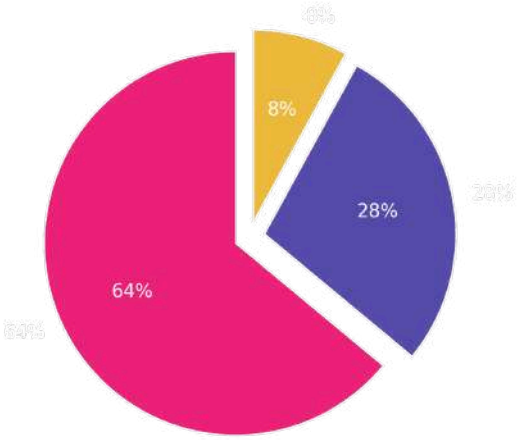


Figure 4: Technology in Science

There is increased enthusiasm (64%) for using digital tools daily basis and a decrease in low engagement (8%), which shows rarely use of virtual labs and simulations increased students' interest. The shift places a great emphasis on the use of interactive technology in the teaching of the subject in a manner that students enjoy (Karlsen et al., 2025). It indicates that the increase in the absorption of digital tools could be related to an increase in the students' engagement level. The reduction in the lower engagement percentages which are demonstrated by the orange and red sections shows that fewer students considered science as boring.

Theme 2: Personalized learning systems strengthening student engagement in science

The incorporation of technology in middle school science instruction grows student interest by making instruction individualized. Using the tools, simulations and virtual laboratory sessions enhances the learning process as each student can learn in their levels, understanding, and interest.

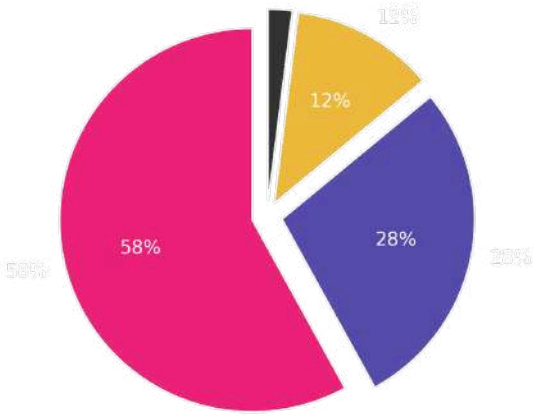


Figure 5: Technology-based learning

It demonstrates the preferences of students regarding the kind of technology-based learning where 58 % of them are highly preferred for educational purposes, 28% are moderately in line with interactive simulations and 12% choose technology for games and quizzes. This implies that there is a general agreement among students as to the fact that modern learning that employs the use of technology enhances their learning.

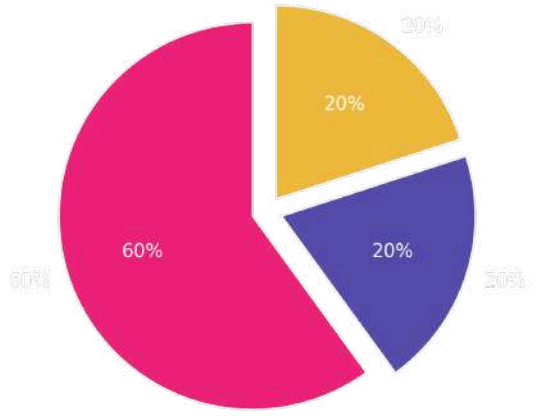


Figure 6: Influence of technology on science topics

60% of the respondent association members stated that technology had a positive impact on their understanding of science topics, and 20% did not see any impact due to technology.

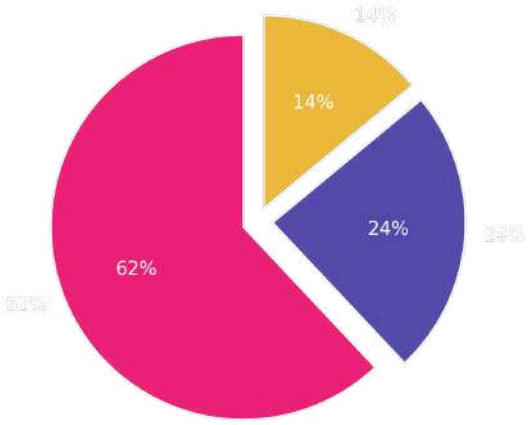


Figure 7: Technology makes science more engaging

This image outlines that 62% of students highly agreed that technology makes science education more encouraging, 24% felt that it can add a little bit of interest, and 14% did not agree with it. All these figures indicate the fact that personalized learning systems accompanied by technology enhance students' interest and understanding of science education (Dumont & Ready 2023).

Theme 3: Technical barriers, inadequate digital Knowledge, and accessibility problems in the classroom

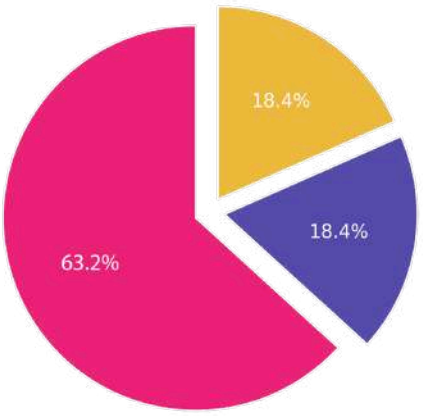


Figure 8: Barriers

The above figure reveals the challenges facing middle school students when using technology in their science learning. The highest portion 63.2% represents a major barrier to technical issues. 18.4% indicate a lack of digital literacy and difficulty in accessing technology, stating difficulties in software applications and poor facilities. These barriers discourage students by raising their level of frustration, avoiding engagement, and even minimizing interactivity when learning through science affecting the use of technology in the learning institutions (Singun, 2025).

Theme 4: Parental perspective for technology-driven education of science

Parents' opinions or perceptions greatly impact students' inquisitiveness in learning sciences

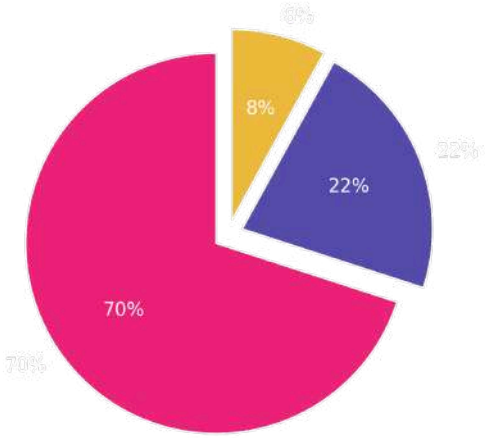


Figure 9: Parents' perception

This figure shows that a majority of parents have a positive attitude towards technology in education since 70% of them had a positive perception, 22% were slightly enthusiastic and 8% had no negative or positive perception towards technology in education. Finally, this figure demonstrates that parents have substantial support for technology-based education in science classrooms.

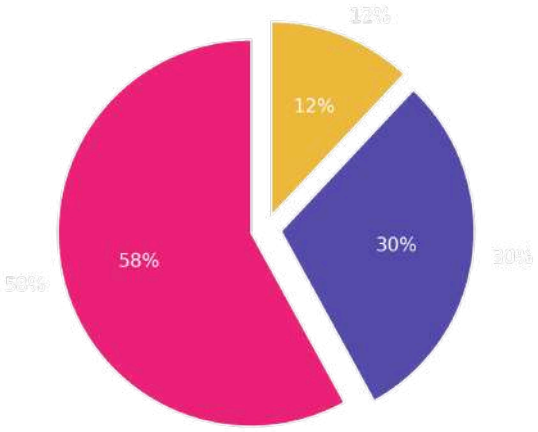


Figure 10: Preference of technology in learning

It shows students' attitudes toward the use of technology in learning rather than conventional processes. Technology has a positive score of 58% and a neutral score of 12% who prefer combined learning methods traditional and technology-based. A score of 30% who choose

the conventional process. The above figure indicates that parents fully support the use of technology in learning to enhance their children's learning in science (Sutherland et al., 2024).

7.2 Discussion

The study reveals the effects of innovative and advanced technologies in enhancing the interest of middle school students in science subjects. For engagement, the tools and models, virtual laboratories, and simulations provide a visual and engaging manner in which learners can grasp difficult concepts. Images 3 and 4 correlate the idea of utilizing tools that enhance how a student attends a lesson implying the incorporation of technology draws more interest. Furthermore, student-centered learning or personalized systems mean that students can move at their individual level, thus enhancing involvement shown in figures 5,6, and 7. Students approve of the presence of technology in shaping their knowledge and interest in science (Baxter & Hainey 2024). However, technical obstacles including insufficient digital understanding, and poor accessibility create crucial challenges, as represented in figure 8. These challenges hamper learning activities and decrease the readiness of students to use technologies successfully. Using technology in education is the parental view represented in figure 10 and 9. The support of parents regarding digital learning, there are still current and preferred methods of learning as compared to traditional ones. Closing this gap through increasing parental engagement and the use of accessibility measures may increase the student's interest in science studies.

8. CONCLUSION, IMPLICATION, AND RECOMMENDATIONS

8.1 Conclusion

In conclusion, this research emphasizes and reveals how modern technology boosts middle school students' interest in science. Computer-aided software applications including digital tools assist in presenting lessons in a dynamic manner that makes the aspect of science even more fun. A personalized approach to learning also enhances the interest level among students and increases the level of learning since it addresses the learners' preferences. However, implementation barriers and concerns with technology-enhanced learning make the use of technology difficult. This research explores that parental support should be acknowledged as a significant factor that reduces or boosts the students' motivation towards technology-enhanced education. The study underscores the importance of planning and integrating technology to enhance students' engagement and address some of the issues in the junior high science class.

8.2 Linking with Objective

Objectives 1 and 2 are linked with theme 2 and outline that technology like virtual labs and simulation can strengthen learners' interest in middle school students. These tools deliver practical experience, boost motivation, and promote scientific ideas (Indra et al, 2023). Objective 3 is linked with theme 3 which illustrates some obstacles in the classroom including poor digital understanding and accessibility problems. However, the ESL approach can handle these barriers by providing effective teaching based on individual learning requirements. Objective 5 is linked to theme 2 and shows a student-centered learning approach can enhance learners' involvement. Personalized solutions can track students' performance and promote interactive sessions. Objective 4 is linked to theme 4 which demonstrates parents' support and opinion towards technology-driven learning are essential for increasing their children's interests.

8.3 Implications

Bringing technology into the teaching and learning of middle school science has effects on the student's performance and the pedagogy used in the classroom. Items like gamified platforms, virtual labs, demonstrations, or any kind of stimulation when integrated with technology bring interest to learning science and help students understand the related concepts in a better way (Laseinde & Dada, 2024). However, inequality increases the risk of the technology divide and subsequently, schools must insist on equal equipment distribution like personalized solutions for all students. Also, students require the use of digital teaching approaches making teachers' training a continuous process. Embracing technology is appropriate as it encourages curiosity and engagement. Competent use of technology results in making the learning environment more democratic and more engaging, in turn, sparking the pursuit of scientific knowledge in the future.

8.4 Recommendations

Educators should incorporate ***technology-aided interaction systems*** such as virtual laboratories, simulations, and game-based learning to strengthen learners' curiosity in science education (Balalle, 2024). Such tools provide the audience with a more enjoyable understanding of complex scientific concepts. AI should be combined with the development of ***personalized learning systems*** to address the learning requirements of an individual student. Thus, the enhancement of teamwork and critical thinking is accomplished through supporting collaborative projects involving different types of digital platforms. Supporting the professional development of the teachers in the adoption and practice of ***sustainable technological teaching methods*** is achieved. Costs should also be expended on technological applications in schools, making sure that the school is equipped with functional equipment and an active internet connection.

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Appendix

RESULTS OF THE ONLINE SURVEY

Part 1: Student Survey (Pre- and Post-Intervention)

➔ Section A: General Information

1. Grade Level: _____
2. Age: 50% 12-13 years, 30% 10-11 years, 18% 14-15 years
3. Gender: 68% female and 32% male

➔ Section B: Enthusiasm for Learning Science

- **Before technology integration:**

How well do you like science?

- Very interested 48.9%
- Somewhat interested 0%
- Neutral 40.8%
- Not very interested 12.2%
- Not interested at all 0%

How much do you enjoy going to science class?

- Always 64%
- Often 28%
- Sometimes 8%
- Rarely 0%
- Never 0%

Are you excited to try out new activities in science? Why or why not?

- **After technology integration:**

When using technology in class for science lessons, has the interest of learning science taken a different direction?

- Significantly increased 60%
- Increased 20%
- No change 20%
- Decreased 0%
- Significantly decreased 0%

What do you like the most about using technology in a science classroom? (Open)

Please indicate how much you agree with the following by selecting a number from 1 (Strongly Disagree) to 5 (Strongly Agree):
- Technology makes science awesomely engaging. 8%
- I comprehend science concepts better with technology. 28%
- That technology keeps me on track during class. 64%

➔ Section C: Feedback

In your opinion, what can be improved when using technology in science class? (Open-ended)

Students can use modern technology in class by making sure to have access to the knowledge centre, such as devices and an internet connection. There should be more focus on activities, and the educational process as a whole should be designed individually for students so everyone does not have to waste time waiting for others.

Part 2: Teacher Reflection Form

How has the infusion of technology changed students' zest for learning in your science classroom? (Open-ended)

It has been observed that students are more attentive as well as inquisitive. They are fond of simulations and technical virtual labs, which introduce more eligibility and interest to the conceptual material.

Do you notice any significant differences regarding students' behavior or concern? If positive, describe. (Open-ended)

Yes, the students are more active during group tasks that involve using the technology.

Identify the challenges you faced in effectively implementing the application of technology in learning. (Open-ended)

Respondents reported that some students had issues with the use of the digital tools offered in their classes and, in general, technical difficulties were a common occurrence in the lessons. Furthermore, it has been revealed that not all learners in the class were equally privileged to study at home.

What, in your opinion, is the most appropriate way to incorporate technology into the teaching of science? (Open-ended)

Utilize practical activities coupled with positive use of ICT, employ the concept of learn, and provide feedback from students.

Part 3: Parent Survey

➔ Section A: General Information

Relation to student:

- Mother 70%
- Father 22%
- Guardian 8%
- Other: _____

➔ Section B: Perceptions of Enthusiasm

How often does your child talk about enjoying science class?

- Always 58%
- Often 30%
- Sometimes 12%
- Rarely 0%
- Never 0%

Do you think the child has changed in attitude towards study science at home since the introduction of technology in science lessons?

Interest in science?

- Increased 60%
- No change 20%
- Decreased 20%

Motivation to study science at home?

- Increased 62%
- No change 24%
- Decreased 14%

Do you think that technology really has an impact on how well your child learns? Why or why not? (Open-ended)

Yes, I think that the program is useful for the child to learn something new. Use of technology enhances its capability to explain lessons through the use of visuals, and this makes them develop curiosity about science.

Part 4: Student Feedback Form

What would constitute the greatest challenge in utilizing technology for learning science? (Open-ended)

Some significant issues occur when such technology is not effective or when the technology used cannot be easily adopted. It is demoralizing to be unable to open apps or simulations to continue learning due to freezing.

In your opinion, does technology facilitate or complicate comprehension of scientific topics? Please elaborate. (Open-ended)

Technology benefits mostly since they assist in easy learning, especially by the use of animations and virtual labs that help in addressing the complex issues in the sciences. But at times it creates complexity if the instructions provided are unclear or there are too many of them.

If you could change one thing about using technology in science classes, what would it be? (Open-ended)

The members should enhance the ease with which the tools are applied. More tutorial or practice time would enable us to become more familiar with them.

Part 5: Data Collection Procedure Explanation

Surveys and Questionnaires:

Distributed to students before and after the implementation of technology in lessons to measure enthusiasm and engagement changes. Parents will complete a short survey at the end of the study to gather external perceptions of student motivation and interest.

Observations:

Conducted during class sessions to record student interactions, participation, and observable enthusiasm trends.

Teacher Reflection Journals:

Teachers will provide written reflections on their experiences with technology integration, noting both challenges and best practices.

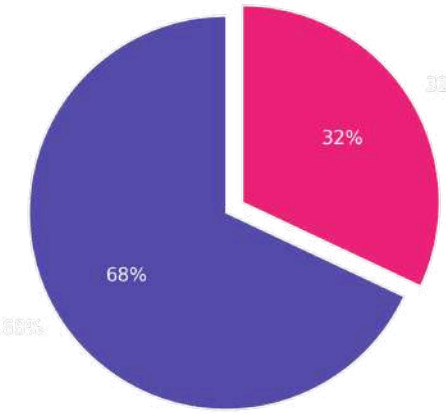


Figure 1: Gender

In the diagram of Figure 1, Purple defines male while Pink defines female.

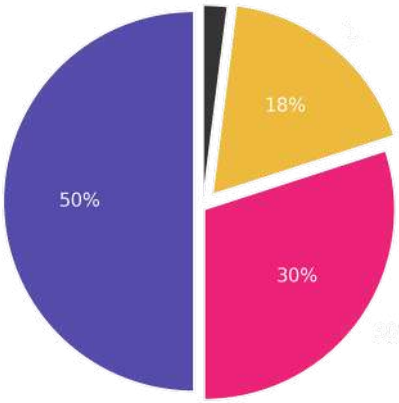


Figure 2: Age group

In the diagram of Figure 2 Purple defines 10-11 years, Pink defines 12-13 years, Yellow indicates 14-15 years and Black defines 16+ years.

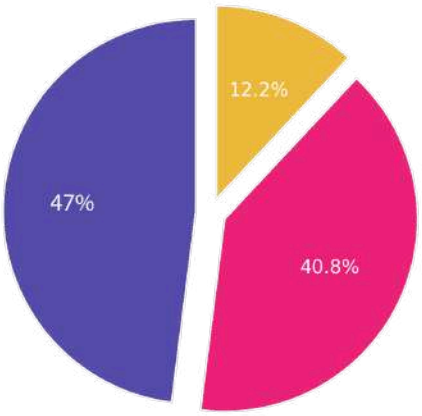


Figure 3: Learning science

In the diagram of Figure 3 Purple defines yes, Pink defines sometimes while Yellow indicates Not really.

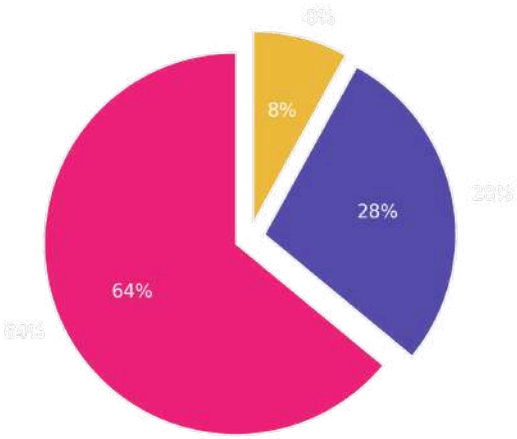


Figure 4: Technology in Science

In the diagram of Figure 4 pink defines everyday, purple shows a few times a week and yellow defines rarely.

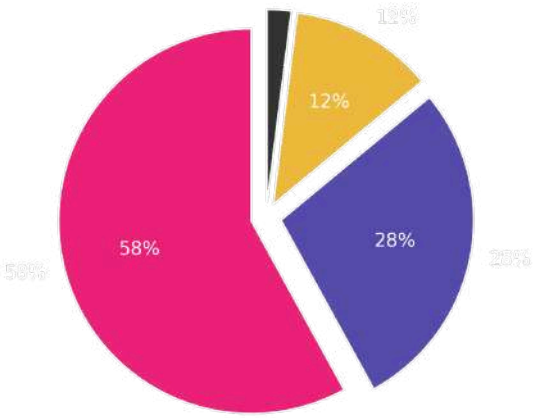


Figure 5: Technology-based learning

In the diagram of Figure 5 pink defines educational videos, purple indicates interactive simulations, yellow defines online quizzes and games and black shows digital textbook

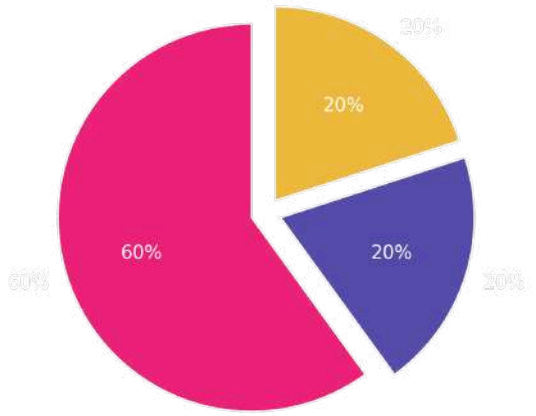


Figure 6: Influence of technology on science topics

In this diagram, blue indicates the percentage of technology usage helps in science topic learning, red indicates that it helps in little, orange indicates that it does not create differences, and 0% technology makes learning confusing.

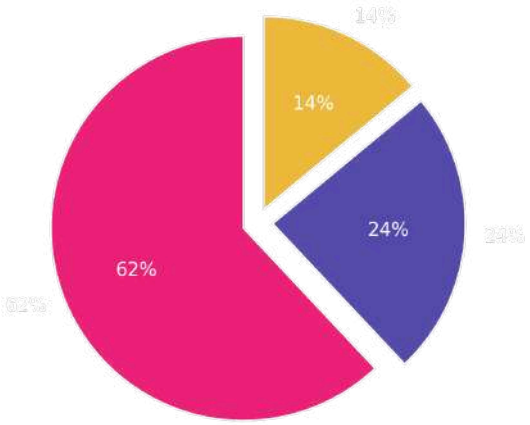


Figure 7: Technology makes science more engaging

This diagram shows that pink indicates a high percentage of technology that makes science learning more interesting, purple suggests technology makes little exciting, yellow suggests technology does not make science interesting, and 0% technology lowers interest in science learning.

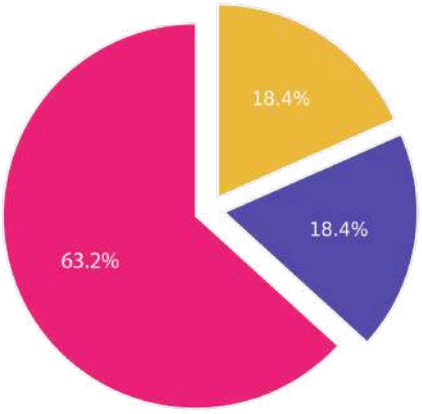


Figure 8: Barriers

In this diagram, pink suggests that technical issues are the biggest barriers in science class, purple indicates that difficulty in technology usage is a barrier, yellow indicates it is distracting, and black does not indicate any challenges.

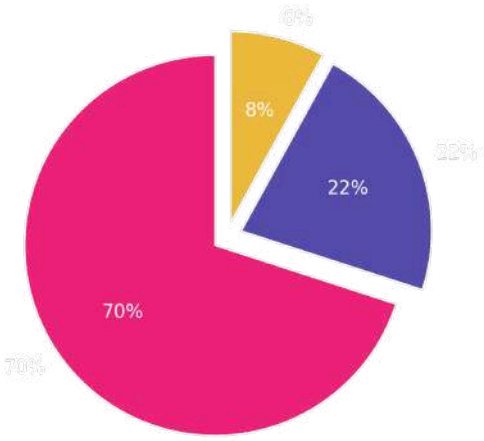


Figure 9: Parents' perception

In this diagram, pink suggests that technology-based learning rather than traditional, purple indicates traditional learning preferences, yellow suggests combined learning, both traditional and technological, and black indicates no preferences.

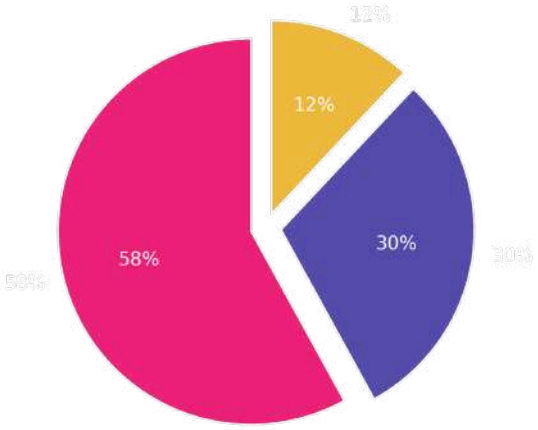


Figure 10: Preference of technology in learning

In this diagram, pink suggests that parents think that technology makes learning more enthusiastic, purple indicates slight engagement, yellow suggests that technology does not change any interest, and black indicates that technology lowers interest in science.