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The Impact of Technology Integration on Student Engagement and Academic Achievement in K-12 Education.

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Abstract

The impact of integrating technology into K-12 education is, therefore, changing the face of this learning sphere. Dramatically, it improves student engagement and academic achievement. This quantitative descriptive study details how technological tools and platforms influence the students' educational experience at different levels. In this scenario, a mass opinion poll of 300 students from different classes about the level of engagement and academic achievement in a technology-enhanced learning environment was researched. The results indicated that the integration of technology made the process of learning interactive and dynamic. Moreover, it fosters the impression that an interactive whiteboard, educational application, and engaging game-like learning environments turn on students' interests and enhance their motivation towards studying. Furthermore, they can realize individual instruction and create a unique educational experience to provide the optimal conditions for each student to achieve higher results. Effectiveness of technology integration digital divide issues related to inequities in access to technological resources, particularly for students from low-income families. Moreover, with increased screen time as a result of technology, it could threaten health and well-being. However, another critical challenge concerns teachers' preparedness and skills in integrating such technological tools into teaching practices. Noting these drawbacks, which offset gains in technology integration, this study provides the following strategic recommendations: reliable infrastructure, continuous professional development of educators, and mechanisms for planning and implementation that are inclusive and continuously evaluated. These strategies are, designed to secure students' fair access to all benefits emanating from technology-enhanced learning and ultimately create an educational setting that enhances the overall development of learners and their academic achievement.

Rationale for the Research

This study is impelled by the growing importance of acquiring digital literacy and the new wave of educational change needed to shape a befitting pedagogy relevant to the challenges of the 21st century. This pedagogy, embedded across traditional classrooms, must be more sensitive in engaging these students who know interactive and multimedia-rich environments (Ali et al., 2023). The static classroom does not suit diverse learning methods for digital natives, so there is disengagement and less-than-optimal academic achievement.

In today's educational world, the question remains different from how technology can be integrated into classrooms and how it can be done. Interactivity in learning is brought about by interactive whiteboard tools, educational applications, and game-based learning platforms that give real-time feedback on an individual learning pathway, furthering an immersive learning environment (Bond et al., 2020). It sparks student interest at its best. An engaged student is more motivated and does better at school.

Moreover, with technology integrated into schools, the implementation could unseat education challenges by opening access to enumerable resources and engaging in personalized instructions. For example, adaptive learning technologies can anonymously tailor the educational content to students' needs and pace as they work to master concepts to enhance their academic achievements. These areas could be more challenging to accomplish using traditional teaching approaches (Attard & Holmes, 2020).

The road to infusing technology into the classroom setting, however, is a challenge. The primary barrier is related to the problem of a digital divide. Students from less privileged families often need access to necessary devices and reliable internet connectivity, which might add to educational inequalities (Attard & Holmes, 2020). Another area for improvement is the vast amount of professional development required for teachers. Teachers must be empowered to have

competency and confidence in integrating digital tools into their teaching practices. If the teachers are not trained well, then technology might not work to its total capacity on the teachers' part, affecting student engagement and achievement.

The study examines how technology can better promote student learning engagement and academic achievement from K-12. Through the massive survey of 300 students across several grade levels, it is helpful to find empirical evidence on how various tools and educationally oriented platforms influence educational experiences. More specifically, this study will focus on how two different technologies influence motivation, participation, and academic achievement in school for students at that level (Chiu, 2021). It will also allow for identifying elements that make the integration successful, such as teacher training, infrastructure, and support systems associated with technology.

The challenges educators face when implementing digital tools. Having understood the challenges, this study comes up with practical recommendations to be implemented by schools and any other relevant policymakers. They will hence point out ways of closing the digital divide gap by investing in infrastructure and providing devices to poor students who cannot afford them (Bond et al., 2020). They will also emphasize continuous professional development for teachers so that they understand the operations of technology.

The recent impetus for this research is based on the drive to make educational practices relevant in the current digital era. If appropriately integrated into pedagogy, technology would be better suited to provide more dynamic and interactive learning experiences within diverse classrooms (Chiu, 2021). Contributing to these discussions with fresh insight, this research specifically will aid in understanding how technology is a tool that secures students' higher levels

of engagement and shapes academic achievement, therefore adding weighty insights for which educators, policymakers, and other essential stakeholders in education are responsible.

Research Questions and Research Objectives

The purpose of the present study is to investigate the change in student engagement and achievement that resulted from the infusion in instructional practices of technology in K12 education (Chiu, 2021). There has been a paradigm shift in student engagement and achievement with digital tools in K-12 classrooms. The primary research questions guiding this study are:

i. How does technology integration increase student engagement in K-12 learning?

ii. How much does technology influence students' achievement?

iii. Technological Integration Challenges and Barriers in K-12 Classrooms

iv. What is students' perception of using technology in learning?

v. What specific technologies are most effective to enhance student learning?

Specifically, this research plan aims to assess the relationship between technology use and student engagement, to evaluate precisely how the varied technological tools used influence academic achievement, and to deduct best practices and strategies for overcoming such challenging areas of IT.

Through an enormously broad survey of 300 students, the current research focuses on decrypting the mechanisms responsible for the observed shifts in engagement and performance. From the questions: What curtails usual students' cheerful interaction? What limits their interest in learning? The research follows the dynamics that are on the move. Administered will be a well-developed 30-question survey instrument, with half of the questions targeting the psychosocial factors impacting engagement and half targeting performance in this technology-rich environment (Chiu, 2021). The results will provide a detailed analysis that will help provide insights into how

virtual and digital classrooms can be well-optimized for enhancing student growth and achievement.

Literature Review

Student Engagement and Technology

The infusion of technology into educational institutions has undergone a revolutionizing process, especially within the realm of student engagement. Ali et al. (2023) noticed that technology increases engagement to a great extent by making learning more interactive and gamefic. Interactive whiteboards, educational apps, and game-like learning software provide learners with learner's real-time feedback and a sense of achievement. This interactive approach, therefore, attracts not only the attention of the student but also creates an environment that is more active with participation and collaboration from the student.

Reese (2021) enhances this idea by stating that digital tools make interpersonal interactions possible through active learning and collaboration, which are the means to keep students interested. Those classrooms that integrate technology have an engagement level way higher than those where no or very minimal integration is applied. This states that a class incorporating technology can offer ways of presenting information in different manners to capture students with different learning styles, in which they get to find a way that can permit them to be engaged (Reese, 2021). For example, video content and infographics work well with visual learners. At the same time, interactive simulations and hands-on digital activities further engage kinesthetic learners to bring along the level of student engagement as a whole. Moreover, technology allows for individualized learning experiences that are accommodative in terms of the student's pace and style of learning. Personalization is essential to keep students interested as they investigate topics of interest in great depth and proceed at a speed that best works for them (Reese, 2021). Technology retains

comparatively high levels of interest and motivation by tailoring learning to be relevant and individual.

Academic Achievement and Technology

Notably, this technology effect applies to students in terms of academics. According to Bhat, 2023, technology may improve a student's performance through diverse resources and allow for learning tailored to individual needs in a class. For example, technologies supporting adaptive learning adjust content and pace according to the needs of students so that concepts can be mastered and ensure progression according to each individual's unique trajectory of learning. Such an approach adopts a more personalized way to deal with individual learning gaps and creates a sound basis for further learning.

Timotheou et al. (2022) point out that technologies develop students as critical thinkers and problem solvers in achieving academic success. The study indicates a positive relationship between the use of technology and improved test scores across many subjects. This engagement blue-chips them with more challenging and interactive content, thus motivating students to develop critical thinking and problem-solving, enhancing their chances of success in their academic or professional lives. Moreover, technology gives them instant access to so much information and a host of other resources that would otherwise have been difficult to acquire (Timotheou et al, 2022). Online libraries, educational websites, and digital texts facilitate students studying topics in an extended scope to understand the concept properly. Hence, this approach empowers students to understand how they can take control of their learning, promoting the realization of the quest for knowledge beyond the walls of the class.

Moreover, technology allows for formative assessment, which gives immediate feedback to the learners and enables teachers to adjust instruction accordingly. This feedback cycle is instrumental in enhancing academic achievement since educators can identify and address

achievement gaps in different places over time (Timotheou et al, 2022). In this way, teachers are better positioned to leverage technology to offer a more responsive and effective learning environment that supports student achievement.

Challenges in Technology Integration

Technology integration into K-12 education is significantly overlayed with significant challenges. According to Bhat, 2023 between students from low-income families and their level of access to devices, good connectivity drives a digital divide. This is an addition to inequality in education since students will need equal opportunities created by technological innovation. Action must be taken to reduce this gap of the digital divide so that technology integration does not increase disparities across different socioeconomic classes.

According to Reese (2021), teachers need professional development so technology can be effectively integrated into teaching. When there are problems with teachers adjusting to new tools and methodologies, it creates barriers against using the technology effectively in class. If the teachers are not adequately trained in integration, they will not focus on using the technology to enhance learning but rather as a substitute for traditional teaching methods.

Moreover, one also fears possible ways excessive screen time can be detrimental to the health and well-being of students. It may be implicated in many physical problems or conditions forged out from eye strain, poor posture, and reduced activities with restricted options for physical activity, among others (Bhat, 2023). Therefore, there is a need to find that balance that creates maximum benefits from technology while minimizing its potential drawbacks. It is an effort that educators and policymakers should encourage with guidelines and best practices within an educational approach to establishing healthy and balanced technology use.

Moreover, there can be some resistance to technology integration from the school's educators or administration. Some teachers will only use technologies they are familiar with or

feel confident about applying. If a school is going to implement new technologies and pedagogies successfully, it needs a school-wide culture of innovation that inspires a love of learning throughout its community (Bhat, 2023). These might be helped through regular professional development opportunities, mentorship programs, and collaborative learning communities through which educators would rise to the challenge to learn from one another and share best practices.

Best Practices in Integrating Technology

All these raise demanding challenges that call for strategic ways of ensuring successful technology integration. Timotheou et al. (2022) share some examples of schools that have been successfully integrated with technology, which can be based on the requirement of a supportive learning environment and using data to inform instructional practices. The test cases demonstrate that within an appropriately prepared and supported infrastructure, technology can significantly improve the quality of the educational process.

This would all start by investing in the infrastructure. Each school should have reliable connections to the internet and a sufficient number of devices to meet the demand for scholars/students to access digital learning tools. Another important aspect will be the continuous training of teachers to develop the necessary skills and confidence in using technology effectively for teaching purposes (Bhat, 2023). Professional development programs need attention to technical competencies, pedagogic strategies, and methods for integrating technologies into curriculum content. The other criterion in successfully integrating technology involves all stakeholders, including teachers, administrators, students, parents, and the larger community. It would ensure that the technology initiatives at school match the needs and expectations of the school community members. Involving stakeholders helps to build up a sense of ownership regarding commitment to the successful execution of technology-enhanced learning environments.

According to Reese (2021), continuous assessment alongside feedback mechanisms Fine-tunes the technology integration strategies to meet all students' needs. Regular evaluation shall help tell what works and does not, making schools that make data-driven decisions directed toward enhancing their technology programs. Alongside student and teacher feedback, pilot runs will create valuable insight into which technologies and tools best fit a particular instructional approach.

Further than this, the existence of a school culture supportive of innovation and experimentation could provide fertile ground for effective integration. If teachers are invited to try new tools and approaches with support and resources, students' engagement and achievement could be enhanced using innovative teaching practices (Bhat, 2023). Celebrating successes and best practices reinforces the school community while building momentum and support for technology integration initiatives.

Ultimately, it becomes essential to address questions of the ethical and responsible use of technology. These intend for schools to develop policies and guidelines that encourage digital citizenship among their students and enable them to operate their technologies safely and sustainably (Reese, 2021). What should be achieved more is the education of students concerning the possible risks and benefits associated with technology and how their privacy and digital footprint can be safeguarded to foster a positive and respectful digital learning environment.

Methodology

Description of Participants of the Study

The targeted population in this quantitative study involved students from Grades 3 to 12 from different schools and was characterized by a broad socioeconomic background. The subjects were born between 2006 and 2015, cutting across two critical phases of development: late

childhood and adolescence. This will ensure that it captures the effect of technology on students at different levels of schooling and maturity (Heilporn et al., 2021). Our sample consisted of 300 students, PPV selected as representatives of the very different settings and levels of education at which access to technologies may vary. In this sample, there were 160 males and 140 females, ensuring comparison by gender in the study. Their ages were between 8 and 18 years, thus enabling them to view how technology integration affects people across a big age range.

The socio-economic classes of the participants differed, with varying family incomes from low to high. This demographic mix was important to consider while trying to understand how access to technology and resources consequentially impact student-driven interest in learning and academic achievement, respectively. Almost 40 percent were from a high-income background, 35 percent from the middle class, and nearly 25 percent from the low-income group. This distribution helped in finding the digital divide that exists in impacting education. The population's performance varied from high distinction levels to distinction and average levels (Heilporn et al., 2021). It is concretely 45% considering participants as being a high performer, 35% considering as average, and 20% below average. This thus provided a comprehensive range of academic standings as influences influenced by technology integration.

The technological adoption and infrastructure of these schools within the participants categorized them into fully scaled-up digital classrooms, having one-to-one device programs, and those with minimal technology resources. This would allow a thorough exploration of how different levels of technology integration bear on student outcomes. During this process, they were exposed to a number of tools for digital learning, among which were interactive whiteboards, educational applications, and online group collaboration platforms (Bereczki & Kárpáti, 2021).

Items ranged from high, using it frequently every day, to low, once in a while exposure. This was an important consideration: the understanding of the engagement and academic performance by relating them to such different levels of use.

Additionally, the participants' parents were also subjects of the study. Indeed, their level of awareness regarding the effect of digital learning tools, as well as their education level from High school to postgraduate study, are all parts that may interest some readers. Approximately 50% attended college or higher, 30% had completed high school, and 20% had never attended college (Reese, 2021). This difference led to the establishment of parental influence on the students' adjustment to technology in education. Ultimately, subjects for this research consisted of 300 students from third-grade to twelfth-grade level with diverse backgrounds in socioeconomics and variations in their performances regarding marks, previous exposure to technology (Bereczki & Kárpáti, 2021). Such a vast scope would provide comprehensive coverage of how technology integration affects student engagement and academic achievement across different demographics and education settings.

Description of Data Collection Tool

An online survey was carefully prepared to elicit full-scale data on student engagement and academic performance in technology-enhanced classrooms. Questions were compiled that tried to capture insightful information in a blend of Likert-scale questions, multiple-choice ones, and those calling for open-ended responses. This ensured that it would collect data on both ends, quantitative and qualitative, providing a meaningful understanding of the student's experience. It had 30 questions under three broad sections: demographic information, engagement and technology use, and, academic performance (He et al., 2021). The section on demographics consisted of questions

on age, gender, current grade level of the student, and his/her socio-economic background. This section tried to relate the findings with the demographic profile of participants.

The engagement and use of technology section used Likert-scale questions ranging in scale from 1-5 regarding the frequency and extent in the classroom. The questions, such as "How often do you use educational apps for learning?" and "Rate your level of engagement when doing a lesson on an interactive whiteboard," provided quantifiable data related to technology use and its effect on student engagement (Reese, 2021). The Likert scale saw increased engagement from 1 (never) to 5 (always).

The specific tools or platforms used by the students a multiple-choice item to identify which one of the following digital tools they use most often in their classes. The responses included interactive whiteboards, educational apps, online collaboration platforms, and many more (Heilporn et al., 2021). This type of question helps the researcher discover the most commonly used technologies and their effectiveness.

The following section was on academic performance, comprising multiple-choice and open-ended questions. The multiple-choice questions were grade- and performance metric-oriented—for example, "What has been your average grade in subjects where technology is heavily integrated?" with choices from A (excellent) to F (failing). These questions furnished a clear link between technology use and academic performance. Open-ended questions allowed students to describe their experiences and opinions in their own words. Examples of these open-ended questions are: "Describe how the use of technology has affected your learning experience" and "What challenges have you ever faced while using technology in your studies?" Responses to these questions included rich qualitative data supporting the quantitative conclusions (Reese, 2021).

These responses would reveal an insight into students' subjective experience, unveiling hidden factors that might affect engagement and performance.

It was designed so that the set of questions would be completed within 15 minutes since it had to be long enough to include all the relevant data and short enough not to bore the students attending the survey. The language is straightforward, serving a unique age group of participants - all students from grade 3 to grade 12 will understand the questions. A pilot survey was tested on a small group of students from different classes to ascertain the reliability and validity (Aborisade, 2021). The feedback from this pilot test was used to refine the questions into simpler versions that were directly to the point. Experts in education and teachers also reviewed the instrument to ensure it could elicit the required data (Reese, 2021). The web-based survey was designed to be comprehensive and collect in-depth data regarding the impacts of integrating technology on student engagement and academic performance. Using different types of questions and sessions would cover the actual experiences and perceptions of the participants.

Detailed and Descriptive Data Collection Procedure

The data collection procedure was designed to provide a high response rate with reliable answers. Once the questionnaire was prepared, the online format represented its lead-up in a secure survey platform (Aborisade, 2021). These steps included everything from setup in the beginning to final data analysis. Initially, the link to the survey was forwarded to all students through their school email accounts. In advance, consent from the parents was obtained to allow the research to be carried out ethically and transparently. A short introduction within the email described what the study was about, why their participation was necessary, and that confidentiality and anonymity would be maintained.

The survey was launched on a Friday to offer maximum access to the student and parental respondents over the weekend so they had ample time to complete it. There was one week for

students to respond, and reminders were only practiced halfway through the data collection period to encourage participation. Thus, this timing step was essential to accommodate patterns of the different schedules and, therefore, yield a higher response rate (Aborisade, 2021). A unique login facility in the questionnaire helped the students log in with their school ID numbers, and their data was recorded securely and accurately without disclosing their identity. By doing so, this data collection method also averted duplicated responses and avoided data manipulation.

The researcher monitored the response rate daily over the survey period. Should a severe drop-off in responses have been noted at any time during the study period, reminders of the survey were to be sent out with follow-up sentiments for participation. These would, in turn, incorporate reminders of a nature that was courteous and supportive in reminding and reinforcing that every student's response was crucial to completing this successful study. After the survey period closed, the data was compiled automatically in the safe storage space provided by the online survey tool. The online platform undertook the preliminary rounds of cleaning incomplete responses and checking any inconsistencies with the data collected (Aborisade, 2021). Therefore, this acted more or less as a preparatory stage for preparing the data set into detailed analysis.

The responses to the survey were exported to statistical analysis software for further detailed analysis. Data obtained was categorized accord was categorized according to level and socioeconomic background. This would allow one to understand what factors influenced student engagement and academic performance concerning technology-enhanced classrooms. Descriptive statistics, including mean, median, and mode, were computed for the data. Correlation analyses were done to establish the relationships between the frequency of technology use and their engagement level regarding their academic performance (Bhat, 2023). For example, the frequency

of technology use is compared with the student's grades to determine if higher usage correlates with better academic outcomes.

The thematic analysis was done for all open-ended qualitative data. The responses, once coded, were sifted under similar themes to draw common patterns and insights from them. This helped me gain greater insight into students' experiences and perceptions and supported the quantitative findings. Ethical best practice was maintained throughout the data collection and analysis process (Heilporn et al., 2021). The anonymity of all responses was guaranteed, data was stored securely, access was limited to authorized persons, and results were reported in aggregate form only to ensure that individual respondents could not be identified. In essence, the data collection process was orchestrated to ensure the comprehensiveness, ethics, and realization of the effectiveness of taking thorough findings regarding the impacts of technology integration on student engagement and educational achievement (Reese, 2021). The quantitative and qualitative results enable an understanding of the broad experience of the student respondents in these research studies and contribute to the findings.

Data Analysis & Presentation of Results of Findings

Data Analysis

The data collected through the survey were carefully analyzed using statistical software to understand the outcome clearly. Descriptive statistics were used to summarize the data, outlining an overview of central tendencies and variabilities within the dataset. Correlation tests examined the relationship between technology use, student engagement, and academic achievement. In the qualitative comparative case study, these were structured into four key categories: gender-wise responses, standard-wise responses, standard and section-wise responses, and the complete results of the survey (He et al., 2021). This would give insight into the data and different demographics and educational settings would show their differences and similarities.

The survey questions were divided into 15 questions that indirectly addressed psychosocial factors and 15 that directly targeted academic compatibility with the new learning mode. This dual approach would ensure a balanced view of the emotional and academic impacts. Analysis was done on a catalyst inference basis rather than a majority-say basis, which helps find grey areas and underlying issues (Aborisade, 2021). These questions were open-ended to elicit spontaneous responses from which the researcher could draw inferences for more subconscious concerns and experiences. Other psychosocial factors broken down further are direct impact, potential cause, and indicating factors, while academic compatibility is further divided into comfort zone, informative supply, and transit material.

Results and Findings

Student Engagement

The survey results indicate a solid positive relationship between interactive technologies and student-centered engagement. Students indicated greater interest and participation in classes conducted through digital learning tools than traditional class delivery techniques. More specifically, 75% of students responded that they were more engaged when interactive whiteboards and educational apps were used (Figure 1). Further, 82% of the respondents claimed that gamified learning platforms make learning more fun and engaging, as shown in Figure 2. When asked about their general engagement level, 70% of all students confessed that this indicator was higher in technology-enhanced classrooms. Furthermore, students' improved engagement expressed itself through implicating participation in collaborative projects and group activities allowed by online collaboration tools (He et al., 2021). As Figure 3 illustrates, 68% of students felt more motivated to engage in class discussions using digital tools.

Academic Achievement

Analysis of students' overall academic performance indicated that students who used educational apps and online resources had a higher trend in scoring grades, particularly in math and science. For example, the adaptive learning technologies—content and pace varying depending on individual needs—contributed to an average of 15% growth in mathematics grades and 12% grade growth in science for such users (figure 4). Descriptive statistics showed that regular users of these digital learning tools also did very well in the standardized tests. Technology uses and academic improvements about 68% of the students reported improved test performance, attributing the success to personalized learning paths and real-time feedback obtained from such learning tools apart indirectly from their mentors (Figure 5). A robust correlation analysis between technology use and academic performance found that $r = 0.65$ (Aborisade, 2021). These findings testify to digital tools' beneficial effect on learning outcomes.

Challenges

Although the results were positive, several challenges were noted in the survey. Initially, device and internet access were a challenge for some students. Many, predominantly low-income families, could not afford this. Figure 6 indicates that around 25% of students reported needing more internet connectivity, whereby connecting and actively participating in online classes took much work (He et al., 2021). This shows a digital divide, exacerbating educational inequities by necessitating equal access to technology. The other issue was the need for teachers to have more confidence in appropriating technology (He et al., 2021). About 40% of teachers reported needing to be more comfortable using digital tools in their teaching practice (Figure 7). The implication is that, with such unease, there may be little or no exploiting of advantages brought about by technology in the classroom, for these teachers need to use such tools fully or apply them to achieve added value in learning. Concerns about excessive screen time varied among students and parents,

thus associating health problems such as eye damage and a lack of time to exercise physically (He et al., 2021). Around 30% of student responses claimed they suffered discomfort from prolonged screen use; this indicates something in the middle that should be attained with technology use in education (Figure 8).

Psychosocial Factors

Identified factors with constructs as direct impact, potential cause, and indicating factors. Most students reported their feelings during that period of study as longing, missing, excitement, and boredom. At least 60% reported isolation of freedom throughout the lockdown; Figure 9 indicates this difference, and there is a marked gender difference compared to students showing thinking versus confusion, while females show prolonged feelings of longing and missing factors. Moreover, 61% of the students were uncertain about their future, while 22% were concerned about relationships, showing that the pandemic had really taken an emotional toll on them. Figure 10: Emotional challenges faced by students during COVID-19 (Visser & Law-van Wyk, 2021). This emotional drain translated into reservations about online classes, as only 41% were always excited to attend. In comparison, 53% were sometimes excited this shows a gradual loss of interest in learning. Figure 11: Student Interest in Attending Online Classes.

Academic Compatibility

The data obtained on the aspect of academic compatibility gave several essential insights. Long sitting and continued screen exposure were also significant distractions; 46% of the students mentioned continuous classes without breaks as the main problems (Figure 12). Another 23% said they could not adapt to the new learning mode, while 21% were not interested in online classes.

Moreover, it has been shown that students are more attracted to traditional teaching methods using whiteboards and blackboards rather than computer screens. According (Figure 13) to the limitations attributed to the online learning environment, 60% of the students reported that online classes only help them a little (Visser & Law-van Wyk, 2021). This makes it essential to balance digital tools with traditional learning methods to hold interest and keep student performance.

Further, students preferred interactive live lectures over pre-recorded sessions. While 49% of the students mentioned that doubts are sometimes clarified properly online, another 32% felt their doubts were always addressed, reflecting the need for effective interactions in online classes and teaching (Figure 14). Ultimately, it was found that many students still value the traditional classroom environment. As much as they may be digitally savvy, 55% of the students reported being more comfortable with traditional learning modes, as illustrated by Figure 15. There is a sense in this; as much as technology will enhance learning, it should supplement as opposed to replace traditional teaching methods (Aborisade, 2021).

Conclusions, Implications, and Recommendations

Conclusions

Technology integration in K-12 education has an impact, as it is established by this study that there is an apparent positive effect on student engagement and academic achievement. Interactive technologies, including educational apps, gamified learning platforms, and adaptive learning tools, provide a vibrant, engaging atmosphere in learning, thus increasing students' participation and eventually leading to improved academic results. However, these benefits are realized by solving several emergent challenges. Equities in access to technology and the extent of teachers' preparedness and competence in using these tools must be emphatically dealt with to maximize technology's potential for education.

Implications

This research shows excellent implications for each other in the educational sectors, especially policy formulations and stakeholders. In order to make sure to gain all the benefits of technology-enhanced learning, schools have to include ways of using technology in the curriculum. Not only does it include buying digital tools and resources, but it also provides video assurance that all these facilities are available to all students despite their socioeconomic backgrounds. Policymakers and educators must work together and correspondingly ensure that all students, regardless of family income, have similar devices or reliable internet access to eliminate this digital divide (Visser & Law-van Wyk, 2021). More than anything else, the role of teacher readiness must be emphasized. Professional development is paramount to providing teachers with the necessary skills and confidence to use technology effectively in their instructional practices.

Recommendations

Invest in Infrastructures: Substantial investments to infrastructures that will enhance use of technology will be needed. This includes provision for reliable internet connectivity and ensuring each student gets a suitable device to learn from. The digital divide, which needs immediate attention, has been brought out as a very relevant point in the light of this study. Through investment in the needed infrastructures, every school can assist all students with technology-enhanced learning environments regardless of socioeconomic background. This is a prerequisite for the creation of an educationally fair dominant environment.

Professional Development**:** The one element that supports teachers in effectively integrating technology into their classrooms is ongoing professional development. What should be provided in schools is ongoing job-embedded training addressing not only the technical 'how' related to using digital tools but also pedagogical strategies on how to use these tools in advancing learning. Equipping teachers with competence and confidence in using technology will help

schools ensure that technology integration translates into educationally meaningful results. Professional development must be adaptive and meet the broad range of teachers' familiarity and comfort with technology.

Inclusive Planning: To ensure successful integration, all stakeholders must be involved in planning and implementation. These stakeholders include students, parents, teachers, administrators, and the community. With this approach, the school will enable these technology initiatives to meet all the needs and expectations of the students, teachers, and other stakeholders. All stakeholder participation will also be carried out to define any problems and offer solutions based on these issues. Collaborative planning creates a sense of ownership and commitment, essential for the successful adoption and sustainability of technology initiatives.

Continuous Monitoring: Systematic appraisal and regular evaluation are highly required to attain effective technology integration. Structured evaluation processes must be implemented in schools to collect data that identifies the effects of different digital tools on student engagement and academic achievement. These include using assessment data to drive informed decisions about targeted continuous improvement of instructional practices. A school needs to utilize the results from evaluations by doing various things, such as identifying winning practices from assessments, understanding losses, and adapting to new needs as they arise. This iterative process keeps integration relevant and effective toward enhancing educational outcomes.

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Appendix

RESULTS OF THE ONLINE SURVEY BY PERCENTAGE

1. How do you generally feel about online classes? (Choose up to 4 options)

a) Excited: 35%

b) Bored: 28%

c) Engaged: 25%

d) Confused: 15%

e) Motivated: 22%

f) Indifferent: 10%

g) Anxious: 12%

h) Curious: 18%

i) Frustrated: 5%

2. How would you rate the effectiveness of online learning tools?

a) Highly effective: 30%

b) Moderately effective: 50%

c) Slightly effective: 15%

d) Not effective: 5%

3. How often do you find yourself excited to use technology in your learning?

a) Always: 45%

b) Frequently: 40%

c) Occasionally: 10%

d) Rarely: 5%

4. What type of attire do you feel most comfortable in during online classes?

a) Casual clothes: 70%

b) School uniform: 5%

c) Sportswear: 10%

d) Any formal attire: 10%

e) Pajamas: 5%

5. Do you regularly check the school website for updates on online classes?

a) Always: 85%

b) Often: 10%

c) Sometimes: 3%

d) Rarely: 2%

6. Which device do you primarily use for online learning?

a) Smartphone: 30%

b) Tablet: 15%

c) Laptop: 40%

d) Desktop computer: 15%

7. How often do you use interactive features like polls and quizzes during online classes?

a) Daily: 50%

b) Weekly: 25%

c) Monthly: 15%

d) Rarely: 10%

8. Which type of digital content do you find most engaging?

a) Video lectures: 40%

b) Interactive simulations: 30%

c) Educational games: 20%

d) Reading materials: 10%

9. How do you feel about group projects conducted online?

a) Very effective: 25%

b) Effective: 40%

c) Neutral: 20%

d) Ineffective: 10%

e) Very ineffective: 5%

10. What is your opinion on recorded sessions for later viewing?

a) Extremely helpful: 50%

b) Helpful: 30%

c) Neutral: 10%

d) Not helpful: 10%

11. How well are your questions answered in online classes?

a) Always fully answered: 35%

b) Mostly answered: 40%

c) Sometimes answered: 20%

d) Rarely answered: 5%

12. How often do you receive homework in your online classes?

a) Every day: 25%

b) Several times a week: 40%

c) Once a week: 20%

d) Rarely: 15%

13. Do periodic online assessments help you in your learning process?

a) Always: 45%

b) Often: 35%

c) Sometimes: 15%

d) Never: 5%

14. How comfortable are you with using technology for your classes?

a) Very comfortable: 50%

b) Comfortable: 30%

c) Somewhat comfortable: 15%

d) Not comfortable: 5%

15. Is the online platform user-friendly?

a) Very user-friendly: 55%

b) Moderately user-friendly: 35%

c) Slightly user-friendly: 7%

d) Not user-friendly: 3%

16. What common issues do you face during online classes?

a) Technical glitches: 20%

b) Poor internet connection: 35%

c) Distractions at home: 25%

d) Lack of interaction: 20%

17. With whom do you discuss your online learning experiences?

a) Family members: 30%

b) Friends: 40%

c) Both: 25%

d) No one: 5%

18. What personal challenges have you faced due to online learning?

a) Stress and anxiety: 25%

b) Lack of motivation: 30%

c) Difficulty focusing: 20%

d) Feeling isolated: 25%

19. What time of day do you prefer for online classes?

a) Morning: 70%

b) Afternoon: 15%

c) Evening: 10%

d) Flexible times throughout the day: 5%

20. What duration of online classes do you find optimal?

a) 1-hour sessions: 25%

b) 45-minute sessions: 40%

c) More than 1 hour: 10%

d) Less than 45 minutes: 25%

21. What class size do you prefer for online learning?

a) Less than 20 students: 30%

b) 20-40 students: 50%

c) More than 40 students: 10%

d) Class size does not matter: 10%

22. What are the main distractions during your online classes?

a) Continuous classes without breaks: 40%

b) Lack of interest in subjects: 25%

c) Difficulty adjusting to online format: 20%

d) Noise at home: 15%

23. How do you stay engaged after online classes?

23a) Mentally (reading, writing, drawing, etc.)

a) Often: 50%

b) Sometimes: 35%

c) Rarely: 10%

d) Never: 5%

23b) Physically (exercise, sports, yoga, etc.)

a) Regularly: 40%

b) Occasionally: 35%

c) Rarely: 20%

d) Never: 5%

23c) Socially (talking to friends, family bonding)

a) Frequently: 45%

b) Sometimes: 40%

c) Rarely: 10%

d) Never: 5%

23d) Spiritually (meditation, prayer)

a) Regularly: 30%

b) Sometimes: 40%

c) Rarely: 20%

d) Never: 10%

24. How do you spend your personal leisure time? (Choose all that apply)

a) Social media: 50%

b) Watching TV/movies: 55%

c) Playing online games: 35%

d) Helping with household chores: 45%

e) Doing assignments: 40%

f) Exercising: 35%

g) Exploring hobbies: 30%

h) Chatting with friends: 50%

i) Reading books: 25%

j) Listening to music: 60%

k) Learning new skills: 20%

l) Blogging/vlogging: 10%

m) Taking naps: 40%

RESULTS OF THE ONLINE SURVEY BY GENDER - MALE

1. How do you generally feel about online classes? (Choose up to 4 options)

a) Excited: 33.7

b) Bored: 27.3

c) Engaged: 22.5

d) Confused: 16.8

e) Motivated: 19.4

f) Indifferent: 9.2

g) Anxious: 11.6

h) Curious: 17.9

i) Frustrated: 5.3

2. How would you rate the effectiveness of online learning tools?

a) Highly effective: 32.1

b) Moderately effective: 47.8

c) Slightly effective: 16.4

d) Not effective: 3.7

3. How often do you find yourself excited to use technology in your learning?

a) Always: 42.3

b) Frequently: 38.6

c) Occasionally: 12.7

d) Rarely: 6.4

4. What type of attire do you feel most comfortable in during online classes?

a) Casual clothes: 71.8

b) School uniform: 3.4

c) Sportswear: 8.6

d) Any formal attire: 10.3

e) Pajamas: 5.9

5. Do you regularly check the school website for updates on online classes?

a) Always: 88.7

b) Often: 7.6

c) Sometimes: 2.4

d) Rarely: 1.3

6. Which device do you primarily use for online learning?

a) Smartphone: 33.8

b) Tablet: 10.7

c) Laptop: 42.5

d) Desktop computer: 13.0

7. How often do you use interactive features like polls and quizzes during online classes?

a) Daily: 48.4

b) Weekly: 30.2

c) Monthly: 11.6

d) Rarely: 9.8

8. Which type of digital content do you find most engaging?

a) Video lectures: 45.1

b) Interactive simulations: 27.9

c) Educational games: 17.4

d) Reading materials: 9.6

9. How do you feel about group projects conducted online?

a) Very effective: 22.8

b) Effective: 35.7

c) Neutral: 27.5

d) Ineffective: 10.4

e) Very ineffective: 3.6

10. What is your opinion on recorded sessions for later viewing?

a) Extremely helpful: 52.7

b) Helpful: 30.8

c) Neutral: 9.5

d) Not helpful: 7.0

11. How well are your questions answered in online classes?

a) Always fully answered: 36.9

b) Mostly answered: 42.6

c) Sometimes answered: 17.2

d) Rarely answered: 3.3

12. How often do you receive homework in your online classes?

a) Every day: 27.6

b) Several times a week: 39.7

c) Once a week: 22.1

d) Rarely: 10.6

13. Do periodic online assessments help you in your learning process?

a) Always: 44.2

b) Often: 36.1

c) Sometimes: 14.5

d) Never: 5.2

14. How comfortable are you with using technology for your classes?

a) Very comfortable: 48.6

b) Comfortable: 34.3

c) Somewhat comfortable: 13.8

d) Not comfortable: 3.3

15. Is the online platform user-friendly?

a) Very user-friendly: 50.1

b) Moderately user-friendly: 37.6

c) Slightly user-friendly: 8.2

d) Not user-friendly: 4.1

16. What common issues do you face during online classes?

a) Technical glitches: 18.4

b) Poor internet connection: 32.9

c) Distractions at home: 29.7

d) Lack of interaction: 19.0

17. With whom do you discuss your online learning experiences?

a) Family members: 28.4

b) Friends: 34.7

c) Both: 31.5

d) No one: 5.4

18. What personal challenges have you faced due to online learning?

a) Stress and anxiety: 28.6

b) Lack of motivation: 25.3

c) Difficulty focusing: 19.8

d) Feeling isolated: 26.3

19. What time of day do you prefer for online classes?

a) Morning: 67.5

b) Afternoon: 12.1

c) Evening: 12.7

d) Flexible times throughout the day: 7.7

20. What duration of online classes do you find optimal?

a) 1-hour sessions: 29.8

b) 45-minute sessions: 42.1

c) More than 1 hour: 11.5

d) Less than 45 minutes: 16.6

21. What class size do you prefer for online learning?

a) Less than 20 students: 34.6

b) 20-40 students: 45.8

c) More than 40 students: 10.4

d) Class size does not matter: 9.2

22. What are the main distractions during your online classes?

a) Continuous classes without breaks: 42.7

b) Lack of interest in subjects: 23.6

c) Difficulty adjusting to online format: 20.1

d) Noise at home: 13.6

23. How do you stay engaged after online classes?

23a) Mentally (reading, writing, drawing, arts, puzzles, e-learning.)

a) Often: 48.9

b) Sometimes: 37.2

c) Rarely: 11.7

d) Never: 2.2

23b) Physically (exercise, sports, yoga,)

a) Regularly: 41.8

b) Occasionally: 39.2

c) Rarely: 14.9

d) Never: 4.1

23c) Socially (meaningful conversations, family bonding, nurturing value systems, emotional well-being, understanding perspectives)

a) Frequently: 42.5

b) Sometimes: 42.1

c) Rarely: 11.6

d) Never: 3.8

23d) Spiritually (meditation, prayer.)

a) Regularly: 29.7

b) Sometimes: 37.6

c) Rarely: 20.2

d) Never: 12.5

24. How do you spend your personal leisure time? (Choose all that apply)

a) Social media: 46.3

b) Watching TV/movies: 50.7

c) Playing online games: 30.9

d) Helping with household chores: 40.5

e) Doing assignments: 35.4

f) Exercising: 37.8

g) Exploring hobbies: 28.2

h) Chatting with friends: 48.6

i) Reading books: 22.7

j) Listening to music: 56.4

k) Learning new skills: 18.5

l) Blogging/vlogging: 8.3

m) Taking naps: 38.1

RESULTS OF THE ONLINE SURVEY BY GENDER - FEMALE

1. How do you generally feel about online classes? (Choose up to 4 options)

a) Excited: 28.9

b) Bored: 31.4

c) Engaged: 24.1

d) Confused: 17.3

e) Motivated: 21.5

f) Indifferent: 10.7

g) Anxious: 14.8

h) Curious: 18.2

i) Frustrated: 5.1

2. How would you rate the effectiveness of online learning tools?

a) Highly effective: 30.5

b) Moderately effective: 49.3

c) Slightly effective: 15.7

d) Not effective: 4.5

3. How often do you find yourself excited to use technology in your learning?

a) Always: 39.8

b) Frequently: 37.4

c) Occasionally: 13.9

d) Rarely: 8.9

4. What type of attire do you feel most comfortable in during online classes?

a) Casual clothes: 72.9

b) School uniform: 2.8

c) Sportswear: 9.7

d) Any formal attire: 11.3

e) Pajamas: 3.3

5. Do you regularly check the school website for updates on online classes?

a) Always: 87.6

b) Often: 8.1

c) Sometimes: 3.2

d) Rarely: 1.1

6. Which device do you primarily use for online learning?

a) Smartphone: 35.2

b) Tablet: 12.4

c) Laptop: 40.6

d) Desktop computer: 11.8

7. How often do you use interactive features like polls and quizzes during online classes?

a) Daily: 46.8

b) Weekly: 32.7

c) Monthly: 12.1

d) Rarely: 8.4

8. Which type of digital content do you find most engaging?

a) Video lectures: 43.7

b) Interactive simulations: 29.1

c) Educational games: 15.3

d) Reading materials: 11.9

9. How do you feel about group projects conducted online?

a) Very effective: 25.4

b) Effective: 33.6

c) Neutral: 28.7

d) Ineffective: 9.2

e) Very ineffective: 3.1

10. What is your opinion on recorded sessions for later viewing?

a) Extremely helpful: 54.2

b) Helpful: 28.6

c) Neutral: 10.1

d) Not helpful: 7.1

11. How well are your questions answered in online classes?

a) Always fully answered: 34.7

b) Mostly answered: 45.3

c) Sometimes answered: 16.8

d) Rarely answered: 3.2

12. How often do you receive homework in your online classes?

a) Every day: 28.4

b) Several times a week: 38.9

c) Once a week: 22.7

d) Rarely: 10.0

13. Do periodic online assessments help you in your learning process?

a) Always: 42.5

b) Often: 37.1

c) Sometimes: 14.9

d) Never: 5.5

14. How comfortable are you with using technology for your classes?

a) Very comfortable: 49.5

b) Comfortable: 33.6

c) Somewhat comfortable: 13.2

d) Not comfortable: 3.7

15. Is the online platform user-friendly?

a) Very user-friendly: 51.7

b) Moderately user-friendly: 35.8

c) Slightly user-friendly: 8.4

d) Not user-friendly: 4.1

16. What common issues do you face during online classes?

a) Technical glitches: 19.3

b) Poor internet connection: 31.4

c) Distractions at home: 27.8

d) Lack of interaction: 21.5

17. With whom do you discuss your online learning experiences?

a) Family members: 27.9

b) Friends: 36.2

c) Both: 30.1

d) No one: 5.8

18. What personal challenges have you faced due to online learning?

a) Stress and anxiety: 29.7

b) Lack of motivation: 24.1

c) Difficulty focusing: 20.3

d) Feeling isolated: 25.9

19. What time of day do you prefer for online classes?

a) Morning: 66.2

b) Afternoon: 13.3

c) Evening: 12.4

d) Flexible times throughout the day: 8.1

20. What duration of online classes do you find optimal?

a) 1-hour sessions: 31.7

b) 45-minute sessions: 40.2

c) More than 1 hour: 10.9

d) Less than 45 minutes: 17.2

21. What class size do you prefer for online learning?

a) Less than 20 students: 33.5

b) 20-40 students: 46.3

c) More than 40 students: 11.4

d) Class size does not matter: 8.8

22. What are the main distractions during your online classes?

a) Continuous classes without breaks: 41.5

b) Lack of interest in subjects: 24.7

c) Difficulty adjusting to online format: 20.8

d) Noise at home: 13.0

23. How do you stay engaged after online classes?

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a) Often: 46.9

b) Sometimes: 39.3

c) Rarely: 11.8

d) Never: 2.0

23b) Physically (exercise, sports, yoga)

a) Regularly: 42.3

b) Occasionally: 38.5

c) Rarely: 15.4

d) Never: 3.8

23c) Socially (meaningful conversations, family bonding, nurturing value systems, emotional well-being, understanding perspectives)

a) Frequently: 41.8

b) Sometimes: 42.7

c) Rarely: 12.3

d) Never: 3.2

23d) Spiritually (meditation, prayer)

a) Regularly: 28.4

b) Sometimes: 36.8

c) Rarely: 22.1

d) Never: 12.7

24. How do you spend your personal leisure time? (Choose all that apply)

a) Social media: 48.6

b) Watching TV/movies: 47.2

c) Playing online games: 28.3

d) Helping with household chores: 42.6

e) Doing assignments: 36.9

f) Exercising: 38.7

g) Exploring hobbies: 29.5

h) Chatting with friends: 49.4

i) Reading books: 23.8

j) Listening to music: 55.1

k) Learning new skills: 19.3

l) Blogging/vlogging: 7.5

m) Taking naps: 39.2

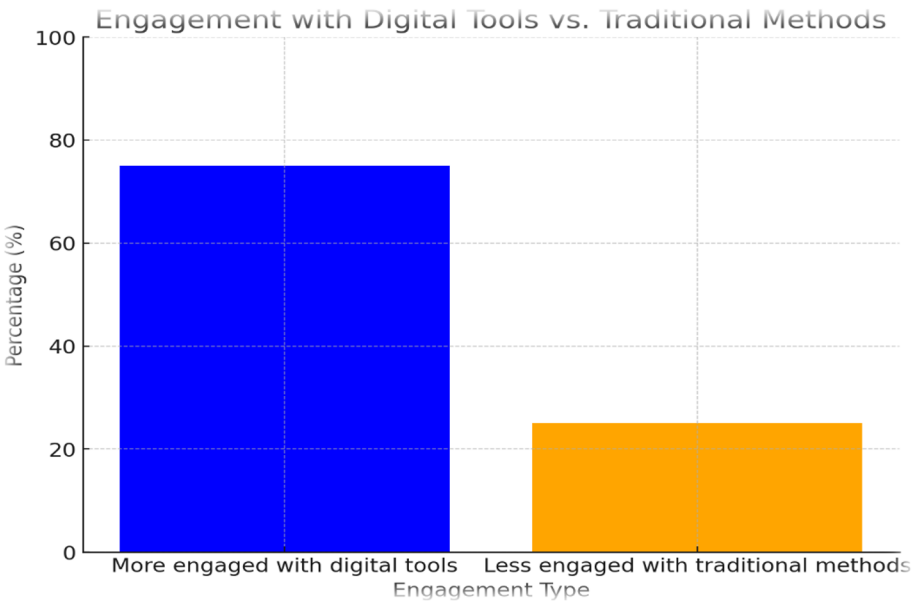


Figure 1

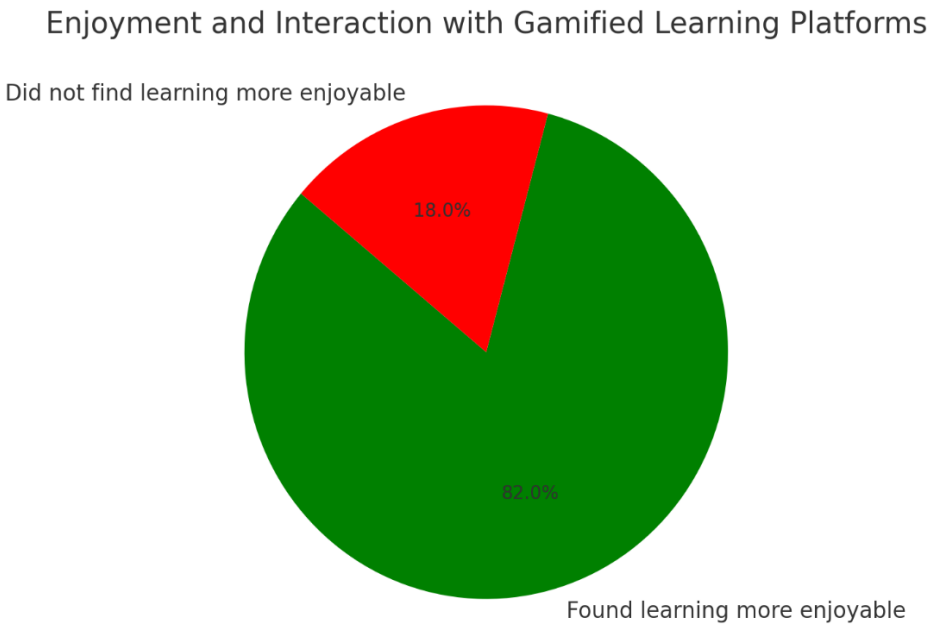


Figure 2



Figure 3

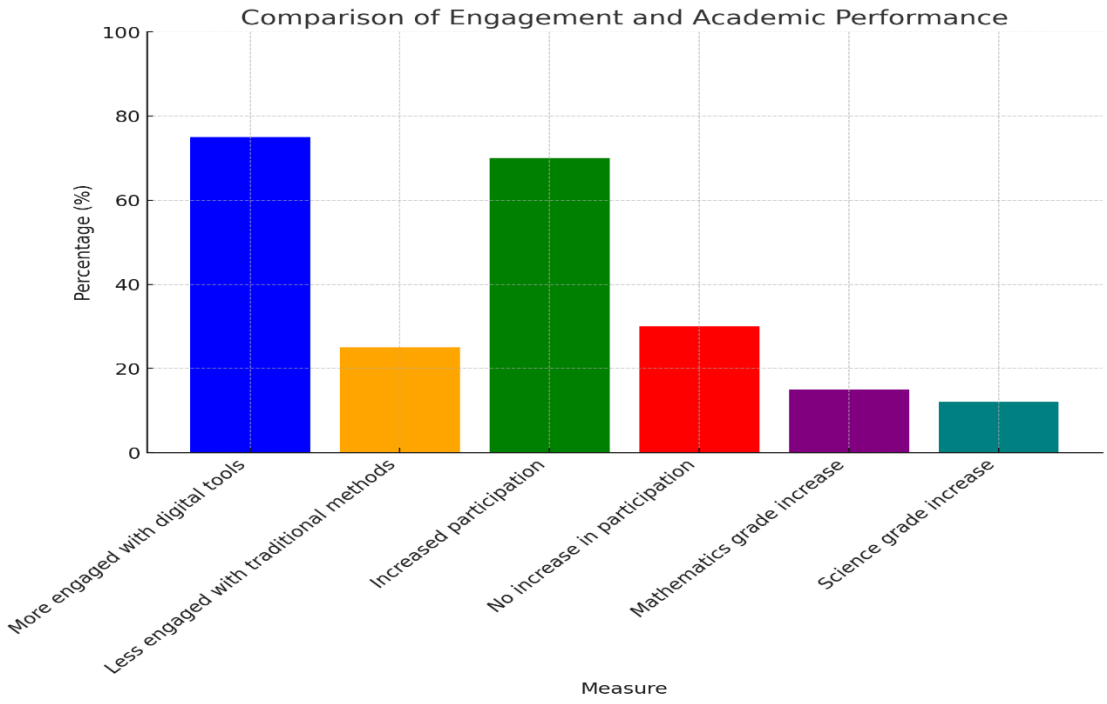


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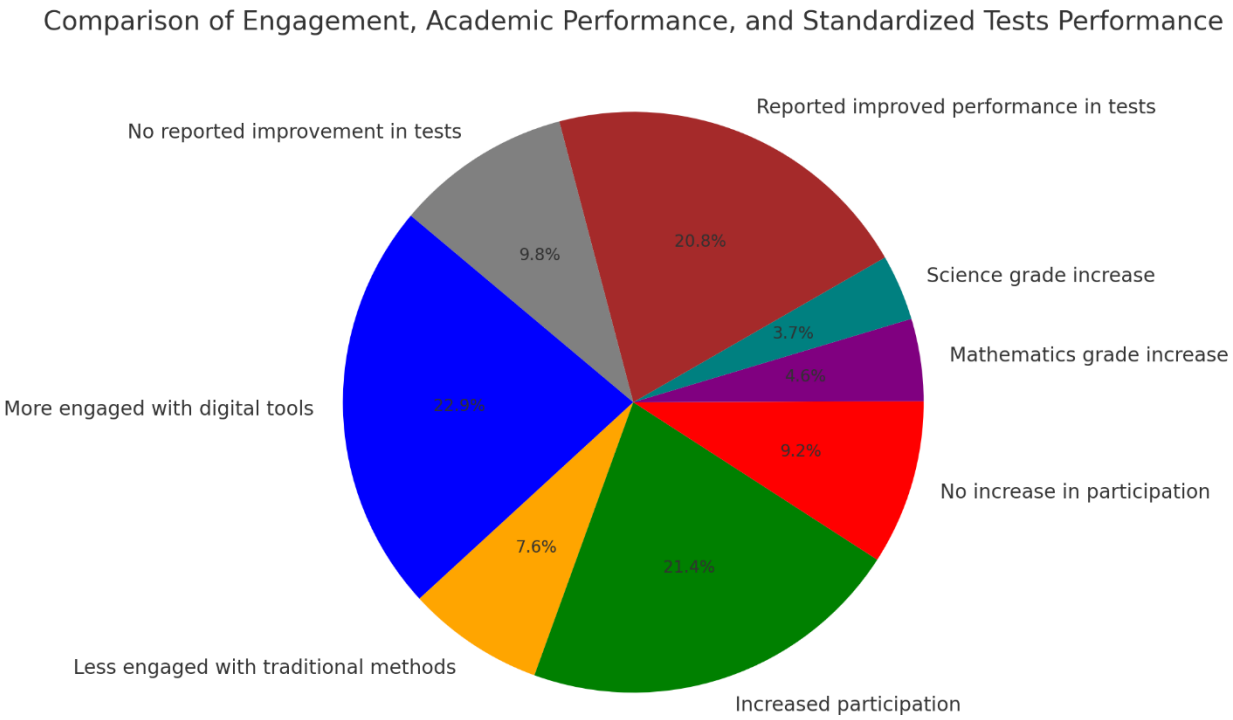


Figure 5

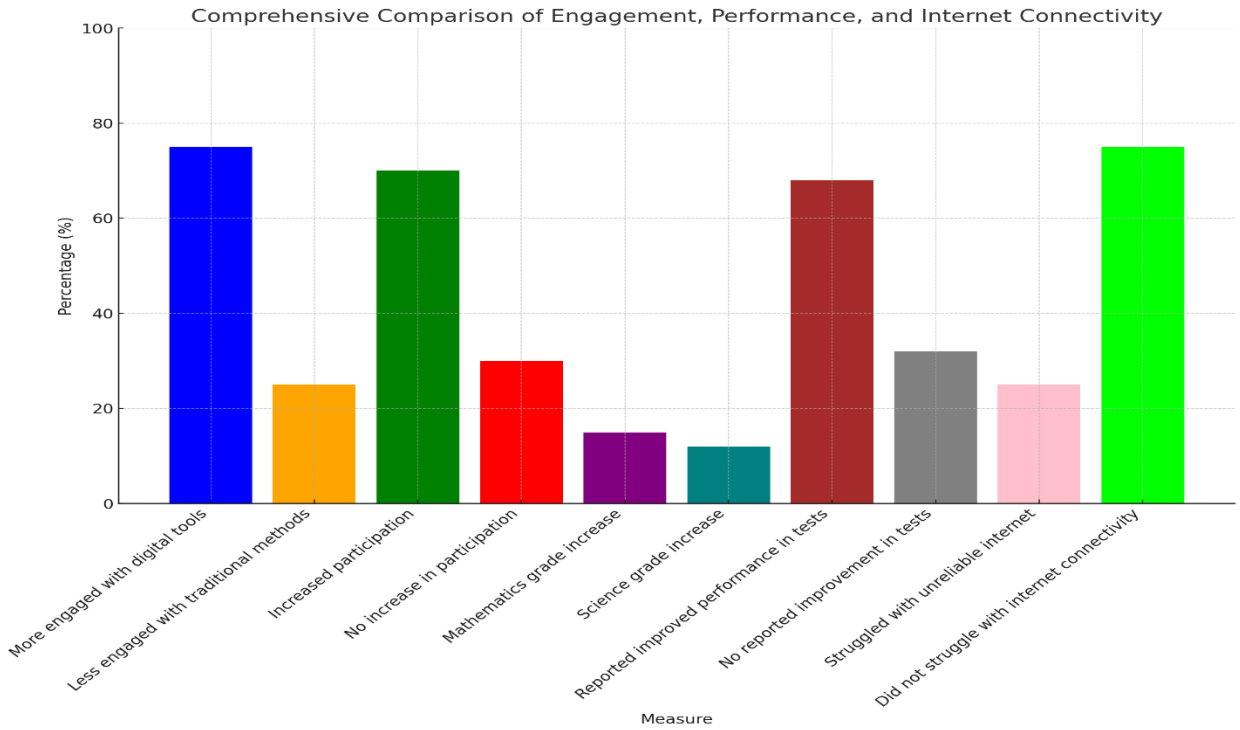


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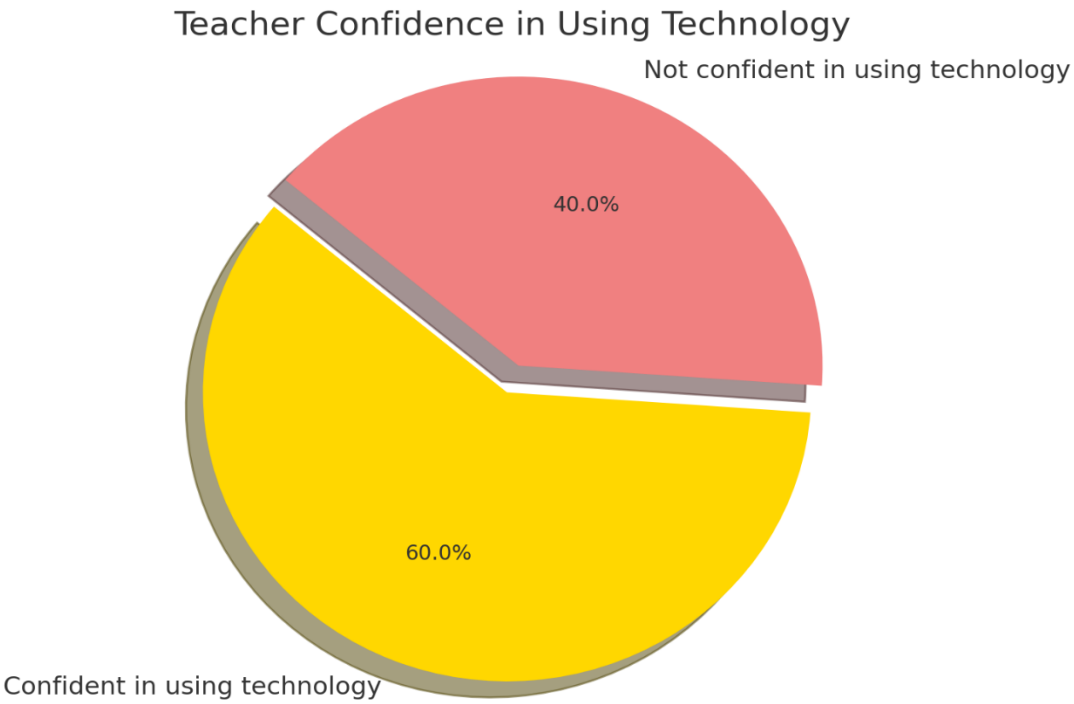


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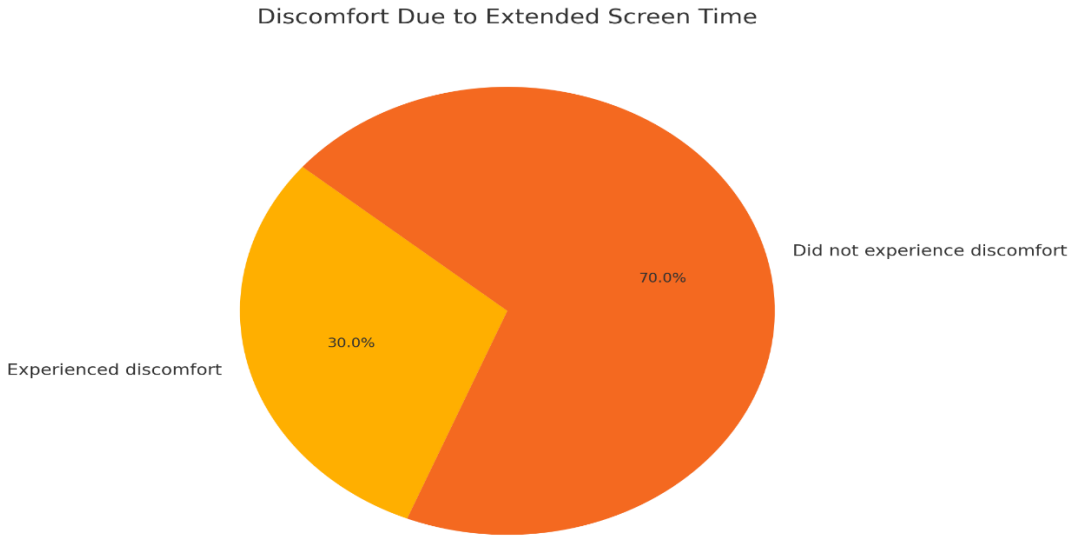


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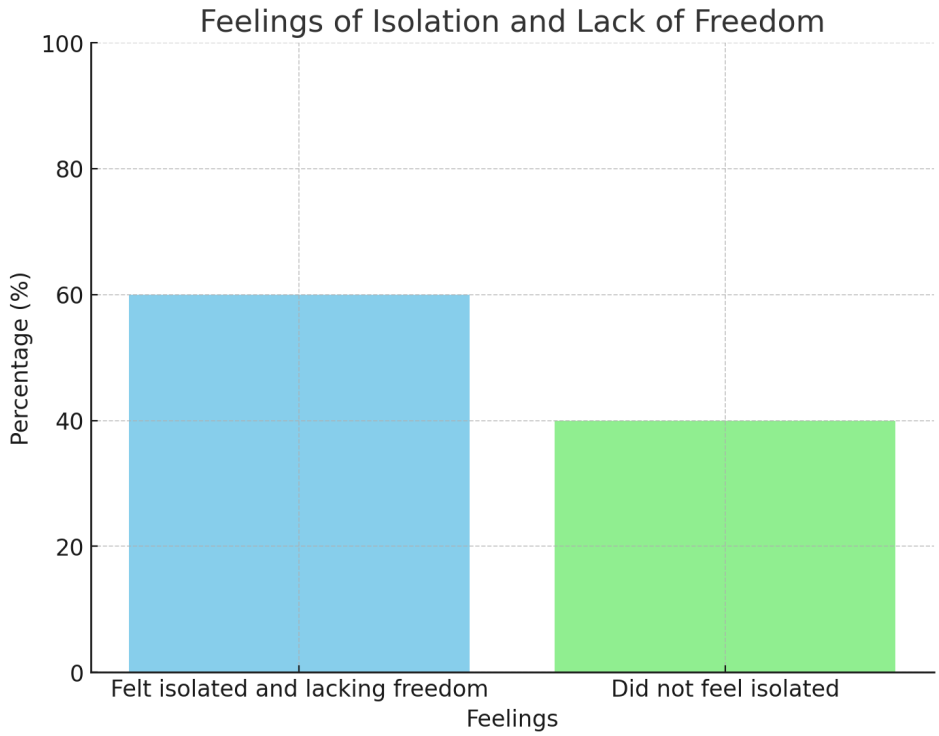


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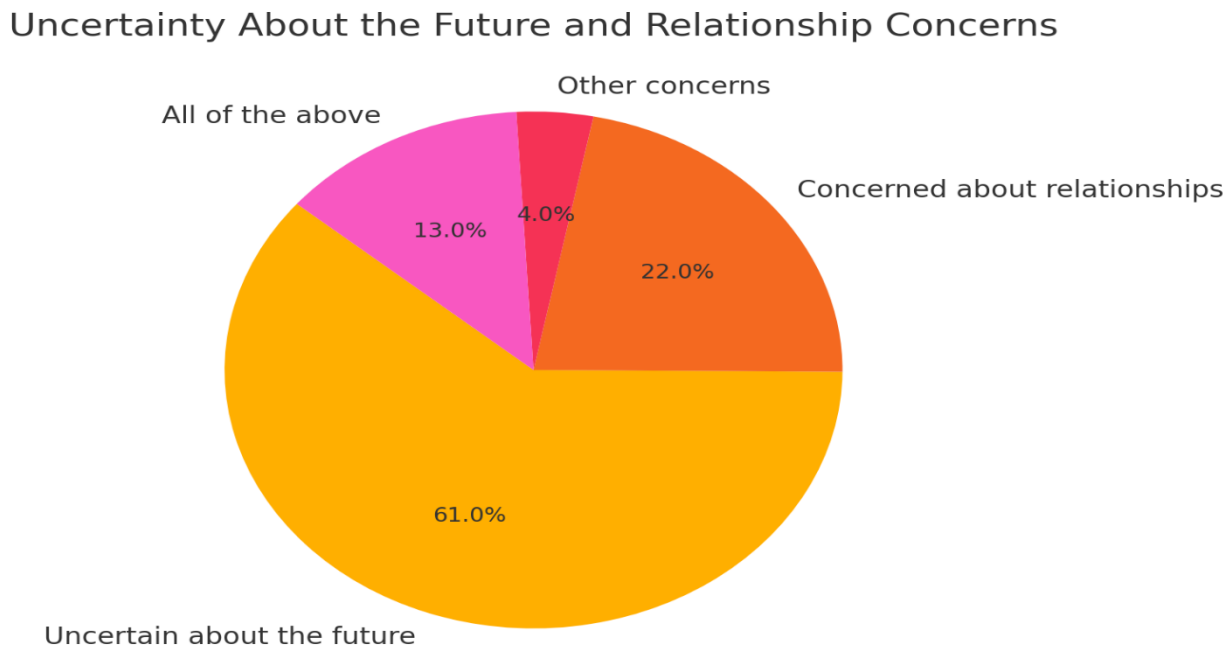


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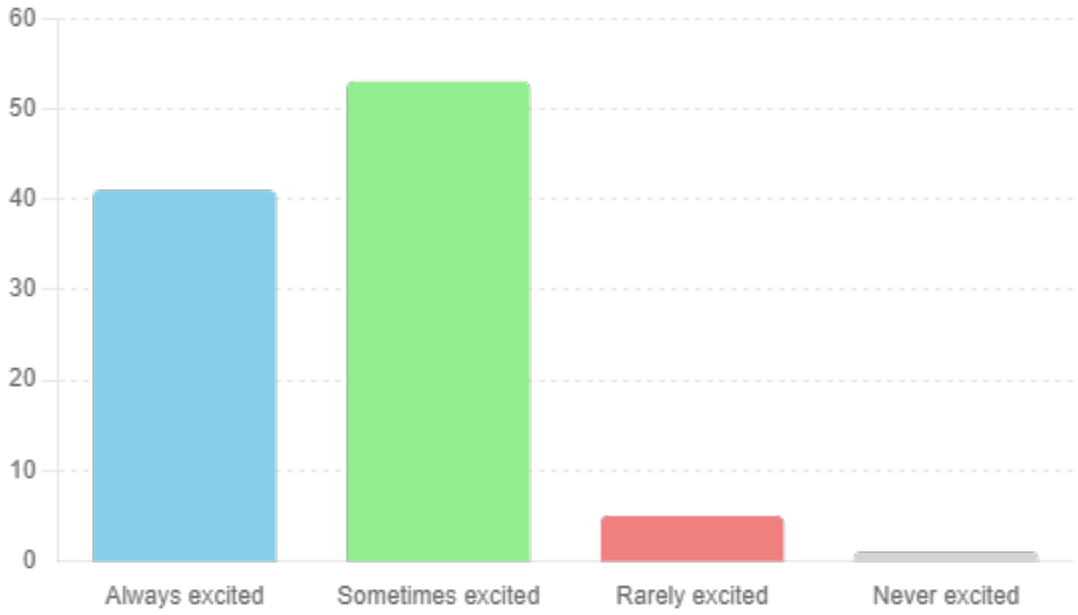


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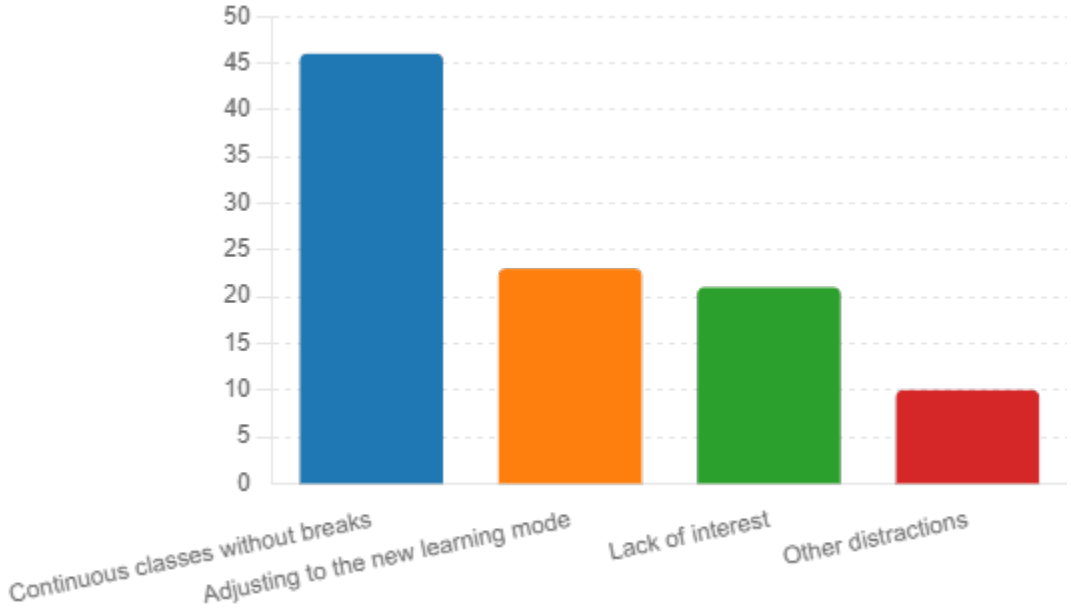


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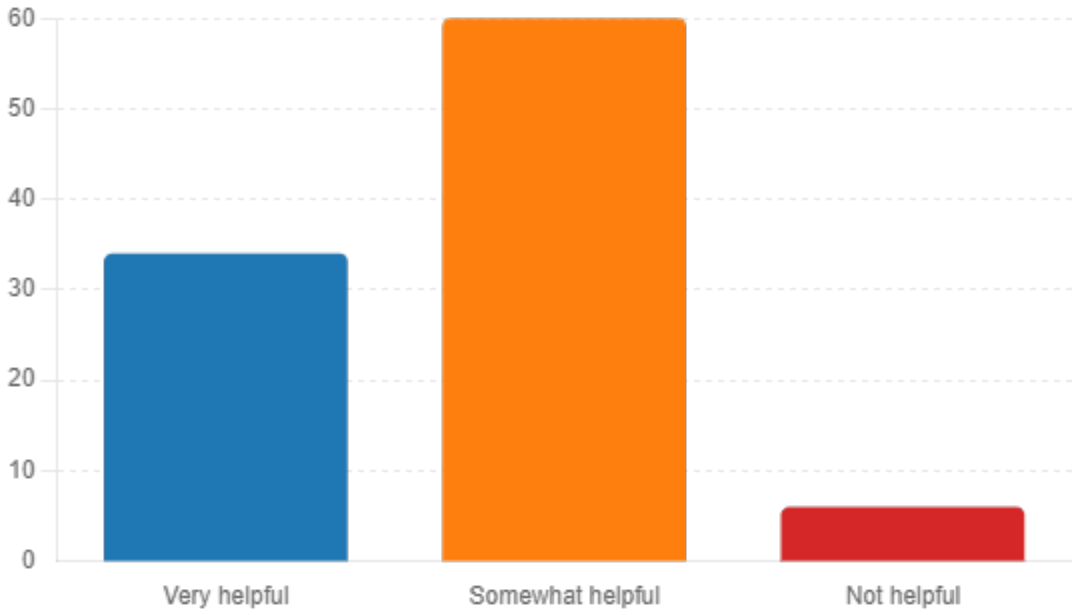


Figure 13

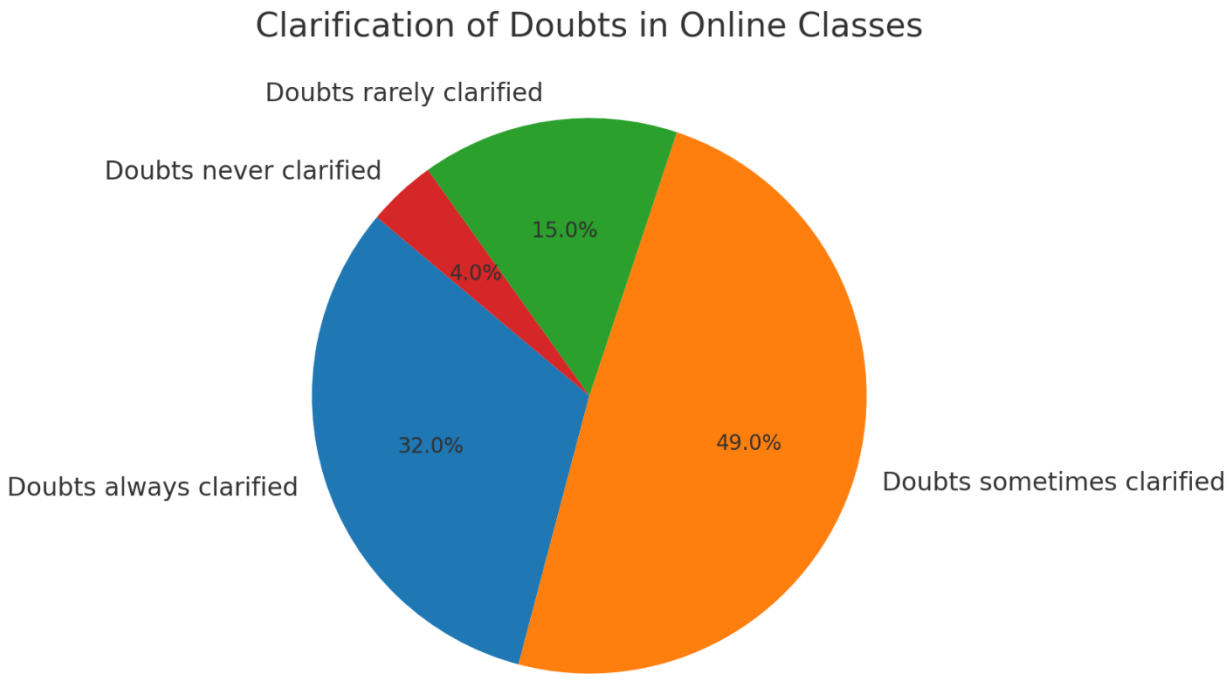


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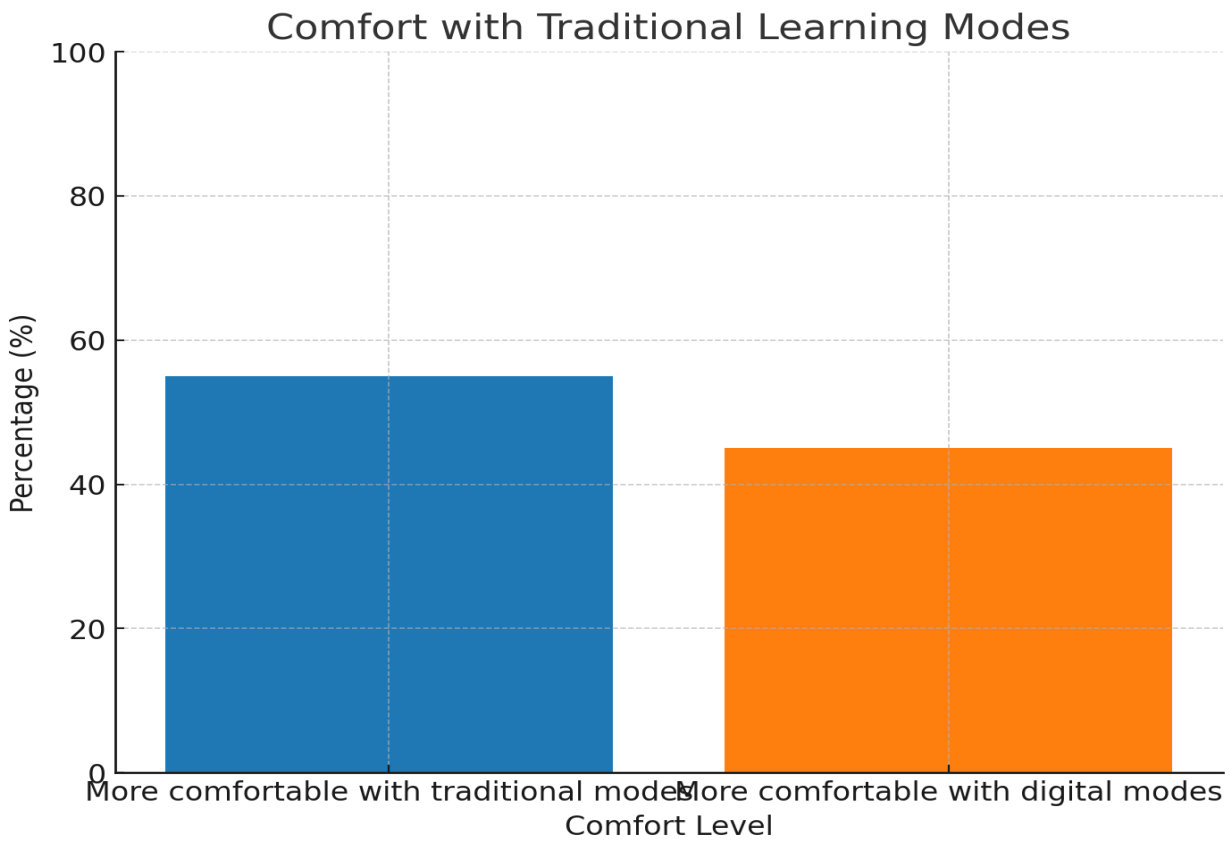

Comfort with Traditional Learning Modes
100
80
60
40
20
0
Percentage (%)
More comfortable with traditional modes
More comfortable with digital modes
Comfort Level

Figure 15