THE IMPACT OF TECHNOLOGY-BASED LEARNING ON STUDENTS' AFFECTIVE, BEHAVIORAL, AND COGNITIVE ENGAGEMENT IN EFL HIGHER EDUCATION

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Abstract

As technology continues to advance, it is crucial to examine its impact on student engagement to inform educational practices and pedagogical strategies. This research aims to investigate whether there is a significant difference in student engagement between the use of technology-based learning and traditional learning, as well as to identify the specific dimensions of student engagement (affective, behavioral, cognitive) that is mostly influenced by technology-based learning A pre-experimental study was conducted to compare the impact of technology-based instruction and traditional instruction on student engagement among higher education students. The data was collected through questionnaires distributed before and after the intervention using technology-based learning to 29 respondents and a t-test was employed to find out the differences between pre-test and post-test. The result revealed significant differences between students' engagement before and after the implementation of technology-based learning, implying that integrating technology into the instructional process positively influences student engagement. The most significant improvement among the three dimensions was in the affective domain. The visual and multimedia components of technology-based learning also contribute to affective engagement. Videos, simulations, and interactive activities captivate students' attention, evoke curiosity, and create memorable learning experiences. These engaging and immersive elements stimulate positive emotions, such as enthusiasm, enjoyment, and interest, thereby enhancing affective engagement. The result implies that educators should embrace technology-based learning approaches to promote positive emotional experiences, motivation, and student engagement, ultimately leading to improved learning outcomes.

Keywords – technology-based learning; traditional approach; affective engagement; behavior engagement; cognitive engagement

Introduction

In recent years, the integration of technology in education has revolutionized the way students learn and engage with course material. It is the teacher's task to make learning more effective and more enjoyable for students. It is also crucial to develop the next generation's ability to think critically using modern technology and networked information (Lin, et.al, 2017). Higher education institutions are increasingly adopting technology-based instructional approaches to enhance student-learning outcomes and promote student engagement. It can expands students' knowledge paradigm by enabling them to share and exchange points of view with teachers and their peers as well as integrating past information into the present learning systems. The most recent and most relevant information is made available to students in a way that makes it easy for them to access it and incorporate it into their learning (Ghavifekr & Rosdy, 2015).

In the learning process, student engagement is a critical factor in educational success and has been associated with improved learning outcomes, higher retention rates, and increased student satisfaction. Engagement is the extent of a student's active participation in a learning activity (Skinner et al, 2008, Veiga et al, 2014). Investigating and comprehending how learning environments and learning design models influence student engagement can help inform the implementation of online programs (Kuh, 2001; Rienties & Toetenel, 2016). Engaged students are active participants in the learning process, demonstrating attentiveness, effort, and involvement in their studies. Scholars have classified these aspects into engagement types such as behavioral, emotional, and cognitive engagement.

Behavioral engagement refers to how deeply a student is involved in the learning activity in terms of attention, effort, and persistence (Skinner, Kindermann, & Furrer, 2009). Affective engagement is a student's attitude toward his school, learning, teachers, and peers (Jimerson et al., 2003). Emotional engagement is defined as the presence of positive emotions such as interest during task involvement and the absence of negative emotions such as anxiety (Skinner, Kindermann, & Furrer, 2009). Cognitive engagement is defined as students' level of investment in learning. It includes being thoughtful and purposeful in each stage of the activities, as well as being willing to put in the effort required to comprehend complex ideas or master difficult skills (Fredricks et al 2004).

With the rapid advancements in educational technology, it is important to understand how different instructional approaches, particularly technology-based instruction, influence student engagement. While technology-based instruction offers various benefits, including increased accessibility, interactive learning experiences, and personalized content delivery, its impact on student engagement remains an area of inquiry. Traditional instruction, on the other hand, relies on conventional methods such as lectures and textbooks. This research seeks to explore whether there is a significant difference in student engagement between the use of technology-based learning and traditional learning, and to determine the specific dimension of student engagement that is most influenced by technology-based instruction. Thus, the study intends to examine the following research questions:

1. Is there a significant difference in student engagement between the use of technology-based learning and traditional approach?
2. What is the specific dimensions of student engagement (affective, behavioral, cognitive) mostly influenced by technology-based learning?

The purpose of this research is to contribute to the existing knowledge base on technology-based instruction and its impact on student engagement in higher education. By comparing the effectiveness of technology-based instruction to traditional instruction and examining the dimensions of student engagement that are most influenced by technology-based instruction, this study aims to provide valuable insights for educators, instructional designers, and policymakers in optimizing instructional approaches and promoting student engagement.

This research holds several benefits for various stakeholders within the higher education community. It will inform teachers and educators about the potential benefits and drawbacks of technology-based instruction in terms of student engagement. It allows them to make informed decisions about instructional design and pedagogical strategies. Furthermore, educational institutions can utilize the findings to develop evidence-based policies and initiatives that foster a supportive learning environment. The students will also benefit from enhanced engagement that lead to improved academic performance and a more meaningful learning experience.

Methodology

Design of Study

This study adopts a pre-experimental design to compare the impact of technology-based instruction and traditional instruction on student engagement among higher educational students. Specifically, a one group pre-test and post-test design was employed to assess the changes in student engagement following the instructional interventions using technology-based learning.

Participants

The study involved a random sample of 29 higher educational students majoring in English Department. The respondents were 13 male and 16 female, age range from 19- years old, and come from various social background. The participants was selected using random sampling techniques to ensure representativeness and reduce potential biases.

Research Instrument

To measure student engagement, the study will utilize Miserandino (1996) self-report questionnaire which is widely used in educational research. The questionnaire assesses key dimensions of engagement, including affective, behavior, and cognitive dimensions. It consists of 15 Likert-scale items, with 5 items allocated to each engagement dimension. The questionnaire has undergone validity and reliability testing to non-sample participants to ensure its validity and reliability.

Procedures

1. Pre-Test:
Before the instructional intervention (technology-based learning instruction), all participants completed the engagement questionnaire to their level of engagement when they were taught by using traditional instruction. This will provide a comparative measure of engagement between the technology-based instruction and the traditional classroom. Pre-test was conducted after four meeting of the implementation of traditional learning.

2. Instructional Intervention:
The technology-based intervention provides instruction utilizing appropriate technological tools such as online platforms, educational software, and multimedia resources. Meanwhile, previously, the same respondents had only received traditional instruction using conventional methods such as lectures, textbooks, and handouts before the intervention. Four meetings were allocated for each instruction.

3. Post-Test:
Immediately after the instructional interventions, all participants completed the engagement questionnaire again to assess the changes in student engagement from technology-based and traditional approaches. Post-test was conducted after four meeting of the implementation of technology-based learning. The post-test data was compared to the pre-test data to determine any differences in engagement levels.

Data Analysis

The collected data were analyzed using appropriate statistical techniques. Descriptive statistics, such as means and standard deviations, will be calculated to summarize the characteristics of the sample and the overall engagement levels. Comparative statistical analyses, including paired sample t-tests will be conducted to examine the differences in student engagement between the technology-based instruction and the traditional instruction. Effect sizes and statistical significance will be considered to assess the practical significance of any observed differences.

Finding and Discussion

Problem 1: Is there a significant difference in student engagement between the use of technology-based learning and traditional approach?

To answer the first problem, first, the data of students' engagement before and after the intervention (using technology-based learning) were collected through questionnaire of engagement by Miserandino (1996). The data description for students' engagement both in technology-based learning and in traditional approach can be seen in the histogram below.

Figure 1 Descriptive Statistics of Students' Engagement in Traditional Learning

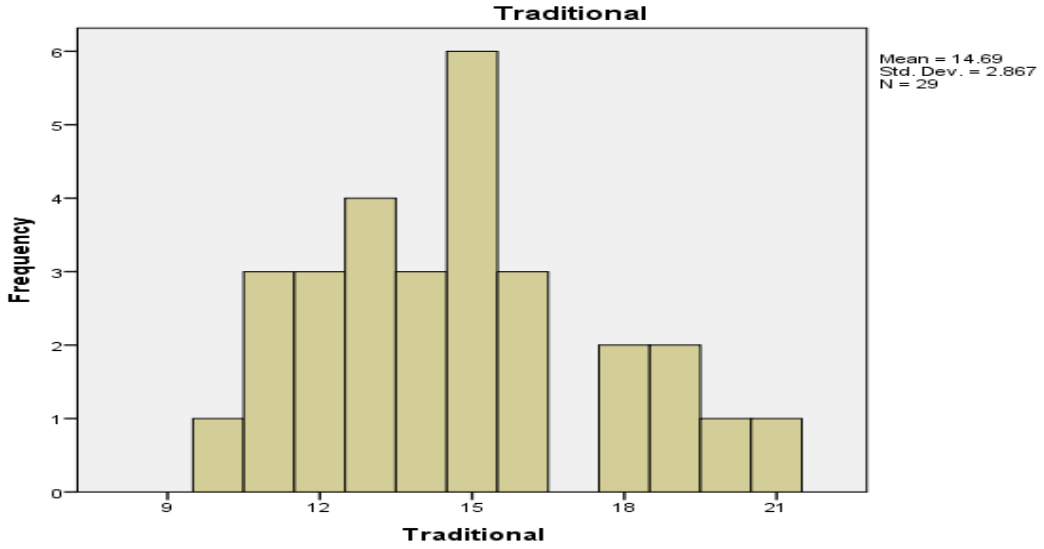
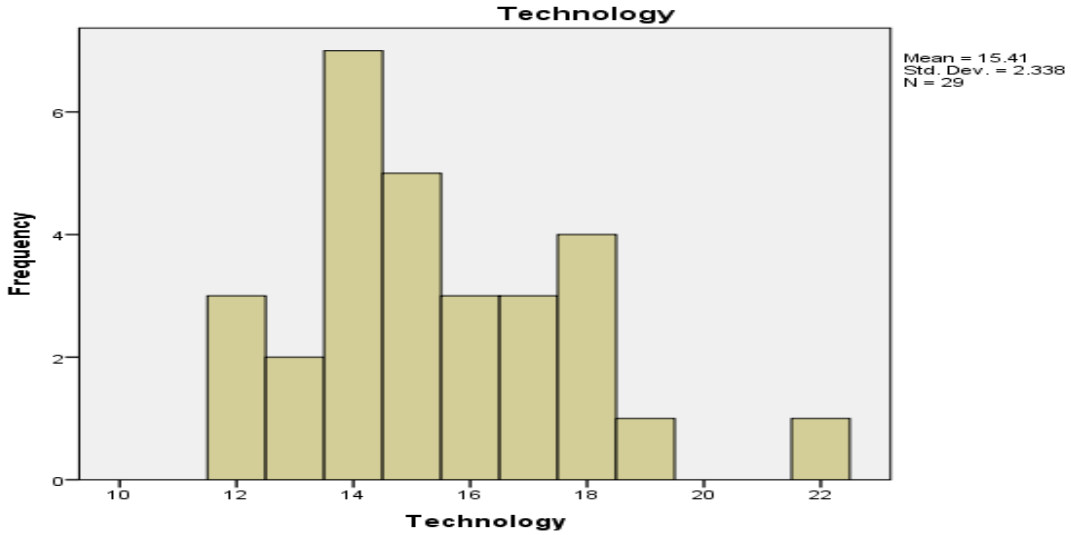


Figure 2 Descriptive Statistics of Students' Engagement in Technology-based Learning



The result of descriptive statistics of students' engagement when taught by using traditional learning and technology-based learning can also be seen in table 1.

Table 1 Descriptive Statistics of Both Instructions

		Traditional	Technology
N	Valid	29	29
	Missing	0	0
Mean		14.69	15.41
Median		14.44[a]	15.00[a]
Mode		15	14
Std. Deviation		2.867	2.338
Variance		8.222	5.466
Minimum		10	12
Maximum		21	22
Sum		426	447
Percentiles	25	12.50[b]	13.72[b]
	50	14.44	15.00
	75	16.20	17.07

a. Calculated from grouped data.

b. Percentiles are calculated from grouped data.

The histograms and the table above presents the descriptive statistics of students' engagement scores between the traditional approach and technology-based learning. The table provides information on the number of valid cases, mean, median, mode, standard deviation, variance, minimum, maximum, sum, and percentiles for both instructional approaches. For the traditional approach, there were 29 valid data, thus all data points were available for analysis. The mean engagement score was 14.69, with a median of 14.44 and a mode of 15. The standard deviation was 2.867. It means that the variability in the scores have a moderate amount. The variance was calculated as 8.222. The minimum score recorded was 10, while the maximum score was 21. The sum of all engagement scores in the traditional approach was 426. The 25th percentile was 12.50, meaning that 25% of the students had engagement scores below this value. The 50th percentile, or the median which represent the middle score was 14.44. The 75th percentile was 16.20. It means that 75% of the students had engagement scores below this value.

Regarding to technology-based learning, there were also 29 valid data. The mean engagement score was slightly higher at 15.41 compared to the traditional approach. The median was 15.00 and the mode was 14. The standard deviation was 2.338. It has a slightly lower amount of variability compared to the traditional approach. The variance was calculated as 5.466. The minimum score recorded was 12, while the maximum score was 22. The sum of all engagement scores in the technology-based learning was 447. The 25th percentile was 13.72, the median was 15.00, and the 75th percentile was 17.07.

Based on these statistics, it can be seen that the mean and median engagement scores were higher in the technology-based learning group compared to the traditional approach. The mode was 15 in the traditional approach and 14 in the technology-based learning group. The standard deviation and variance were lower in the technology-based learning group. It

means that there was a less variability in the engagement scores compared to the traditional approach.

Table 2 Paired Samples Correlations of Students' Engagement

		N	Correlation	Sig.
Pair 1	traditional learning & technology-based learning	29	.887	.000

The paired samples correlation analysis was conducted to examine the relationship between students' engagement and learning instruction. The correlation coefficient (r) was found to be .887. The p-value, indicated as "Sig.," was .000, which is less than the conventional threshold of .05. This suggests a statistically significant positive correlation between students' engagement and learning instruction. Meanwhile, the result of paired sample t-test to find out the difference between traditional learning and technology-based learning can be seen in the table below.

Table 3 Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Traditional - Technology	-6.207	3.321	.616	-7.47	-4.943	-10.066	28	.000

The findings revealed that there was a significant difference between the technology-based and traditional learning. Specifically, when taught by using technology-based learning, the students demonstrated significantly higher levels of engagement compared to when taught through traditional methods. The correlation analysis showed a strong positive relationship ($r = 0.887$, $p < 0.05$) between the use of technology-based learning and student engagement. Additionally, the mean difference of 6.207 further supported the notion that technology-based learning contributed to greater student engagement. The t-count score, 10.066 and indicates a substantial difference between the mean levels of student engagement in the technology-based learning group and the traditional instruction. The level of significance was 0.00, which is higher than 0.05 level of significance. Therefore, the observed difference between the means is statistically significant.

These results provide empirical evidence that integrating technology in the instructional process positively influences student engagement. Technology-based learning holds promise for enhancing the learning experience and promoting active student participation. Technology-based learning offers numerous advantages over traditional approaches reliant solely on textbooks. It has been demonstrated that technology-based learning significantly increases student engagement in the learning process. It stimulates the students' interest, captures students' attention, and motivates active participation through incorporating multimedia elements, interactive features, and personalized learning experiences (Schindler, et al., 2017).

Besides, technology-based learning provides a dynamic and interactive environment that appeals to students' digital fluency and familiarity with technology (Clements, 2015). It

offers diverse formats such as videos, animations, simulations, and interactive exercises that cater to different learning styles and promote engagement by presenting information in a visually appealing and interactive manner (Annetta et al, 2009). In contrast, traditional approaches relying on textbooks often lack the multisensory and interactive components that can actively engage students (Parveen, 2016).

Furthermore, technology-based learning promotes active learning and student-centered approaches (Schindler et al., 2017; Chawinga, 2017). With access to online resources, students can explore topics beyond the confines of a textbook, engage in collaborative discussions, and participate in virtual experiments or simulations. For instance, conference rooms and whiteboards offer chances for in real time, group conversations and problem-solving exercises (Schindler et al., 2017). Students may benefit from active learning, problem-solving, and reflection when using blogs in the classroom (Chawinga, 2017). These opportunities for active participation and exploration foster deeper understanding, critical thinking, and problem-solving skills. Traditional approaches primarily relying on textbooks often limit student interaction to passive reading and memorization (Siddique et al., 2013). It is a hindrance on active engagement in the learning process.

Technology-based learning also provides immediate feedback and adaptive learning experiences (Hudson et al., 2012). Through online quizzes, assessments, and technology-based learning platforms, students can receive instant feedback on their progress and can track their performance (Hapsari, et al., 2016; Wahyuni et al., 2020). It enables them to identify areas for improvement and adjust their learning strategies (Rashid & Asghar, 2016). On the other hand, traditional approaches often lack immediate feedback mechanisms that makes it challenging for students to gauge their understanding and progress accurately. Moreover, technology-based learning facilitates personalized learning experiences tailored to individual student needs (Kearsley & Schneiderman, 1998). Adaptive learning platforms and intelligent tutoring systems analyze students' performance data and provide customized content and recommendations, addressing their unique learning gaps and pacing. This personalized approach enhances student motivation and engagement by addressing their specific learning needs and fostering a sense of ownership over their educational journey (Robin & McNeil, 2012). Meanwhile, traditional approaches relying solely on textbooks offer limited customization and differentiation possibilities.

In conclusion, technology-based learning has demonstrated its ability to significantly enhance student engagement compared to traditional approaches dependent solely on textbooks. By incorporating multimedia elements, interactivity, personalization, and immediate feedback, technology-based instruction offers a more engaging and student-centered learning experience. Educators should use technology to create dynamic and interactive learning environments that foster active participation, critical thinking, and personalized learning which can promote higher levels of student engagement and improved learning outcomes.

Problem 2: What is the specific dimensions of student engagement (affective, behavioral, cognitive) mostly influenced by technology-based learning?

Affective Dimension

The paired samples analysis that examines the two learning instructions on affective dimension can be seen in the next table.

Table 4 Paired Samples Statistics of Affective Dimension

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Traditional learning	12.28	29	2.086	.387
	Technology-based learning	15.90	29	2.193	.407

In the traditional learning, the mean score is 12.28, based on a sample size of 29. The standard deviation is 2.086, indicating the variability of scores within this condition. The standard error mean is .387, reflecting the precision of the sample mean. For the Technology-based learning, the mean score is 15.90, also with a sample size of 29. The standard deviation is 2.193, and the standard error mean is .407. Meanwhile, the paired samples t-test examined the differences between the traditional and technology-based learning as seen in the table below.

Table 5 Paired Sample t-test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Traditional learning – Technology-based learning	-3.621	1.115	.207	-4.045	-3.196	-17.483	28	.000

The mean difference was -3.621, indicating that, on average, the Traditional condition had lower scores compared to the Technology condition. The standard deviation of the differences was 1.115, and the standard error mean was .207. The 95% confidence interval for the difference ranged from -4.045 to -3.196, suggesting that we can be reasonably confident that the true mean difference falls within this interval. The t-value was -17.483 with a degree of freedom (df) of 28. The p-value, indicated as "Sig. (2-tailed)," was .000, which is less than the conventional threshold of .05, indicating a statistically significant difference between the Traditional and Technology conditions.

Behavioral Dimension

Table 6 Paired Samples Statistics of Behavioral Dimension

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Traditional learning	16.10	29	2.691	.500
	Technology-based learning	17.41	29	2.338	.434

The analysis focuses on the Behavioral Dimension in the context of paired samples. The mean score of behavioral engagement in traditional learning is 16.10, based on a sample size (N) of 29. The standard deviation is 2.691, reflecting the variability of scores within this

condition. The standard error mean, measuring the precision of the sample mean, is .500. In contrast, for the technology-based learning, the mean score is 17.41, also with a sample size of 29. The standard deviation is 2.338, and the standard error mean is .434. Meanwhile, the result of paired sample t-test in behavioral engagement between traditional learning and technology-based learning can be seen in table 7.

Table 7 Paired Samples Test of Behavioral Dimension

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Traditional learning-Technology-based learning	-1.310	1.671	.310	-1.946	-.675	-4.222	28	.000

The mean difference between the Traditional learning and Technology-based learning conditions was -1.310. The standard deviation of the differences was 1.671, and the standard error mean was .310. The 95% confidence interval for the difference ranged from -1.946 to -0.675. This indicates that we can be reasonably confident that the true mean difference falls within this interval. The t-value was -4.222, with degrees of freedom (df) equal to 28.

Cognitive Dimension

The table below describes the cognitive dimension in the context of paired samples.

Table 8 Paired Samples Statistics of Cognitive Dimension

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Traditional	14.69	29	2.867	.532
	Technology	15.41	29	2.338	.434

For the traditional learning, the mean score is 14.69, based on a sample size (N) of 29. The standard deviation is 2.867, reflecting the variability of scores within this condition. The standard error mean, measuring the precision of the sample mean, is .532. In contrast, for the technology-based learning condition, the mean score is 15.41, also with a sample size of 29. The standard deviation is 2.338, and the standard error mean is .434. Meanwhile, the result of paired sample t-test in cognitive engagement between traditional learning and technology-based learning can be seen in table 9.

Table 9 Paired Samples Test of Cognitive Dimension

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	traditional learning - technology based learning	-.724	1.509	.280	-1.298	-.150	-2.584	28	.015

The mean difference between the traditional learning and technology-based learning conditions was found to be -0.724. The standard deviation of the differences was 1.509, and the standard error mean was 0.280. The 95% confidence interval for the difference ranged from -1.298 to -0.150, indicating that we can be reasonably confident that the true mean difference falls within this interval. The t-value was -2.584, with degrees of freedom (df) equal to 28. The p-value, indicated as "Sig. (2-tailed)," was 0.015, which is less than the conventional threshold of 0.05.

After finding out the mean scores and the difference (t-count) of each dimension of engagement, the mean and difference of the three dimension of engagement were compared and the result was as follows.

Table 10 Comparison of mean and t-count

Dimension of Engagement	Mean difference	t-count
Affective	3.621	17.483
Behavioral	1.310	4.222
Cognitive	0.724	2.584

The research question aimed to investigate the specific dimensions of student engagement (affective, behavioral, cognitive) that are most influenced by technology-based learning. The findings of the study revealed varying levels of influence on these dimensions, with the affective dimension being the most significantly impacted by technology-based learning, as indicated by the highest t-count of 17.48. The behavior dimension had a t-count of 4.22, while the cognitive dimension had a t-count of 2.58.

The significant influence of technology-based learning on the affective dimension of student engagement suggests that incorporating technology in the learning process has a profound effect on students' emotional aspects of engagement. Technology has the potential to create a stimulating and immersive learning environment, fostering positive emotions, motivation, and interest among students. The interactive and multimedia features of technology-based instruction can capture students' attention, evoke curiosity, and enhance their emotional connection to the subject matter. As a result, students may exhibit higher levels of enthusiasm, enjoyment, and overall positive affect towards their learning experience.

One argument for the significant influence on affective engagement is the personalization and customization opportunities offered by technology-based learning. Technology enables adaptive learning experiences that can cater to individual learning preferences, pace, and interests (Robin & McNeil, 2012). Technology-based instruction can create a more engaging and emotionally satisfying learning journey by tailoring content and resources to meet students' specific needs. Students feel a sense of autonomy and ownership over their learning process that can increase their affective engagement (Saraswati et al., 2021).

Furthermore, the interactive nature of technology-based learning promotes social interactions and collaborative learning that can positively influence affective engagement. Online platforms, discussion forums, and virtual group projects enable students to connect with peers, share ideas, and receive support (Ivone et al., 2020). The opportunity for collaborative learning through technology can enhance students' emotional engagement by providing a supportive and engaging learning community. Additionally, the visual and multimedia elements of technology-based instruction can evoke emotions and create memorable learning experiences (Reinders, 2011). Videos, simulations, and interactive activities appeal to students' visual and auditory senses. It makes the learning process more enjoyable and emotionally engaging. The incorporation of gamification elements, such as rewards, challenges, and progress tracking can further enhance affective engagement by tapping into students' intrinsic motivation and sense of achievement (Kearsley & Schneiderman, 1998; Chang & Wei, 2016).

In conclusion, the findings showed the significant influence of technology-based learning on the affective dimension of student engagement. The immersive and interactive nature of technology-based instruction, along with its personalization and social interaction opportunities, contribute to heightened emotional engagement among students. The positive affective experiences associated with technology-based learning can foster enthusiasm, motivation, and a sense of ownership in students, ultimately enhancing their overall engagement and learning outcomes. Teachers should take advantage of technology's capacity to construct emotionally stimulating learning environments that encourage affective aspects of student engagement and support in their overall development.

Conclusions

According to the findings, it can be said that using technology-based learning had a substantial impact on student engagement when compared to using a traditional method, with the emotional aspect being most influenced by this instructional strategy. The affective aspect of student involvement is significantly influenced by technology-based learning. A dynamic and emotionally engaging learning environment is produced by the integration of multimedia components, personalization, social interaction, and immersive experiences. These findings emphasize how crucial it is to make use of technology to raise student involvement in their studies, especially affective engagement in classroom settings. It is suggested that educators should adopt technology-based learning approaches as a means to foster positive emotional experiences, enhance motivation, and increase overall engagement among students. Educators can create a learning environment that inspires positive emotions, motivates students, and encourages active participation in the learning process by integrating technology into the instructional process. Therefore, this can ultimately result in better learning outcomes for students.

Ethical Clearance

The ethics approval for this study was obtained from Universitas Riau Kepulauan (019/D-FKIP/UNRIKA/III/2023)

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