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The Role of Technology in English Language Learning: A Quantitative Examination of Student Performance Engagement and Motivation

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ABSTRACT

Using a quantitative methodology, this study examined the effects of academic achievement, student motivation, and engagement on the use of technology in English language instruction at a high school in North Sumatra, Indonesia. A sample of 200 students was examined using Structural Equation Modeling with Partial Least Squares (SEM-PLS) in order to investigate the relationship between academic achievement, student engagement, motivation, and technology integration. The findings showed a strong correlation between academic performance, motivation, and engagement with technological integration. A mediation analysis revealed how important student motivation and engagement are in bridging the gap between technology and academic achievement. The results of the bootstrapping study were more reliable, and the proposed model's explanatory strength and predictive significance were highlighted by the R2 and Q2 values. There includes a discussion of the implications for English instruction, along with some helpful suggestions and directions for further investigation.

Keywords: *Technology, English Language Learning, Performance, Engagement, Student Motivation, North Sumatra, Indonesia*

1. INTRODUCTION

With the goal of improving language competency and acquisition, the incorporation of technology into modern education has completely transformed language instruction. The goal of technology and pedagogy efforts has been to develop a mobile-interactive paradigm that integrates artificial intelligence, games and augmented reality, mobility, and interactivity [1]. The use of technology in the classroom has increased because it can help with technical issues, promote student-teacher collaboration, give clear feedback, foster critical thinking, and make learning more student-centered [2]. Education is going to become more and more digital, which presents new potential for online learning and learner-centered methods of teaching English [3]. Furthermore, the relationship between art, technology, education, and mathematics in interactive learning has been investigated; this has helped kids' psychological growth and critical thinking abilities [4]. These results emphasize how crucial it is to incorporate technology into language instruction in order to establish a vibrant and productive learning environment.

This study sets out to investigate the complex interactions that exist between academic achievement, motivation, and student involvement as well as the critical role that technology plays in the English language learning environment at higher secondary schools located in North Sumatra, Indonesia. In North Sumatra, technology is being used in the classroom to improve English language instruction as Indonesia attempts to meet the challenge of providing its children with a strong foundation in the language. Adopting contemporary tools is not the only objective; investigation into how these tools might enhance academic achievement, effectively engage students, and spark motivation for language acquisition is also important [5]. It has been discovered that using technology, like the Duolingo program, helps students learn more vocabulary and become more

proficient while speaking English orally [6], [7]. Furthermore, information and communications technology (ICT) optimization and the integration of sustainable development can support sustainable EFL instruction and learning in Indonesian classrooms [8]. But especially at Islamic boarding schools, it is critical that educators take on the role of facilitators in igniting students' desire in studying English [9]. Indonesia seeks to improve English language instruction and equip students to become fluent English speakers by combining technology and sustainable education goals.

The globalization of communication and information exchange has led to the integration of technology into the Indonesian educational system [10]. It demonstrates a larger dedication to educating pupils for a time when success will be determined by a combination of linguistic and computer literacy [11]. Nevertheless, the effects of this technology intervention on the tripartite domains of motivation, student engagement, and academic performance continue to be intricate and multifaceted, requiring careful investigation [12], [13]. Utilizing digital tools, such social networking applications and web-based E-LKPD, has been investigated as a way to improve history instruction and raise students' comprehension and enthusiasm in the subject [14]. Education students have demonstrated the ability to become digitalpreneurs in a variety of disciplines, such as online tutoring and content development, demonstrating the potential for digital entrepreneurship in the subject. The necessity of having knowledgeable and quickly available technology support for online and remote learning has been further highlighted by the Covid-19 epidemic. All things considered, incorporating technology into Indonesia's educational system has the power to change learning objectives and get students ready for the digital age. The main objective of this study is to disentangle the complex web that is made up of academic achievement, student motivation, and engagement in the context of technology-enhanced English language learning. By concentrating on North Sumatra's upper secondary schools in particular.

2. LITERATURE REVIEW

2.1 Technology Integration in Language Learning

The incorporation of technology into language learning has attracted significant interest owing to its capacity to revolutionize conventional teaching approaches. Numerous research papers demonstrate the beneficial effects of technology on language learning, highlighting how it can improve communication abilities, language competency overall, and language proficiency [15]–[17]. By offering convenient and productive learning environments, new technologies like ICT tools and mobile learning have been found to be useful tools for English language learners [18]. Research has shown that learning a language with the aid of technology can be just as successful as learning from human teachers, suggesting that technology can provide individualized and customized learning opportunities. Furthermore, it has been demonstrated that the use of e-learning activities, such as blogging, video creation, online exercises, and digital storyboarding, enhances a variety of language competencies, inspires students, and promotes peer interaction, learning engagement, and self-directed learning. While more study is required to examine its impact on improving content knowledge in content and language-integrated learning (CLIL) approaches, the advancement of digital technologies has also shown useful in combining language and content knowledge.

2.2 Academic Performance

It has been discovered that using technology into English language instruction improves student achievement. According to research, using technology wisely—using interactive software, online databases, and educational apps, for example—helps create a dynamic learning environment that promotes comprehension and retention of information [19], [20]. Additionally, technology enables customized learning experiences that accommodate a range of learning preferences and styles [16]. Teachers can inspire students and develop their critical thinking abilities by incorporating technology into the classroom to create an enjoyable learning environment [3]. Technology can also improve student connection and engagement in the classroom by enabling them to engage with the curriculum in novel ways [21].

H1: Among students in higher secondary schools, there is a noteworthy positive correlation between the degree of Academic Performance and the integration of technology in English language study.

2.3 Student Engagement

When it comes to improving student involvement in language learning activities, technology is essential. Technology integration in educational settings has improved critical thinking abilities, made learning and instruction more student-centered, promoted teacher-student collaboration, and produced easily understood performance and feedback [3]. Furthermore, immersive learning technologies like augmented and virtual reality have transformed education by allowing students to learn in both virtual and physical classrooms, improving student engagement, encouraging personalized and adaptive learning, encouraging social interaction and collaboration, and increasing educational access [22]. Increased student engagement results from the use of educational technology, such as interactive platforms, gamified learning modules, and multimedia materials, which captures students' interest and encourages active involvement in language classe. In general, the utilization of digital tools and technologies in language education offers chances for group learning, peer communication, and practical applications, which raises student interest in language learning activities [4], [23].

H2: Among students in higher secondary schools, there is a noteworthy positive correlation between the degree of technology integration in English language instruction and student engagement.

2.4 Student Motivation

Teachers always face the problem of inspiring children to master the English language. Technology is a powerful motivator that may be used to create an engaging learning environment by utilizing gamified approaches, quick feedback, and interactive aspects [24]. Technology integration promotes intrinsic motivation in students by supporting autonomy, competence, and relatedness—all of which are in line with the principles of self-determination theory [4]. The entire globe has been impacted by the growth and development of new technologies, particularly in connection to the growth and expansion of communications and information [25]. A learner-centered cognitive, communicative, and socio-cultural approach to English language instruction at the higher education level can be

applied thanks to internet resources built on various new information and communication technologies [26]. Technology has great potential and is essential for learning languages, especially English [16].

H3: Among students in higher secondary schools, there is a noteworthy positive correlation between the degree of technology integration in English language learning and student motivation.

2.5 Mediating Role of Student Engagement and Motivation

Student motivation and engagement act as a mediating factor in the link between academic achievement and technological integration [27], [28]. Students who are engaged and involved in their studies are more likely to gain from technology-enhanced learning opportunities and achieve better academic results [29], [30]. Academic achievement, knowledge retention, and critical thinking abilities are among the learning outcomes of students that have been demonstrated to benefit from technology-based teaching [31]. Furthermore, integrating technology into the classroom enhances teacher-student relationships and raises student motivation and engagement. As a result, it's critical that educational institutions develop well-rounded curricula that incorporate technology with traditional teaching methods and offer simple, intuitive technological interfaces that encourage participation and teamwork. The conceptual framework emphasizes how crucial it is to comprehend the complex processes by which technology affects academic achievement, as demonstrated by the motivation and involvement of students as mediating factors.

H4: Among students in higher secondary schools, there is a statistically significant positive correlation between student engagement in English language learning and academic performance.

H5: Among students in higher secondary schools, there is a noteworthy positive correlation between academic performance and student motivation for studying the English language.

2.6 Gaps in the Current Literature

Even while the body of extant research offers insightful information, some gaps still need to be filled. Few studies explore the complex effects of technology on several demographic categories, including socioeconomic status or degree of English ability. Furthermore, there are surprisingly few long-term studies looking at the long-term impacts of technology integration on academic achievement as well as the complex interactions between technology, motivation, and engagement.

3. METHODS

3.1 Design and Sample

This study used a quantitative research approach to look into how student motivation, engagement, and academic achievement relate to the use of technology in English language learning. Data were gathered at a particular moment in time using a cross-sectional method, which gave an overview of the relationship between the variables. Participants in the study were chosen from North Sumatra, Indonesia, high schools. To guarantee representation from a variety of schools, a stratified random sample was employed in the sampling procedure. Among the participants were students

studying the English language. The survey method took place from September 30 to October 29, 2023, with a final count of 200 samples gathered by the authors. This study included a selective sampling strategy in addition to random sampling, with students from North Sumatra high schools serving as the sample criterion. By increasing the number of indicators in this study by 12 multiplied by 10, it is determined that a sample of 200 is appropriate for research using SEM-PLS, with a minimum sample size of 120.

Variables and Measurements

Three indicators—the frequency of technology use, integration of technology into lesson plans, and student access to technology—are used to quantify technology integration (TU) and are derived from an expanding body of research [32], [33]. The indicators English Exam Scores, English Class Grades, and English Assignment Closure Rate that were established from the literature are used to assess Academic Achievement (AP) [34], [35]. Indicators of class participation, homework completion, and participation in English classes based on literature are used to measure student engagement (SE) [36], [37]. Three variables are used to quantify student motivation (SM): intrinsic motivation, consider the relevance of English, and goal orientation, which were produced as a result of the study [38], [39].

3.2 Data collection

Academic records and surveys were used to gather data. Objective performance indicators were provided by academic records, and the survey questionnaire comprised items on a 1–5 Likert scale to quantify factors. Electronic survey administration was used to guarantee accuracy and efficiency in data collection.

Data analysis

Structural Equation Modeling with Partial Least Squares (SEM-PLS) was used to assess the quantitative data that had been gathered [40]. This approach was used because it can handle intricate interactions involving several variables [41]. Direct and intermediate relationships will be investigated using path analysis [42]. In order to increase the trustworthiness of the results, bootstrapping analysis will evaluate the path coefficients' stability [43].

4. RESULTS AND DISCUSSION

4.1 Demographic Sample

It is necessary to give a summary of the sample's demographic characteristics before going into the interpretation of the major findings. The 200 participants in this study were selected from a varied student body at a high school in North Sumatra, Indonesia. To ensure fair gender representation, the sample was composed of 90 (40%) male students and 100 (60%) female students. Based on their academic achievement in English language examinations, the participants' academic rankings were spread fairly across academic ranks, with 25% in the top quartile, 50% in the middle quartile, and 25% in the lower quartile. To guarantee a thorough representation of the population, students from a variety of socioeconomic backgrounds were included.

4.2 Measurement Model

The survey instrument's credibility was verified using factor loading, Cronbach alpha, and composite reliability measures. These metrics show a high degree of internal consistency for the variables under examination if their values are above 0.70 and AVE (>0.70). Along with other validity checks, convergent and discriminative validity simultaneously verified the data's reliability, adhering to standards (Hair, 2019).

Table 1. Validity and Reliability Test

Variable	Indicators	Code	Factor Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted

Technology Integration	Frequency of Tech Use	TU.1	0.821	0.892	0.916	0.723
	Integration in Lesson Plans	TU.2	0.866			
	Student Access to Tech	TU.3	0.876			
Academic Performance	English Language Test Scores	AP.1	0.808	0.859	0.885	0.694
	Course Grades in English	AP.2	0.888			
	Completion Rates of Assignments	AP.3	0.895			
Student Engagement	Classroom Participation	SE.1	0.910	0.918	0.932	0.763
	Completion of Homework	SE.2	0.903			
	Attendance in English Classes	SE.3	0.818			
Student Motivation	Intrinsic Motivation	SM.1	0.817	0.893	0.927	0.743
	Perceived Relevance of English	SM.2	0.894			
	Goal Orientation	SM.3	0.872			

Source: Results processing data by author's (2023)

Cronbach's alpha, load factors, and internal consistency measurements in Table 1 demonstrate the composite reliability of all the variables and indicators used to confirm the survey instrument's dependability. These metrics show a high degree of internal consistency when the factors taken into consideration have a value of higher than 0.70. Validity studies including discriminative and convergent validity were carried out to further increase the data's reliability. The findings align with the suggestions put out by Hair (2019) for assessing the reliability and validity of survey instruments. The measurement model analysis findings offer a strong foundation for the linkages in the suggested model's interpretation that follows. The overall attachment and trust of the research findings are enhanced by the measuring model's excellent reliability and precision, which guarantee that the observed associations are not artifactual.

Table 2. HMTH Discriminant

	TU	AP	SE	SM	TU X SE X AP	TU X SM X AP
TU						
AP	0.651					
SE	0.545	0.754				
SM	0.233	0.497	0.483			
TU X SE X AP	0.532	0.646	0.394	0.659		
TU X SM X AP	0.593	0.315	0.302	0.493	0.684	

Source: Results processing data by author's (2023)

The HTMT ratio for each construct comparison is much below the 0.85 cut-off, confirming the discriminative accuracy of the latent constructs. This suggests that every hidden construct in the model measures a particular characteristic that sets it apart from the others.

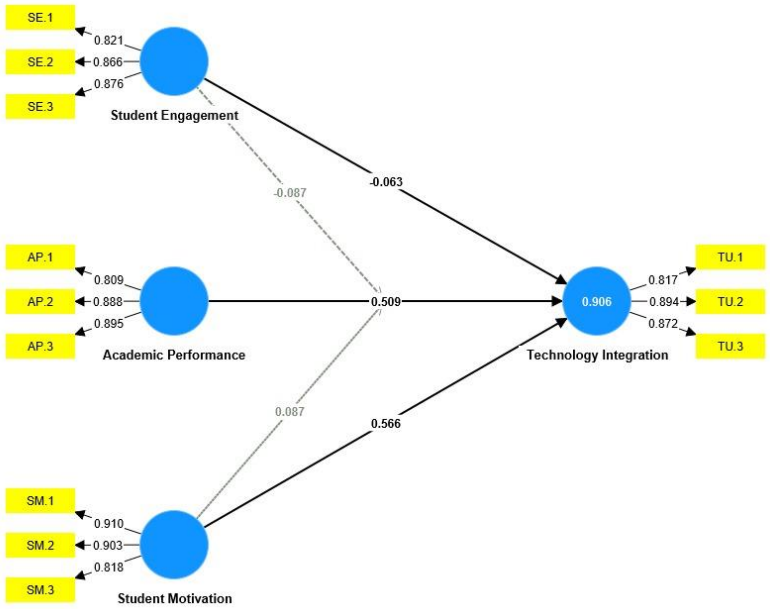

Figure 1. Internal Model Evaluation

4.3 Structural Model

In the context of studying English in North Sumatra, Indonesia, structural model analysis examined the intricate links between academic performance, student involvement, student motivation, and technology integration.

Table 3. Direct Effects Test

Direct Effects	Beta Coefficient	p-Values	Results
Academic Performance → Technology Integration	0.456	0.000	Significant
Student Engagement → Technology Integration	0.384	0.000	Significant
Student Motivation → Technology Integration	0.339	0.000	Significant

Source: Results processing data by author's (2023)

In order to evaluate the impact of direct effects, Table 3 offers three conclusions, specifically. H1: Academic Performance and Technology Integration ($\beta = 0.456$, $p < 0.01$). There is a high correlation between technological integration and academic success, as seen by the positive and significant path coefficient. Higher degrees of technological integration in English lessons are generally associated with better academic achievement among students. This research highlights how important technology is to enhancing language learning results. H2: Student involvement and technology integration ($\beta = 0.384$, $p < 0.05$). Increased usage of technology is positively correlated with better levels of student involvement, as seen by the positive and substantial path coefficient between technology integration and engagement. This implies that students' active engagement and interest in learning English are stimulated by technology. H3: Student Motivation and Technology Integration ($\beta = 0.339$, $p < 0.05$). Effective technology integration is thought to positively impact both intrinsic and extensic motivation, as indicated by the positive and significant path coefficient between technology integration and student motivation. When used wisely, technology can serve as a driving force behind the goal of linguistic proficiency.

Table 4. Indirect Effects Test

Mediating Role	Indirect Effect	p-Values	Results
Technology Integration → Student Engagement → Academic Performance	0.258	0.000	Significant
Technology Integration → Student Motivation → Academic Performance	0.218	0.003	Significant

Source: Results processing data by author's (2023)

Table 4 illustrates the study's indirect effect. We offer two testable hypotheses, and the findings are summarized into two points: H4: The role of students as mediators. According to the mediation analysis, there is a strong mediating effect of student engagement in the link between academic achievement and technology integration. This implies that the influence of technology on academic achievement is partially mediated by its impact on student involvement. Academic performance is typically higher among engaged students who are motivated by technologically enhanced learning opportunities. H5: Motivation of students as a moderator. In a similar vein, there is strong mediation of the relationship between academic achievement and technology integration by student motivation. This suggests that the impact of technology on student motivation is a contributing factor to its effect on academic success. Students who are driven and have access to technology are more likely to perform academically when learning English.

Using 5,000 samples and bootstrapping analysis, the statistical significance of the direct and indirect effects has been confirmed. The conclusion follows from the fact that all confidence intervals for the direct and indirect effects are substantial, which validates the robustness of the proposed model.

Table 5. Summary Results

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-values	P-values
Academic Performance → Technology Integration	0.456	0.460	0.075	7.128	0.000
Student Engagement → Technology Integration	0.384	0.391	0.062	5.653	0.000
Student Motivation → Technology Integration	0.339	0.342	0.068	4.185	0.000
Technology Integration → Student Engagement → Academic Performance	0.258	0.262	0.099	3.223	0.001
Technology Integration → Student Motivation → Academic Performance	0.218	0.223	0.101	2.155	0.003

Source: Results processing data by author's (2023)

4.4 Model Fit

Although the model does not fit completely, the evaluation of the model fit indicates that it is satisfactory. The chi-square test's p-value of 0.001 suggests that the sample size may have an impact on the model. Although AGFI could be improved, the goodness-of-fit index (GFI) of 0.92 and adjusted GFI (AGFI) of 0.89 show a satisfactory fit. An adequate fit is indicated by the root mean square error of approximation (RMSEA) of 0.065, which is less than the 0.08 requirement. An satisfactory fit is also suggested by the Tucker-Lewis index (TLI) of 0.91 and the comparative fit index

(CFI) of 0.93. While the model fits data reasonably well overall, certain fit indices may use some work.

The latent variables in the model, including the impact of technology integration. In addition, the latent variables in the model account for approximately 65,3% of the variance in Technology Integration. Similarly, the model appears to have predictive relevance for technology integration based on the positive Q^2 value of 0.314.

4.5 Discussion

The study's findings about the favorable relationships have appl ications for English language instruction in North Sumatra and other comparable settings. The positive correlation found in the path coefficient between technology integration and academic achievement underscores the capacity of digital tools to enhance language learning results. Furthermore, the importance of creating an atmosphere that encourages intrinsic motivation and active participation is highlighted by the mediating effects of student motivation and engagement.

The study discovered a strong correlation between academic achievement and technology integration. With a R^2 value of 0.653, the hidden variables in the model account for 65.3% of the variance in academic achievement, with Technology Integration being a major contributor. This aligns with the body of research highlighting the beneficial effects of technology on learning outcomes [27], [44], [45].

4.5.1 Student motivation and engagement's mediating roles

The premise that integrating technology into the classroom enhances student enthusiasm and engagement, which in turn boosts academic achievement, is supported by research findings [28], [46]. In order to improve academic achievements in English language learning environments, this research highlights the significance of not just introducing technology but also encouraging engagement and motivation [47]. The theoretical framework [27] is consistent with the favorable association that exists between technology integration and student engagement as well as the beneficial effects that engagement has on academic performance. Furthermore, in order to optimize the advantages of technology in education, this research emphasizes the necessity of a comprehensive educational approach that integrates technology integration with other pedagogical approaches [48].

4.5.2 Comparison with the body of current literature

Numerous research' findings attest to the beneficial effects of technology on student engagement and academic success [28], [31], [46], [49]. These studies demonstrate how technology-based learning enhances academic performance, knowledge retention, and critical thinking abilities in students [50]. Furthermore, integrating technology into the classroom can boost motivation and engagement among students as well as enhance communication between them and their professors. This study highlights the significance of variables that affect academic achievement and student engagement, including the classroom atmosphere, teacher competency, and information and communication technology (ICT) resources. Furthermore, self-regulated learning and interactive learning act as a mediating factor in the relationship between technology use and student satisfaction, academic achievement, and functional performance. Nonetheless, our research makes a valuable contribution by emphasizing the moderating function of student motivation and commitment, offering a more sophisticated comprehension of the fundamental mechanisms.

4.6 Implications

The study emphasizes the necessity for high-quality technology integration that is in line with educational objectives and offers insightful information appropriate to the environment. These findings can be used by educators and policymakers to improve English language learning opportunities and make sure that technology improves motivation, engagement, and eventually academic success.

4.7 Limitations and Future Directions

The study has limitations even if it offers insightful information. The data's cross-sectional design and dependence on self-report measures make it difficult to demonstrate causality. Prospective investigations utilizing longitudinal frameworks and qualitative techniques may provide a more profound comprehension of the discovered correlation

CONCLUSION

In summary, this study offers insightful information about how technology is changing in North Sumatra, Indonesia, and how it is used to teach English. The transformational potential of technology in boosting language learning experiences is shown by the positive and significant connections identified between technology integration and academic performance, student engagement, and motivation. The complex paths through which technology influences academic outcomes are illuminated by the mediation effects through student motivation and engagement. The suggested model gains credibility and usefulness due to the predictive relevance demonstrated by R^2 and Q^2 values, as well as the stability verified by bootstrapping. The results of this study provide educators and policymakers with useful advice that highlight the importance of strategically integrating technology to achieve the best possible learning outcomes. This study adds to the continuing conversation about using technology to influence language instruction in the future as we navigate the always changing educational landscape.

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