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The Impact of Technology on Students' Academic Performance: A Case Study in Hanoi, Vietnam

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A B S T R A C T

This study investigates the impact of technology on the learning experiences of Hanoi students, focusing on their perceptions of technological accessibility and how their habits in using technology affect their academic performance, learning efficiency, and motivation to acquire new knowledge and information. Integrating technology into education allows students to apply theoretical knowledge and skills practically, exposing them to advanced learning methods and creating a conducive environment for knowledge acquisition. This technological integration benefits not only students but also teachers, enabling them to seamlessly incorporate information into classroom lessons using videos, projectors, PowerPoint, and more. Data was collected from 400 university students in Hanoi, and this study used technology to develop measurement tools. The study assessed students' views on teachers' teaching methods and the combined use of technology with self-study. Using SPSS software, the study applied rigorous criteria to test the reliability and confirm the measurement variables, ultimately presenting the results and conclusions of the research objectives.

Keywords: Education, Technology, Students' Academic Performance, SEM.

1. Introduction

In today's rapidly developing world, technology is applied across various sectors, including agriculture, industry, services, and especially education. M.L. Niess (2005) emphasized that the integration of technology in education has made significant strides over the past decade. H. Kay's (2004) research, which surveyed teachers equipped with computers and technology in their teaching environments, demonstrated positive results, indicating improvements in students' learning attitudes and initiative. Achieving these positive outcomes required educators to adapt and incorporate technology into their lessons, a challenging and lengthy process (A. Ertmer & Ottenbreit-Lefwich, 2010). Matthew J. Koehler and Punya Mishra (2009) affirmed that integrating technology into teaching is complex due to the challenges it poses for educators. Despite these challenges, Kimberly A. Lawless and James W. (2007) noted that technological knowledge has become a fundamental skill in teaching, and the availability of electronic resources in educational environments necessitates that teachers effectively integrate technology into their teaching processes, although this integration often lags behind other teaching activities.

Today's youth, particularly university students, are exposed to technology early through video games and television programs broadcast on TV or social media platforms. F. Katz (2008) highlighted the ongoing competition between technology and education as a crucial factor influencing economic growth rates and social inequality. Statistics from previous studies show that students in rural areas of middle-income countries have less access to technology compared to those in urban areas (Croft et al., 2019). The COVID-19 pandemic significantly impacted the global economy and prompted widespread adoption of remote learning. Dr. A.W. (Tony) Bates (2005) discussed distance education in his book, stating that it allows students to study at their convenience without face-to-face contact with teachers, with technology being a critical element. E-learning, a form of distance education, has been highlighted for its convenience, cost-effectiveness, and user satisfaction (Jorge G. Ruiz et al., 2006). During the pandemic, many students accessed the internet from home, with studies showing that young people in rural areas and low-income households had less internet access compared to those in urban or wealthier areas (UNICEF, 2020). This disparity in technology access affects students' academic performance and information acquisition.

Students today frequently use technology for learning, especially through smartphones (Singh & A. Samah, 2018). Smartphones function as handheld computers, allowing students to access the internet anytime and anywhere, providing a wealth of information that facilitates proactive and convenient self-study. Smartphones are regarded as smart learning tools for students. Previous studies indicate that while desktop computers are available in universities, most students prefer using their phones for reading materials and information retrieval (Mwalukasa, 2023). This shows that universities have integrated technology into teaching and learning. Online learning environments and internet technology, social media provide new forms of communication between professors and students, facilitating information and idea exchange. New technologies include wikis, email, Twitter, etc., making it easier for students to access diverse knowledge. The COVID-19 pandemic prompted schools and universities to close and switch to remote learning. Technology was again applied extensively in teaching through online learning via E-learning, TV programs, MS Teams, and other online learning

applications (Salamatina, 2020). This allowed students to continue their education and communicate with instructors from home. Technology offers many benefits for student learning.

According to K. Ratheeswari (2018), combining technology with teaching and training programs significantly enhances teaching quality. Applying technology creates an ideal learning environment for students, improving their desire to learn and their learning outcomes, as shown through their academic performance. Previous studies on technology's impact generally identified positive benefits (Raja & P.C. Nagasubramani, 2018). However, other studies found that using technology has both positive and negative aspects affecting learning, with more positive results according to surveys from instructors. Instructors feel that the level of technological support varies by field, and technology increases students' motivation to learn (Carstens et al., 2021). Another study concluded that technology positively impacts education but can also cause negative effects (Walia et al., 2021). Thus, technology not only benefits and supports student learning but also has potential negative impacts.

Studies have found both positive and negative impacts of technology on student academic performance. Technology is a good tool for supporting student learning, but is it used properly and appropriately? Research indicates that applying technology in student learning is essential for integrating technological skills into both teaching and learning processes. Students need to know how to use and interact with technology properly to keep pace in today's ever-changing technological world (Strom, 2021). Today's technology offers many tools that can impact students' learning motivation. Different types of technology can reinforce or hinder students' basic skills knowledge. The main goal of education is to increase learning motivation, and technology can be a means to achieve this goal (Flanagan & Jennifer Lyn, 2008). Another study showed a bidirectional relationship between technology use and academic performance, with an overall negative but statistically insignificant correlation with academic performance. However, significant positive correlations appeared between certain types of technology, such as social media use (Rashid & Asghar, 2016). Young people today spend a lot of time on social media, and smartphones are the means for them to access this online space. Research indicates that social media improves students' information acquisition and has both positive and negative impacts (Raut & Patil, 2016). Engaging in social media helps students update knowledge relevant to their field of study through groups and widely shared social knowledge online. Reading is an essential habit for personal development. Li-Bi Shen (2006) found that new technologies impact students' on-campus learning and reading habits, with students reading online information more frequently than offline information. Male and female students showed different impacts from technology on their learning. Excessive technology use can lead to distractions from studying. Smartphones are considered indispensable to many students, providing significant academic and entertainment functions. Some students rely too heavily on their technology, leading to a lack of independent thinking. Additionally, possessing such useful technology can lead to immersion in video games or gaming addiction among young people. Research shows an inverse relationship between academic performance and time spent playing video games, with adolescents who spend less time gaming achieving better academic results, while those who play more have poorer academic performance due to less study time (Gómez et al., 2020). Technology provides students with a familiar environment for accessing necessary information and knowledge. However, Esteban Vázquez-Cano et al. (2022) highlighted the issue of fake or misleading information. Access to abundant information and knowledge is advantageous, but discerning truth from falsehood is not easy. Believing false information impacts students' learning and daily lives, affecting their interactions and communication with society.

Technology positively influences students' learning environments, providing an advantage in learning through participation in digital experiences (LN Rufaidah et al., 2021). Another study shows technology motivates students' learning (Granito & Chernobilsky, 2012). Technology application in online learning has motivated some university students (Harandi, 2015). Previous research indicates that technology positively impacts students' academic performance (ISTE, 2002) but also has negative aspects. Based on previous knowledge, this study surveys factors of technology use affecting student learning directly or indirectly through education and teaching, presenting statistical results and conclusions about the impacts of technology on student learning, shown through satisfaction levels, learning positivity, and academic performance.

2. Research Model & Hypotheses

Based on the theoretical foundation and previous studies, a research direction has been developed and focused on students' access to technology, their ability to use technology, and their technology usage habits, all of which affect their learning outcomes. In addition, as mentioned earlier, technology also affects education, including educators. Teachers' technological proficiency will be investigated to what extent it affects students' learning. Therefore, the research model and hypotheses are proposed as follows:

H1: Technological accessibility impacts students' academic performance

H2: Technological proficiency impacts students' academic performance

H3: Teachers' technological proficiency impacts students' academic performance

H4: Technology usage habits impact students' academic performance

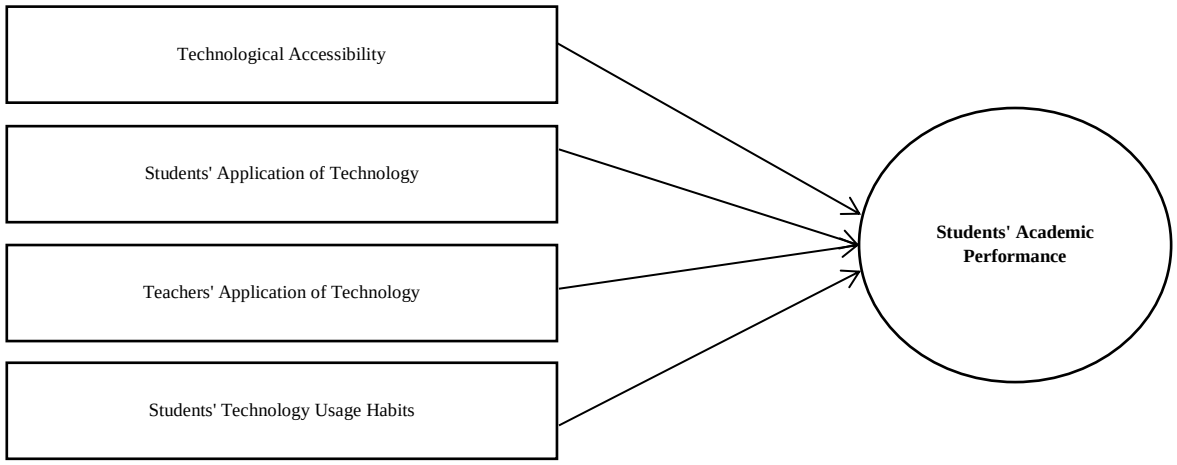

Fig. 1 - Proposed Research Model

H1 aims to demonstrate that students' accessibility to technology influences their learning. As previously established, most young people today are exposed to technology at an early age, indicating a general accessibility to technology among students. However, there are notable disparities where some students have limited access to technology. Recognizing this difference, it was used as the basis for the first hypothesis.

Previous research has shown that most students today are exposed to technology at an early age, prompting investigation into how they learn to use technology and their proficiency levels. Technological proficiency here refers to how students engage with new technologies, whether they find it challenging to use technology for specific purposes, and whether students with varying levels of technological accessibility (H1) find it easier or harder to use technology. Additionally, previous studies cited in the literature review highlighted another factor: students' technology usage habits. These studies revealed that students often develop non-academic habits when using technology, such as dependency on technology. These insights led to the formulation of H2 and H4.

H3 was developed based on the overview, which discussed the impact of technology on education and educators. The methods and new technologies that teachers incorporate into their teaching significantly affect student learning by influencing how knowledge is conveyed to students.

This study employs a quantitative research approach, using survey methods to collect data. The research collects quantitative data to predict and examine the correlation between variables based on the collected data. The quantitative approach aims to provide a deeper understanding of technology usage behavior and its effects on students' learning in Hanoi. Referencing the study by Sondakh et al. (2023) and the book by Willem E. Saris and Irmtraud N. Gallhofer (2014), the authors used questionnaires as the data collection tool. This method offers several advantages, including easy data access, high reliability, and low operational costs.

3. Results and Discussion

3.1. Sample

Since this research study investigates the impact of technology on students' academic performance, focusing on the population of Hanoi students, the author employed a survey methodology, and collected data from 400 individuals using a questionnaire distributed via Google Forms. The primary objectives were to assess the reliability and validity of the measurement scale, test its effectiveness, and validate the proposed model. While the author received 400 valid responses, observations are considered not well-structured, in general, due to the non-probability collecting method. Therefore, there exists biases in the regression results, and the author report only standardized coefficients after robust modelling.

3.2. Descriptive Statistics

Table 1 below shows the demographic statistics of respondents. In terms of gender, a 2%-difference implies that the data is quite well-structured with a 10.32%. In terms of age, the data shows a non-normal distribution due to convenient sampling method and other constraints related to data collection, e.g. financial constraint. The majority of respondents aged between 18 or under to 20 (91%), which are mostly freshmen and sophomores, with only a small fraction of third-year students. Only a small portion (9%) are 21 or older, which are third year and last-year (fourth year) students for most higher education programs offered in Vietnam (some programs with high-level of specialization such as medical programs require 6 years of formal education and training rather than only 4 years). Only around 40% students were born and raised in Hanoi, while the other 60% moved to Hanoi from other cities to study, which represents the hometowns of Hanoi students' population. Regarding household income, the majority of surveyed students come from middle class families, 45.25% from low-middle class and 33% from high-middle class, only a small percentage from low-income families and high-income families, 12% and 9.75% respectively.

Table 1 - Demographic statistics

Demographic characteristics		Number	Percentage (%)
Gender	Male	204	51
	Female	196	49
Age	18 or under	184	46
	19 - 20	180	45
	21 - 22	28	7
	23 or older	8	2
Hometown	Hanoi	157	39.25
	Others	243	60.75
Income	Under 10 million VND	48	12
	10 - 20 million VND	181	45.25
	20 - 30 million VND	132	33
	Above 30 million VND	39	9.75

Table 2 - Descriptive statistics

Variables	Items	Mean	Std. Dev.
Technological Accessibility	TA1 - General technological items accessibility	4.20	0.779
	TA2 - Personal technological items accessibility	3.51	1.007
	TA3 - Internet accessibility	3.48	1.178
	TA4 - Academic materials accessibility	3.16	0.814
Students' Application of Technology	SAT1 - In-class applications	4.05	0.795
	SAT2 - Outside of class general applications	4.19	0.892
	SAT3 - Outside of class academic applications	3.18	1.189
Teachers' Application of Technology	TAT1 - Willingness to apply	3.88	0.996
	TAT2 - Technological applications update	3.91	0.780
	TAT3 - In-class applications	4.41	0.626
	TAT4 - Outside of class applications	3.96	1.082
Students' Technology Usage Habits	STUH1 - Frequency of general usage	4.31	0.745
	STUH2 - Total time of general usage	4.16	0.815
	STUH3 - Frequency of academic usage	3.39	1.267
	STUH4 - Total time of academic usage	3.41	1.199
	STUH5 - Technological practice	3.70	1.404
	STUH6 - Technological update	4.09	1.324
Perceived Academic Performance	PAP1 - In-class participation	3.57	1.001
	PAP2 - Understanding of in-class materials	3.60	0.922
	PAP3 - Performance self-evaluation	3.85	1.171
	PAP4 - Comparison with other students	3.51	1.065

Variables	Min	Max	Mean	Std. Dev.
GPA	1.84	4.00	3.13	0.415

Table 2 above shows the descriptive statistics of the main variables in this paper. From Table 2, the author observes similarities in general accessibility yet discrepancies in personal accessibility of technological items. Most students have access, in general, to technology from schools, universities, local communities, while a significant portion gains access personally. Internet access is as common as personal technological items access but online academic materials access appears to be less popular. Students expose to applications of technology in-class quite frequently, yet they do not tend to apply technological advances to academic activities outside of classes, with evident differences between students. Regarding, teaches' applications of technology, the adoption of technology appears to be prevalent in classes while their willingness to apply technology, their usage outside of classes, and their habits of updating novel technology seem to vary more greatly. In terms of students' usage habits, students immerse themselves in technology, in general, but they do not incline to utilize technological advances for academic purposes.

3.3. Measurement overview

Table 3 - Reliability and validity assessment

Variables	Items	Corrected Item - Total Correlation	Cronbach's Alpha if Item Deleted
Technological Accessibility Cronbach's Alpha = 0.846	TA1 - General technological items accessibility	0.754	0.776
	TA2 - Personal technological items accessibility	0.638	0.791
	TA3 - Internet accessibility	0.829	0.751
	TA4 - Academic materials accessibility	0.683	0.739
Students' Application of Technology Cronbach's Alpha = 0.833	SAT1 - In-class applications	0.655	0.723
	SAT2 - Outside of class general applications	0.654	0.697
	SAT3 - Outside of class academic applications	0.805	0.678
Teachers' Application of Technology Cronbach's Alpha = 0.905	TAT1 - Willingness to apply	0.708	0.722
	TAT2 - Technological applications update	0.885	0.805
	TAT3 - In-class applications	0.739	0.837
	TAT4 - Outside of class applications	0.777	0.805
Students' Technology Usage Habits Cronbach's Alpha = 0.871	STUH1 - Frequency of general usage	0.844	0.676
	STUH2 - Total time of general usage	0.821	0.662
	STUH3 - Frequency of academic usage	0.618	0.655
	STUH4 - Total time of academic usage	0.890	0.877
	STUH5 - Technological practice	0.636	0.786
	STUH6 - Technological update	0.641	0.736
Perceived Academic Performance Cronbach's Alpha = 0.892	PAP1 - In-class participation	0.756	0.669
	PAP2 - Understanding of in-class materials	0.726	0.846
	PAP3 - Performance self-evaluation	0.799	0.826
	PAP4 - Comparison with other students	0.837	0.823

The table above shows that the coefficients of all variables (four independent, one dependent) are greater than 0.6, and the total correlation coefficients of their corresponding items are all greater than 0.3. Ergo, no variables are eliminated, the scales are suitable for further analysis. In general, the data is considered good.

3.4. Results and Discussion

Table 4 summarizes the linear regression analysis results, which examines the relationship between the four independent variables and two dependent variables. There are ten models in total, the first five shows the impacts of predicators on student's perceived academic performance while the second five on their actual academic performance (GPA). In the five models, the first one (base model) includes only four independent variables, the second expands the base model with interactive variables, specifically technological accessibility with the other three, the third expands the base model with gender as a dummy and its appropriate interactive variables with others, the fourth with students' hometown, and the fifth with students' household income. All models have their adjusted R^2 ranged between 0.6 and 0.8, which proves that all models explain the data quite well. Nevertheless, since the data is structured around freshmen and sophomores, we can experience biases towards this specific group of students in Hanoi.

While the two base models indicate that all independent variables are statistically significant and have positive impacts on students' academic performance, then author observes that technology shows greater influences on perceived academic performance than GPA, and the latter tolerates a lower significance level (it is less likely that we incorrectly reject the null hypotheses that the explanatories do not impact the dependent variable) in general. Evidently, variables related to students themselves personally should have a more considerable impact on students' academic performance than general technological conditions (accessibility and the usage of teachers). An important insight to highlight is that said variables of general technological conditions become statistically insignificant in the models with interactive variables, which implies that when we consider certain characteristics, said variables only matter to certain groups.

From the table below, we can draw the conclusions that the data implies male students perform slightly better than female students while we cannot conclude the same, statistically, about their hometown and family background (specifically household income). Students with better technological accessibility perform better, academically, if they share the same other technological conditions, which implies that access to technology matters, and it affects students' academic performance, but such effects display themselves more evidently as students and teachers apply technology to education. In terms of gender, while male students have a slightly greater academic performance, they perform far worse, compared to female students, when technology is incorporated to education. The explanation behind this result, as reported by several Vietnamese universities, is that when exposing themselves to technology, male students tend to distract themselves to entertainment than female students. In terms of hometown, the data suggests that students from Hanoi have considerable technological advantages compared to students from other cities. Regarding household income, the data proves that students from higher income families perform significantly better over students from lower income families as technological advances are employed in higher education.

Table 4 - Linear regression results

Variables	**Perceived Academic Performance**					**GPA**				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Technological Accessibility (TA)	0.262*	0.157	0.267	0.233*	0.288*	0.238**	0.215*	0.258*	0.224*	0.223**
Students' Application of Technology (SAT)	0.414***	0.180***	0.169*	0.119**	0.301**	0.318***	0.336**	0.328**	0.346***	0.354***
Teachers' Application of Technology (TAT)	0.189*	0.039	0.178**	0.111	0.205*	0.105*	0.172	0.171*	0.195*	0.192
Students' Technology Usage Habits (STUH)	0.280*	0.219*	0.158*	0.226*	0.220**	0.227***	0.176**	0.248**	0.245**	0.236*
TA*SAT		0.248**					0.281**			
TA*TAT		0.172*					0.231***			
TA*STUH		0.218***					0.162**			
Gender (Male = 1)			0.054***					0.091***		
Gender*TA			-0.237*					-0.239**		

Gender*SAT			-0.279***					-0.253**		
Gender*STUH			-0.228***					-0.218***		
Hometown (Hanoi = 1)				0.061					0.051*	
Hometown*SAT				0.247**					0.311***	
Hometown*TAT				0.194***					0.245**	
Hometown*STUH				0.233***					0.249**	
Income (20 million and above = 1)					0.088*					0.048*
Income*SAT					0.274***					0.318**
Income*TAT					0.251**					0.241*
Income*STUH					0.181***					0.274**
Adjusted R^2	0.6385	0.7797	0.6184	0.6337	0.6984	0.6821	0.7958	0.7833	0.6252	0.6723
					*	Sig. 10%	**	Sig. 5%	***	Sig. 1%

4. Conclusion

The research has underscored the profound influence of technology on student learning, encompassing critical dimensions such as learning efficiency, learning interest, and initiative in learning. The findings reveal a nuanced interplay between technology and student outcomes, with both positive and negative effects observed. The data demonstrates that technology significantly shapes student learning experiences. However, this impact is multifaceted, affecting various aspects of the learning process for male students, students from small towns and cities, and from a low-income household. While technology enhances accessibility, engagement, and personalized learning, it also introduces challenges; for example, distraction. In the broader educational context, the author recognizes that technology's impact extends beyond students. Teachers' ability to effectively integrate technology into their teaching practices plays a pivotal role. Innovative methods, informed by technology, can transform pedagogical approaches, making learning more dynamic and adaptive. Nevertheless, students' ability to leverage technology with their usage habits and applications, especially to academic activities, prove to be more critical to students' academic performance, both perceived performance and actual performance. Students who embrace technology as a tool for exploration, collaboration, and self-directed learning exhibit greater initiative and interest in their educational journey. Teachers should enhance their technological competencies and pedagogical strategies, while students, schools, universities, and local authorities should help equip students with essential skills to navigate the digital landscape effectively, especially students from small towns and cities, as well as students from low-income families. In addition, students should learn to balancing their screen time by purposeful using technology for academic purposes while mitigating potential drawbacks, especially for male students. In summary, this research sheds light on the intricate dynamics between technology, education, and student learning. By fostering a positive direction, marked by active participation, initiative, and sustained interest, educators and policymakers can optimize the transformative potential of technology in both urban and rural educational settings.

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