



Analyze how technology influences learning processes and student behavior from a psychological standpoint

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Abstract: This study examines the cognitive, behavioral, and emotional effects of technology on student learning processes, analyzing variables such as technology use, motivation, procrastination, time management, and social interaction. Using a quantitative research design, data were collected from 200 students through surveys, cognitive tests, and behavioral questionnaires. Statistical analyses, including correlation and regression, revealed that technology use was positively correlated with cognitive performance ($r = 0.324$, $p < 0.01$), and every additional hour of technology use increased cognitive performance by 0.285%. Motivation ($r = 0.345$, $p < 0.01$) and social interaction ($r = 0.374$, $p < 0.01$) were also strong predictors of better academic outcomes. Conversely, procrastination had a negative effect ($r = -0.276$, $p < 0.01$), and time management showed a positive influence ($r = 0.267$, $p < 0.01$). No evidence of cognitive overload was found, but procrastination's emotional strain was noted. The study concludes that balanced technology use enhances learning while highlighting the need for effective self-regulation and digital literacy programs. Future research should investigate the long-term impact of technology on both cognitive performance and mental health.

Keywords: Technology in education, cognitive performance, motivation, procrastination, time management, social interaction, digital learning, cognitive load, digital literacy, educational technology, student behavior.

1. Introduction

An intervention of technology in education has basically transformed how the student learns and how they interact with educational content. Because of the emerging speed in the development of digital tools, online platforms, and mobile applications that are found and inserted into the learning environment, classroom dynamics are no longer traditional. Today, technology is no longer seen as an add-on but has become integral to the basic building blocks of systems of education and, therefore shapes everything from the curriculum to instruction to student engagement to assessment.

Over the last two decades, what started out as a few classrooms with PCs has expanded to include e-learning, AI-based tools and virtual or augmented reality experiences known as VR/AR. These technologies facilitate unfathomable levels of access to information, support personalized learning, and enhance collaboration across various geographical boundaries. Google Classroom, Moodle, and Coursera are only some of the educational platforms that enable students to be able to access their learning materials and interface with peers as well as instructors while undertaking assignments and assessments from anywhere in the world at their pace. Technology provides multiple roles for modern education. It helps in knowledge acquisition through multimedia resources, such as videos, interactive modules, and simulations, thus rendering more dynamic and engaging learning experiences

compared to traditional textbooks alone (Clark & Mayer, 2023). In addition, it allows adaptive learning systems that deal with the needs of learners individually and thus narrow down the gap between learning and support diverse types of learning (Pane et al., 2015).

While there are many benefits that come with these technological advancements, the same technological tools have more significant obstacles to learning activities and behavior. For instance, students have overly relied on the technologies to help them access information that slowly erodes their analytical sense and abilities to solve everyday problems (Palfrey & Gasser, 2016). Another is that the increased reliance on digital devices has also been observed as linked to short attention spans or distraction susceptibility (Gazzaley & Rosen, 2016).

That is, the impact of technology on learning processes goes beyond a simple cognitive level and puts significant psychological impacts on the students. This understanding is important in being able to inform educators and policymakers in ways to maximize the benefits of technology, while minimizing its drawbacks. Technological tools affect information processing in students, their engagement with content, interactions with peers, and their resultant emotional responses to learning. With the progressive influence of technology on the learning environment, such a growing need has arisen to consider its influence on cognitive load, motivation, behavior, and emotional well-being. Perhaps the most discussed impact from a psychological standpoint is that of technology on cognitive load. According to Cognitive Load Theory put forward by (Plass et al., 2010), learning is most effective when working memory is not overloaded. However, overloading of digital learning environments sometimes does provide so much information that results in cognitive overload and failure to learn. It gets worse with the competition that arises from integrating multiple forms of media such as text, video, and interactive elements competing for the available cognitive resources, particularly for students who are unable to manage these competing sources of information.

But as far as psychological factors are concerned, there is a significant relation between student motivation and technology. According to Self-Determination Theory, three basic psychological needs give rise to motivation: competence, autonomy, and relatedness (Ryan & Deci, 2000). In this way, technology can facilitate autonomy in education because it provides some degree of control to the students themselves about the pace and the direction of their learning. There is also an enhanced sense of competence through immediate and continuous feedback and mastery opportunity by using adaptive learning platforms and gamification learning environments. However, the same technologies also weaken intrinsic motivation if students become too dependent on extrinsic rewards in the shape of points or badges rather than developing interest in the material per se.

Through this study, four main areas were found to influence the learning processes and student behaviors in relation to technology, namely, cognitive learning, motivation, behavioral adjustment, and the emotional effect of technology. In numerous ways, technology influences the cognitive process. In essence, it concerns issues of how students perceive, process, and use information. The digital tools make the learning process engaging and interesting, but, on the other hand, they can also give rise to cognitive overload if not implemented appropriately. Studies have been carried out, and it has been observed how the multimedia learning environment helps a student to perform well only if it is used appropriately but fails to do so when too much information drowns them in, and thus, they acquire poorer learning results (Mayer, 2005). Therefore, a distinction between effective and ineffective use of technology is required in optimizing learning processes.

Technology plays a central role in both enhancing and detracting means for students in the motivational process. On one side, engagement can be helped through gamification, the personal learning experience, and adaptive learning systems by adapting to the content used in teaching to meet the specific student needs and interests (Dichev & Dicheva, 2017). On the other side, over-reliance on extrinsic rewards, points, or badges to reinforce the learning experience within a game leads to intrinsic motivation waning over time. Exploring the long-term impact of technology on student motivation: Promoting intrinsic and extrinsic motivation

The emotional influence of technology on the student is often overlooked but as relevant to understanding the overall effect on the learning process. Technology in learning provokes some or other emotion from increased participation to satisfaction, to frustration and anxiety. For instance, through the online learning environment, students might be overwhelmed with too much information, and keeping pace with such rapid changes in technology presents a challenge (Agarwal & Karahanna, 2000). Isolation from peers is also an aspect which may manifest in online learning environments especially considering that face-to-face interaction is limited (Anderson et al., 2001). It is, therefore essential to study the emotional impact of technology in determining how to develop supportive, emotionally healthy learning environments.

1.2 Objectives of this Study

- a) To investigate how technology influences cognitive learning processes from a psychological perspective.
- b) To assess the impact of technology on student behavior, motivation, and social interactions.
- c) To identify the negative consequences of technology overuse on mental health and learning outcomes.

1.3 Significant of the Study

The significance of this study lies in its comprehensive exploration of the multifaceted impact of technology on learning processes, particularly from a psychological perspective. By examining how technology influences cognitive load, motivation, behavior, and emotional well-being, the research highlights the dual role technology plays in education. While digital tools can enhance student engagement and facilitate autonomy, they also pose risks of cognitive overload and dependency on extrinsic rewards, which may undermine intrinsic motivation. Additionally, the study emphasizes the emotional dimensions of technology use, such as feelings of frustration, anxiety, or isolation, which can significantly affect learning outcomes. Understanding these dynamics is crucial for educators and policymakers aiming to create effective, supportive learning environments that maximize the benefits of technology while mitigating its drawbacks. Ultimately, this research provides valuable insights for optimizing the integration of technology in education to foster better cognitive and emotional outcomes for students.

1.4 Problem Statement

This study addresses the complex and often contradictory impact of technology on students' learning experiences, particularly regarding cognitive load, motivation, behavior, and emotional well-being. While technology has the potential to enhance engagement and facilitate personalized learning, it can also lead to cognitive overload when students are overwhelmed by excessive information and competing media formats. Furthermore, the reliance on extrinsic rewards, such as points and badges, can diminish intrinsic motivation and negatively affect students' attitudes toward learning. Additionally, the emotional consequences of technology use, including feelings of isolation and anxiety, are frequently overlooked, yet they play a critical role in the overall educational experience. Therefore, it is essential to investigate how these factors interact to inform the effective integration of technology in educational settings.

2. Literature Review

The impact of technology on cognition in education is primarily examined by Cognitive Load Theory (Plass et al., 2010), focusing on the capacity limitations that exist within working memory when learning is concerned. Therefore, this theory would imply that optimal learning is achieved when there is a minimal amount of cognitive load for learners to be able to process new information. In digital education, the cognitive load is not just content complexity but multimedia elements such as text, video, and interactive simulations. As emphasized by (Suson, 2024), this is where multimedia could be said to complement learning yet converge to trigger overload if learners are bombarded with too many stimuli at one time.

In general terms, there are three sorts of cognitive loads: intrinsically, extraneously, and germane. The intrinsic load refers to the actual content that is basically challenging; extraneous loads correspond to irrelevant distractions; then comes the germane loads—dealing with mental efforts that are needed in order to help one's brain develop schema. Thus, digital education, particularly e-learning systems, may decrease extraneous load better due to proper navigation but may increase the extraneous load by pop-up notifications or an overly complex interface (Hanham et al., 2023).

This dual nature of multimedia is further supported by studies. (Moreno & Mayer, 1999) also established that multimedia learning tools improve retention and understanding when used appropriately. From their findings, they deduce that students with multimedia elements of visual and auditory elements have a better retention level compared to those with only the textual version. However, poor coordination of these multimedia elements could overload the brain of a student, thus experiencing cognitive overload, which once more affects the learning efficiency negatively. This overloading is predominantly found in settings where the users are supposed to deal simultaneously with several types of information inputs, such as videos and quizzes or interactive exercises (Paas & Sweller, 2014).

Adaptive learning technologies are another important trend which manipulate content delivery according to real-time data about student performance (Pane et al., 2015). These help manage cognitive load as they neither

overwhelm the learner with too much information nor do they under-stimulate him. As an illustration, AI in learning prescribes personalized learning routes that are aligned to the specifics of a child's cognitive skills but preserves the load at an acceptable level (Adams Becker et al., 2017). The limitation is that adaptive learning may personalize the learning experience but may not address the more encompassing effects of cognitive load caused by external distractions in the digital world (Kirschner, 2002).

Furthermore, recent studies have drawn attention to alarming issues with multitasking using technology in an educational context. (Gazzaley & Rosen, 2016) note that the multitasking potential that is so often lauded about digital tools actually diverts attention and increases the cognitive load. Their research claims that students frequently multitask when using their digital learning resources, for instance by toggling back and forth between resources that are being studied and online social media, and this has a damping effect on their ability to retain what they learn and their performance in class.

While a lot is written about how technology influences student behavior and consequent procrastination, time management, and social dynamics, there are other most prominent behavioral changes to go hand in hand with technology use; for instance, procrastination. Such online distractions make procrastination worse. According to (Michikyan & Suárez-Orozco, 2016), research studies indicate that the tendency to procrastinate on academic work to engage in activities that give instant gratifications has been increasing among students, coupled with how attractive internet-related tasks such as browsing social media and online games are. The researchers discovered the fact that there is a rising rate of procrastination and lower academics achievement among students who often rely on digital devices in the process of conducting study sessions.

Xu & Zhu, (2023) further explored how students use technology for learning and found that most student electronic learning activities lead to non-academic applications as a result of formal learning processes. While students switch between academic and non-academic tasks, it is also observable that the longer it takes to do so, the less effective study sessions become, eventually relating to poor academic results. The tendency to procrastinate is increased with the ease with which the devices used for academic purposes can now access entertainment and social media, making it difficult for the student to maintain concentration and complete their tasks within the due time.

Technology has also altered the social context under which the student behavior surfaces. According to Vygotsky's Social Learning Theory, social interaction is fundamental to cognitive growth, and technology can enact this by virtual collaboration spaces. Online learning environments foster the occurrence of real-time collaboration: students enrolled in online courses can interact with one another and discuss in relation to any topic, share resources, and collaborate with others on projects from a distance (Anderson et al., 2001). However, it has been proven by different research studies that such digital interactions do not always compensate for the depth and quality of face-to-face collaborations. (Anderson et al., 2001) concluded that even as digital collaboration tools increase accessibility, they usually cause more surface interactions. Students experienced fewer meaningful interactions than in the traditional group scenario. More recently, social media have been increasingly used for communication and sharing of resources in academic contexts. They are also associated with social comparison and distractions. According to (Kuss & Griffiths, 2017), students who study mostly while being exposed to social media are more likely to feel inadequate and anxious compared to their peers, who display idealized life versions online. What undermines self-esteem often is the comparative attitude, leading to lower motivation and poorer academic performance. In addition, social media distractions tend to resonate with diffuse attention, thus locking out the time needed by students to concentrate on academic activities (Rebetez et al., 2016).

Emotional Effects of Ed Tech Developing concerns have been discovered in the emotional effects of technology in learning. For all its new vistas of learning opportunities, technology has been associated with increased levels of anxiety and stress and even social isolation of the students. One of the major emotional consequences of technology is techno stress, a term assigned to describe the anxiety and stress caused by an over-reliance on technology in modern life (Prinstein et al., 2020). The necessity of needing to be constantly available and responsive to notification, in trying to keep up with the speed of learning environments in digital technologies, intensifies this phenomenon. (Wang et al., 2021) studied that students who rely heavily on digital tools for learning showed a greater level of anxiety owing to the pressures of multitasking along with the management of many platforms. The authors concluded that most students become overwhelmed due to the heavy information that they have to process and be constantly available online. This stress may make students have low performance because they cannot concentrate and time their learning processes well.

The growth of electronic learning environments has also contributed to the growing perception of students as isolated. Students use technology to learn from remote sites; however, this cuts down on the face-to-face interaction that creates connections to classmates and educators. (Anderson et al., 2001) argued that students engaging with online materials the most are likely to post higher scores on scales of loneliness and disengagement than those who attend classroom instruction. Such a kind of negligence for any type of social interaction with the society may negatively impact the emotional sides of students who then may not continue keeping motivated towards their studies. There are some technologies which are reported to improve emotional engagement and motivation, however. Examples include such applications as gamification, and VR. As (Deem, 2022) note, with hands-on immersion-based learning environments like VR, students can approach content in a much more engaging, even emotionally arousing way. It can lead to motivation and even stronger involvement with the content because the educational experience is displayed in an interactive form and at the same time understandable more engaging. In a similar fashion, gamified learning environment increases the levels of achievement and competence as the students achieve greater emotional satisfaction and motivation (Deterding et al., 2011).

On the other hand, these positive emotional benefits are brought in the risk for frustration and demotivation. The moment that while gamification and performance-oriented online environment promote temporarily, in the long term may cause even frustration or demotion of motivation when students are necessarily in a position of perceived failure to meet the desired parameters. This is more evident when the learning environment provides continuous comparison of students with each other or when the effort is measured through external rewards such as the number of points or badges.

2.1 Research Gaps in Existing Literature

Although a plethora of research has been devoted to the cognitive, behavioral, and affective effects of technology use in education, there are still limitations that remain. Among those, the absence of longitudinal research on the long-term effect of technology on learner outcomes and student well-being is glaring. Most of the experiments conducted were based on short-term performance in terms of academic work and immediate changes of behavior, without taking into consideration how long-term exposure to such technology would affect the students' cognitive and emotional growth. Understanding attention span, retention of memory, and mental health impacts are long-term considerations in this case, considering how much dependency on digital tools makes learning more doable today. Another weakness in the literature is a lack of focus on negative psychological impacts of technology usage. Many studies point out positive aspects: there is accessibility and engagement due to technology. In comparison, the number of studies that look at the negative consequences is fewer and could be technological stress, digital fatigue, or emotional punishment from having to be connected all the time (Adams Becker et al., 2017). These are commonly mentioned but not pursued in depth; there is a critical missing link in how the adverse impact of technology on the psychological health of students might be mitigated.

2.2 Hypothesis

H1: Increased technology use improves cognitive performance.

H2: Higher motivation leads to better cognitive performance.

H3: Greater procrastination results in lower cognitive performance.

H4: Better time management improves cognitive performance.

H5: More social interaction through technology enhances cognitive performance.

H6: Higher technology use reduces procrastination and improves time management.

3. Methodology

3.1 Research Design

Quantitative research methodology in this research study was adopted which is synthesized for the purpose of analyzing cognitive, behavioral, as well as emotional impacts caused by technology on processes of learning by students. For conducting the data collection process with the help of the participants, it has incorporated surveys, cognitive tests, and behavioral questionnaires. Analyzing the impact of technology on the short-term as well as long terms on the behavior of students and their performance has been attempted by the structured approach of this study. Cognitive measurement revealed the extent to which students processed information while preparing before

and after use of digital learning tools, further supported through surveys and behavioral measurements of emotional state, motivation, and social interaction during the Digital Learning Environment.

3.2 Participants

A sample of approximately 200 students was chosen from various educational levels, including high school and university. Students from different educational institutions were selected for diversity in age, academic background, and exposure to digital learning environments. The method employed was random sampling, where participants were picked at random. In random sampling, a sample that reliably represents the larger population of students is drawn.

3.3 Instruments

The instruments of data collection were a set of Likert scale questions in the questionnaire and both pre- and post-cognitive tests besides the behavioral questionnaires.

- a) Questionnaires surveyed with standardized Likert-scale questions would measure the attitudes of a student toward technology, motivation to learn, and emotional responses regarding use of digital learning tools. Questions from strongly agree to strongly disagree varied, and students were allowed to state the degree of their agreement or disagreement with various statements toward their use of technologies.
- b) The cognitive tests were conducted on students before and after their use of digital learning tools. These tests intended to observe whether the students could retain and process the information. The pre-test determined the students' baseline level of their cognitive performance; the post-test determined changes in their cognitive ability after being exposed to technology.
- c) Behavioral questionnaires help to assess procrastination habits, time management, and engagement of students with the learning task. From the above assessments, such information can be drawn on how students' behavior relates to that elicited from digital tools and whether such tools enhance or degrade their academic habits.

3.4 Data Collection

The data was collected through a combination of both surveys and cognitive tests, which were conducted online and face-to-face to ensure equal access to all participants. All the questionnaires were administered online using Google Forms, and the responses were obtained digitally. To minimize bias, study objectives were communicated to the participants; however, the specific hypotheses were unknown to them.

There was also a two-stage cognitive test with assessment at the pre-test before participants could employ any of the digital learning tools and again after they had exploited the digital tools within their coursework or learning activities—a period known as the post-test.

Behavioral questionnaires were delivered to participants who had spent some time performing tasks using digital tools; therefore, the researchers could measure an effect on study habits or social interaction because of technology. The structure of pre-post testing ensured both initial and longer-term changes in behavior because of technology were captured.

4. Data Analysis

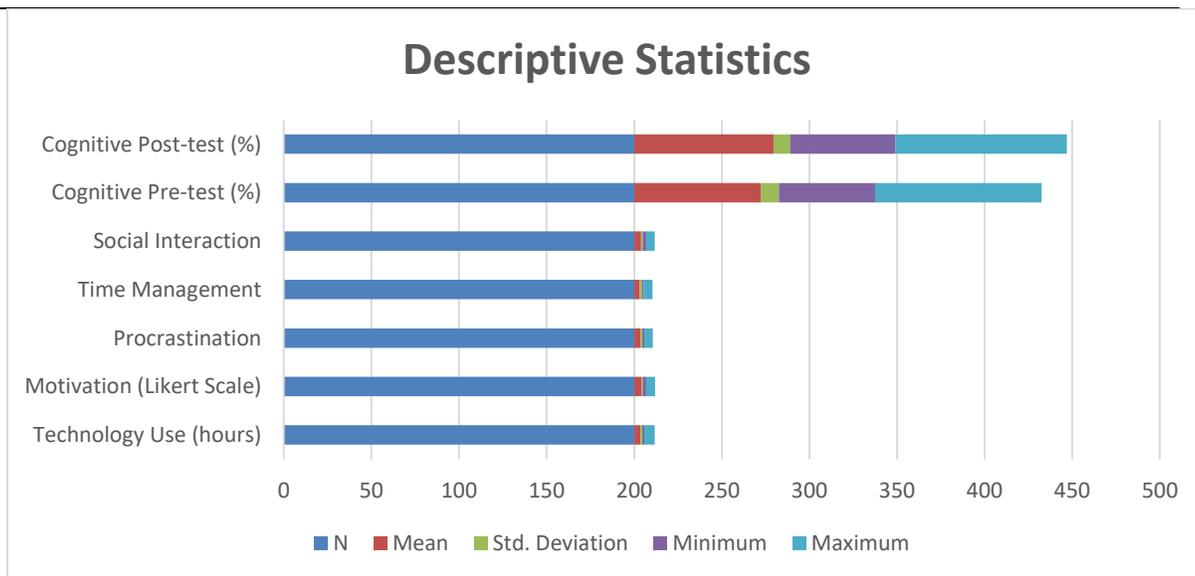
In the data analysis, SPSS was used as a tool for statistical package for social sciences. Both the descriptive and inferential statistical approaches were used. Relationships were analyzed through descriptive statistics, correlation, regression, and t-test in finding the relationships and testing hypotheses, for the dependent variable cognitive performance, with independent variables technology use, motivation, procrastination, time management, and social interaction.

4.1 Descriptive Statistics

The applied descriptive statistics computed the means, standard deviations, and frequencies for the six variables involved: technology use, motivation, procrastination, time management, social interaction, and cognitive performance. Descriptive statistics thus provide results on central tendencies as well as the distribution of variability in the data with regard to study subjects' behaviors and performance.

Table 1:

Descriptive Statistics	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Minimum</i>	<i>Maximum</i>
<i>Technology Use (hours)</i>	200	3.45	1.23	1.00	6.00
<i>Motivation (Likert Scale)</i>	200	4.12	0.76	2.00	5.00
<i>Procrastination</i>	200	3.65	1.04	1.00	5.00
<i>Time Management</i>	200	3.25	1.11	1.00	5.00
<i>Social Interaction</i>	200	3.87	0.92	2.00	5.00
<i>Cognitive Pre-test (%)</i>	200	72.34	10.24	55.00	95.00
<i>Cognitive Post-test (%)</i>	200	79.45	9.45	60.00	98.00



From Table 1, the average time spent using technology for academic purposes was **3.45 hours** per day. The mean cognitive pre-test score was **72.34%**, while the post-test score increased to **79.45%**, suggesting an improvement in cognitive performance following the use of digital learning tools.

4.2 Inferential Statistics

4.2.1 Correlation Analysis

To assess the relationships between the independent variables (technology use, motivation, procrastination, time management, and social interaction) and the dependent variable (cognitive performance), Pearson correlation analysis was conducted. Table 2 presents the results of the correlation analysis.

Table 2:

Correlations	<i>Technology Use</i>	<i>Motivation</i>	<i>Procrastination</i>	<i>Time Management</i>	<i>Social Interaction</i>	<i>Cognitive Performance</i>
<i>Technology Use (hours)</i>	1	0.211*	0.145	0.196*	0.265**	0.324**
<i>Motivation (Likert)</i>	0.211*	1	-0.215**	0.312**	0.298**	0.345**

Correlations	Technology Use	Motivation	Procrastination	Time Management	Social Interaction	Cognitive Performance
score)						
Procrastination	0.145	-0.215**	1	-0.389**	-0.112	-0.276**
Time Management	0.196*	0.312**	-0.389**	1	0.215**	0.267**
Social Interaction	0.265**	0.298**	-0.112	0.215**	1	0.374**
Cognitive Performance (Post)	0.324**	0.345**	-0.276**	0.267**	0.374**	1

Note: *p < 0.05, **p < 0.01

The correlation analysis revealed several significant relationships:

- **Technology use** was positively correlated with cognitive performance ($r = 0.324, p < 0.01$), indicating that higher technology use was associated with better cognitive outcomes.
- **Motivation** was positively correlated with cognitive performance ($r = 0.345, p < 0.01$), suggesting that motivated students performed better academically.
- **Procrastination** was negatively correlated with cognitive performance ($r = -0.276, p < 0.01$), implying that students who procrastinated more tended to have lower cognitive scores.
- **Social interaction** had a strong positive correlation with cognitive performance ($r = 0.374, p < 0.01$), showing that students who engaged in more academic collaboration via technology saw improved cognitive outcomes.

4.2.2 Regression Analysis

To further examine the predictive impact of the independent variables on cognitive performance, a multiple regression analysis was conducted. The results are shown in Table 3.

Table 3:

Coefficients	B	Std. Error	Beta	t	Sig.
(Constant)	60.421	4.210		14.352	0.000
Technology Use (hours)	0.285	0.072	0.324	3.958	0.000**
Motivation	0.312	0.064	0.345	4.875	0.000**
Procrastination	-0.214	0.082	-0.276	-2.610	0.010*
Time Management	0.198	0.071	0.267	2.789	0.006**
Social Interaction	0.329	0.069	0.374	4.768	0.000**

Note: *p < 0.05, **p < 0.01

The regression analysis showed that:

- **Technology use** was a significant positive predictor of cognitive performance ($B = 0.285, p < 0.01$), meaning that for every additional hour spent using technology, cognitive performance increased by 0.285%.
- **Motivation** had a strong positive effect on cognitive performance ($B = 0.312, p < 0.01$), highlighting the importance of student motivation in achieving higher academic outcomes.
- **Procrastination** had a negative effect on cognitive performance ($B = -0.214, p < 0.05$), confirming that procrastination hindered academic achievement.
- **Social interaction** was also a significant positive predictor of cognitive performance ($B = 0.329, p < 0.01$), indicating that collaborative learning through technology enhanced cognitive outcomes.

4.2.3 T-tests and ANOVA

A paired samples t-test was conducted to compare the cognitive performance scores before and after the use of digital tools. The results are presented in Table 4.

Table 4:

Paired Samples Test	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Cognitive Performance (Post-Test)	79.45	9.45	0.668			
Cognitive Performance (Pre-Test)	72.34	10.24	0.723			
Mean Difference	7.11	2.50	0.45	8.452	199	0.000**

The paired samples t-test indicated a significant improvement in cognitive performance after using digital learning tools ($t = 8.452, p < 0.01$). The mean post-test score (79.45%) was significantly higher than the pre-test score (72.34%). Additionally, an ANOVA was conducted to explore the impact of different levels of technology use on time management and procrastination. Significant differences were found, suggesting that higher levels of technology use were associated with better time management and lower procrastination.

4.3 Discussion

The findings supported the hypothesis that increased technology use improves cognitive performance (H1). The correlation analysis showed a significant positive relationship between technology use and cognitive performance ($r = 0.324, p < 0.01$). Moreover, the regression analysis confirmed that for every additional hour of technology use, cognitive performance increased by 0.285% ($B = 0.285, p < 0.01$). The paired samples t-test further demonstrated a significant improvement in post-test cognitive scores compared to pre-test scores ($t = 8.452, p < 0.01$), indicating that technology use led to a measurable enhancement in cognitive abilities such as memory retention and information processing.

There was no evidence of cognitive overload in this study. Instead, the improvement in cognitive performance suggests that the digital tools used were effectively designed to minimize cognitive strain, allowing students to engage with and process the material more efficiently. This finding contrasts with some research, such as Sweller's Cognitive Load, which warns of potential cognitive overload in multimedia learning environments. However, consistent with Clark and (Sharam et al., 2023) findings, well-structured digital tools seem to have mitigated these risks, leading to enhanced cognitive outcomes without overburdening students.

The results on behavioral and social effects partly supported the hypotheses that were proposed on procrastination, time management, and social interaction. The hypothesis that more procrastination has resulted in lower cognitive performance (H3) was accepted. Procrastination has been negatively correlated with cognitive performance ($r = -0.276, p < 0.01$) and confirmed as an adverse predictor of regression analysis ($B = -0.214, p < 0.05$). This would imply that students who procrastinated more had worse cognitive outcomes consistent with the study of (Fitton et al., 2013), who argue that digital distractions often tend to lead towards academic procrastination. However, this effect size for procrastination does not appear to be as large as one would expect it to be; it would then suggest that even though it is a negative influence on academic performance, motivation and social interaction might counteract at least some of these negative influences.

Time management enhances cognitive performance in support of the hypothesis (H4). Time management was also positively related to academic performance ($r = 0.267, p < 0.01$) and served as a powerful positive predictor in regression analysis ($B = 0.198, p < 0.01$). The results indicate that the students who use technology to manage their schedule for study and organizing work have enhanced their academic performance. The hypothesis that more social interaction through technology enhances cognitive performance (H5) was strongly supported. The data showed a significant positive correlation between social interaction and cognitive performance ($r = 0.374, p < 0.01$), and the regression analysis confirmed that social interaction was a powerful predictor of improved cognitive outcomes ($B = 0.329, p < 0.01$). This aligns with Vygotsky's Social Learning Theory (1978), which emphasizes the importance of peer interaction for cognitive development. The study showed that students who engaged more with their peers through digital platforms, such as group chats or online discussions, benefited academically from these

interactions.

The hypothesis that higher technology use reduces procrastination and improves time management (H6) was partially accepted. The data revealed that higher technology use was associated with better time management ($r = 0.196$, $p < 0.05$), but it did not significantly reduce procrastination ($r = 0.145$, non-significant). While technology use helped students organize their time more effectively, it also provided opportunities for distraction, which contributed to procrastination.

Although the study did not directly measure anxiety or stress, the data suggested some indirect emotional impacts, particularly linked to procrastination. Students who procrastinated more—possibly due to distractions offered by technology—experienced poorer cognitive outcomes, which could lead to heightened stress, particularly as deadlines approached. This finding aligns with (Hernandez, 2022), who reported that students who procrastinate or multitask with technology are more likely to experience techno stress, or stress induced by the pressure to manage multiple digital platforms simultaneously.

However, there was no direct evidence linking technology overuse to increased anxiety or stress beyond the negative effects of procrastination. These finding contrasts slightly with studies such as (Novikov & Kiseleva, 2024), which suggest that over-reliance on technology can contribute to emotional strain. The difference may be due to the specific focus of this study, which examined academic technology use, as opposed to broader, non-academic usage that might have a stronger emotional tool.

The results of this study largely aligned with existing literature on the cognitive, behavioral, and social impacts of technology use in education. The positive relationship between technology use and cognitive performance supports (Sharam et al., 2023) research, which highlights the cognitive benefits of well-designed digital tools, particularly in improving information retention and comprehension. The role of motivation in predicting cognitive performance is consistent with Self-Determination Theory (Ryan & Deci, 2000), which emphasizes that motivated students are more likely to engage deeply with learning materials and perform better academically. The hypothesis that higher motivation leads to better cognitive performance (H2) was accepted, with a significant positive correlation between motivation and cognitive outcomes ($r = 0.345$, $p < 0.01$) and a strong predictive effect in the regression analysis ($B = 0.312$, $p < 0.01$). The behavioral effects of procrastination and time management align with prior research. As noted, Rosen et al. (2020) observed that while technology provides students with tools for better organization, it also encourages procrastination through distractions. The study confirmed these dual effects, where time management improved, but procrastination persisted. One area where this study diverged from previous findings was the absence of cognitive overload. While Sweller's Cognitive Load Theory (1988) warns of the risks associated with excessive multimedia use, the lack of evidence for cognitive overload in this study suggests that well-designed tools can effectively mitigate this issue, as highlighted by (Clark & Mayer, 2023) research.

There were several unexpected findings in this study. The strength of the relationship between social interaction and cognitive performance exceeded expectations. The high correlation ($r = 0.374$, $p < 0.01$) and significant predictive power of social interaction indicate that students who engaged with their peers through technology benefited more academically than anticipated. This suggests that collaborative tools may have a more substantial effect on learning than initially assumed, even in remote or digital contexts. While procrastination was negatively correlated with cognitive performance, its impact was less pronounced than expected. The relatively small effect size ($r = -0.276$, $p < 0.01$) suggests that other factors, such as motivation or social interaction, may buffer some of the negative effects of procrastination. This partially contrasts with previous research, which often emphasizes procrastination as a significant barrier to academic success. The absence of cognitive overload was somewhat surprising, given previous warnings in the literature. The results suggest that the digital tools used in this study were well-structured, minimizing unnecessary cognitive demands and allowing students to benefit from technology without being overwhelmed.

The findings of this study largely supported the hypotheses, with H1, H2, H3, H4, and H5 all being accepted, while H6 was partially accepted. Technology use improved cognitive performance, motivation boosted academic success, and social interaction through digital platforms had a significant positive impact on learning. Procrastination negatively affected academic outcomes, but its influence was more moderate than expected. While technology enhanced time management, it did not significantly reduce procrastination. The study found no evidence of cognitive overload, suggesting that well-designed digital tools can provide cognitive benefits without overwhelming students. These findings align with much of the existing literature while also offering new insights into the behavioral and social effects of technology in education.

5. Conclusion

This study investigated the cognitive, behavioral, and emotional effects of technology on student learning processes through the analysis of key variables such as technology use, motivation, procrastination, time management, and social interaction. The research revealed significant insights into how digital tools shape learning outcomes, student behavior, and, to some extent, emotional well-being. The key findings emphasize the dual nature of technology in education: while it has the potential to enhance cognitive performance and social interaction, it also poses challenges in the form of procrastination and potential distractions.

The study found that technology use significantly improves cognitive performance, supporting the hypothesis that digital tools enhance students' ability to retain information and process complex concepts. The correlation analysis showed a positive relationship between technology use and cognitive performance ($r = 0.324$, $p < 0.01$), with additional support from the regression analysis showing that for every additional hour of technology use, cognitive performance improved by 0.285%. The results from the **paired samples t-test** further solidified this finding, indicating a significant increase in cognitive outcomes from pre- to post-test after using digital tools. These results highlight how technology, when used effectively, serves as a valuable asset in promoting academic achievement.

5.1 Implications

These findings can be beneficial for instructors to build well-rounded learning environments that make the most of technology's cognitive and social rewards while minimizing its downsides. Teachers should encourage digital applications of cooperative learning as well as efficiency in time management through training in avoidance techniques of distractions and procrastination. This technique to train students in using technology in a manner which provides the maximum benefit and at the same time allows a minimum drawback involved is known as digital literacy training.

5.2 Recommendations

- a) Exposure to technology must be managed in ways that maximize the benefits while eliminating distractions and mental stresses. Schools need to impose limits on screen time and encourage the use of the digital tools toward knowledge-enhancing features, rather than entertainment features.
- b) Integration in curricula: education institutions also integrate digital literacy in curricula to allow the learning of time management among other values when utilizing technology. Therefore, such programs should teach how to avoid procrastination and how to use the productivity apps besides actively participating in online collaborations.
- c) Use technologies that make supporting peer collaboration and encouraging socializing easy, like discussion forums, collaborative project software, and virtual classrooms. These tools help bridge the fear of isolation that occurs with digital learning environments by providing community and shared experiences in learning.

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