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The Effects of Hybrid-Based Learning on Student Engagement in High School

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ABSTRACT

Background: Hybrid learning has gained popularity due to its ability to blend classroom teaching with online learning. The software does give helpful tools to teachers, but it remains unclear how it encourages students in secondary school.

Objective: The study aims to explore how Technology Accessibility and Use, Instructional Design and Content Delivery, Teacher Support, and Interaction, and Student Self-Regulation and Motivation can predict high school students' engagement in their studies by using a novel approach that combines several factors into one well-defined structure.

Methodology: A quantitative approach was applied to study the correlational model. A Likert-scale questionnaire was used to conduct the survey, and results were obtained from 384 high school students enrolled in either public or private institutions. The data were managed using SPSS, which facilitated analysis with descriptive statistics, correlations, and multiple regression.

Results: The study demonstrated that each independent variable correlated with student engagement. However, all the significant predictors in the regression analysis were Instructional Design and student Self-Regulation, while Technology Accessibility was only useful for predicting negativity. There was not a strong connection between Teacher Support and the decisions made by parents.

Conclusion: The study highlights that both effective teaching methods and motivated students are essential in hybrid courses. According to the research, improving engagement in secondary hybrid education requires creating organized content, giving students more control in learning, and delivering practical teacher training.

KEYWORDS: Hybrid Learning, Student Engagement, Secondary Education, Instructional Design, Self-Regulation, Educational Technology

INTRODUCTION

Educational delivery has undergone rapid changes, transitioning from traditional classrooms to a hybrid model that incorporates technology. Educational approaches have undergone significant shifts, and hybrid-based learning has emerged to provide students with more flexibility and consistency, particularly during the pandemic [1]. Using hybrid learning to combine online and personal learning has become an important aspect of educational progress. The ability of Online learning to engage students in education, adapt to individual needs, and maintain continuity in changing situations helps it lead the way in modern education reform [2, 3]. Although hybrid learning is being used more frequently, many remain uncertain about its effectiveness in supporting student involvement in secondary education.

The involvement of students—physically, emotionally, and mentally—is regarded as a significant outcome for educational achievement, overall satisfaction in school and later recall [4]. Hybrid models rely on engagement, as learners typically control their learning, and teachers are not always directly present. Hybrid learning, when properly implemented, has been shown to enable learners to become more adaptable and take the lead in their learning [5, 6]. When these environments are built correctly, they can help students participate

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more effectively and learn the concepts more thoroughly. On the other hand, studies have pointed out important issues. Insufficient educational technology, a lack of clear teaching approaches, and limited interaction with teachers have been found to limit student interest and lead to uneven outcomes [7-9].

Currently, research indicates that many studies focus on university education, leaving hybrid learning at the secondary level less studied [10]. Most research explores one factor alone, whether technology or teacher support, and little is explored about how these aspects connect to maintain students' engagement [11, 12]. There have been few studies that attempt to explain how elements such as instructional design, online resources, teachers' feedback, and student interest affect engagement, especially among young students studying in government-established schools and private schools.

This study examines the influence of four significant aspects of hybrid learning—Technology Accessibility and Use, Instructional Design and Content Delivery, Teacher Support and Interaction, and Student Self-Regulation and Motivation—on student engagement [13-15]. The study is conducted using a survey of 384 high school students and a quantitative method to measure their engagement. When students from public and private schools are involved, the findings can be applied more broadly and demonstrate how engagement varies across different settings.

Additionally, the study yields new findings regarding the impact of all four factors through the use of quantitative analysis. Analyzing data from 384 students, each from a different educational journey, enables researchers to go beyond simply knowing what happens to predict when it will take place. The current study responds to recent reports in the literature that highlight a lack of large, data-driven studies on the effectiveness of hybrid learning for pre-university populations [16, 17]. The research model developed here may help build improved interventions for hybrid learning, which has proven to be more successful in schools [18]. The study aims to identify what factors significantly contribute to students' involvement in hybrid high schools.

CONCEPTUAL FRAMEWORK

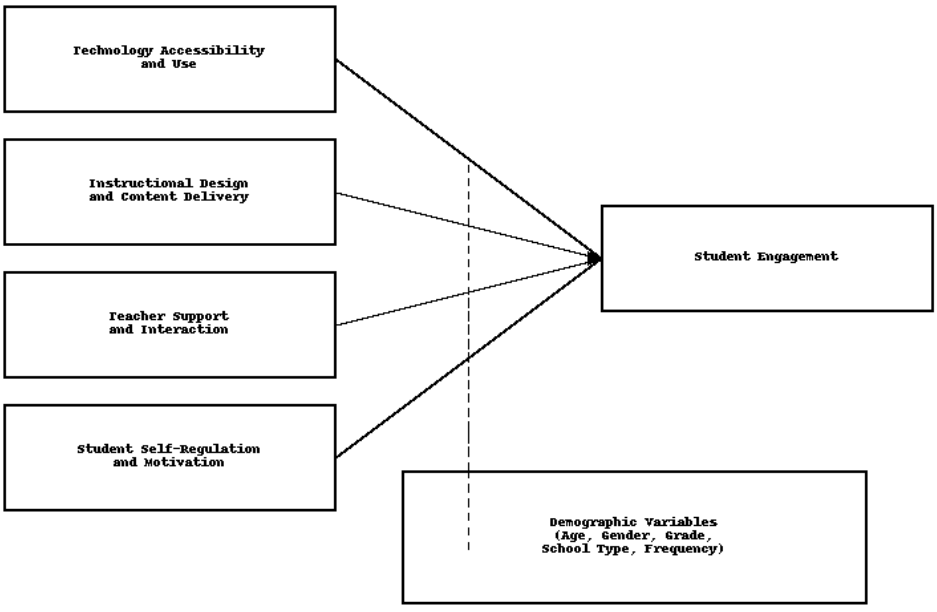

Figure 1. Factors Affecting Student Engagement with Demographic Moderation.

The conceptual framework in **Figure 1** demonstrates how Technology Accessibility and Use [19],

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Instructional Design and Content Delivery [20], Teacher Support and Interaction [7], and Student Self-Regulation and Motivation [21], affect Student Engagement in hybrid learning [22]. The various independent variables are directly linked to Student Engagement, the dependent variable, as indicated by the arrows. Moreover, Age, Gender, Grade Level, Type of School, and Frequency of taking part in hybrid learning influence the relationships between the variables [23]. The model illustrates how multiple elements are interconnected to enhance student involvement in secondary hybrid education.

METHODOLOGY

Research Design

The research employed a quantitative method to investigate the impact of hybrid-based learning on student participation in high school. The design allowed scientists to study how different independent variables interact, including Technology Accessibility and Use, Instructional Design and Content Delivery, Teacher Support and Interaction, Student Self-Regulation and Motivation, and the second variable, Student Engagement [24]. The approach facilitated a statistical approach to determine the extent to which these factors predict student engagement within a hybrid learning context.

Participants

The research included 384 students from high schools. The survey was distributed to students from both public and private institutions to include all types of education in the results. Since the sample is inclusive, the results can be applied more broadly [25]. Participants in the survey were between 14 and 18 years old, with 24.7% under 14 years old, 26.8% aged 14–15, 25.8% aged 16–17, and 22.7% aged 18 and above. There were 53.4% male and 46.6% female students. The academic grade levels were evenly represented, with 23.7% in 9th grade, and 23.4% sharing their thoughts, followed by 26.8% in 11th grade and 26% in 12th grade. Additionally, the frequency of hybrid learning participation varied, with 34.1% of students engaging 1 to 2 days per week, 32.3% attending 3 to 4 days per week, and 33.6% participating 5 days per week. This demographic composition is detailed in Table 1, making the sample as diverse as possible (**Table 1**).

Table 1. Demographics

Category	Frequency	Percent	Valid Percent	Cumulative Percent
Age				
Under 14	95	24.7	24.7	24.7
14 - 15	103	26.8	26.8	51.6
16 - 17	99	25.8	25.8	77.3
18 and above	87	22.7	22.7	100.0
Total (Age)	384	100.0	100.0	
Gender				
Male	205	53.4	53.4	53.4
Female	179	46.6	46.6	100.0
Total (Gender)	384	100.0	100.0	
Grade Level				
9th grade	91	23.7	23.7	23.7
10th grade	90	23.4	23.4	47.1
11th grade	103	26.8	26.8	74.0
12th grade	100	26.0	26.0	100.0
Total (Grade Level)	384	100.0	100.0	
Type of School				
Public	189	49.2	49.2	49.2
Private	195	50.8	50.8	100.0
Total (Type of School)	384	100.0	100.0	
Frequency of Hybrid Learning				

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Participation per Week				
1 - 2 days	131	34.1	34.1	34.1
3 - 4 days	124	32.3	32.3	66.4
5 days	129	33.6	33.6	100.0
Total (Hybrid Learning)	384	100.0	100.0	

Instrumentation

A structured, self-completed questionnaire was used to collect the data, consisting of five key constructs: Student Engagement, Technology Accessibility and Use, Instructional Design and Content Delivery, Teacher Support and Interaction, and Student Self-Regulation and Motivation. A validated self-administered Likert-scale questionnaire follows the most effective methods in quantitative educational studies, allowing for the standardized measurement of psychological and behavioural constructs [26].

Data Collection Procedure

The institutional review board provided ethical approval for the study before we began collecting data. Participants and their guardians provided informed consent to participate in the study. Some participants received their questionnaire electronically, while others received it in paper form, based on their accessibility needs, during the active implementation of hybrid learning in the academic term. Participants involved in the study were promised their responses would remain private and anonymous.

Data Analysis

The study employed the statistical software SPSS to analyze the data. Descriptive statistics listed the main demographics and how the variables were spread. Cronbach's alpha was used to assess the reliability and consistency of the scale. Pearson correlation analysis was performed to explore the relationship between different variables, followed by multiple regression analysis to determine the extent to which the independent variables influence Student Engagement. The assumptions underlying regression analyses, including normality, linearity, homoscedasticity, and the absence of multicollinearity, were checked and verified before running inferential tests.

RESULTS

In **Table 2**, you will find key statistics for each of the important variables. The measure of Student Engagement among the 384 participants yielded a mean score of 1.68 (SD = 0.77), with values ranging from 0.00 to 3.80, indicating moderate levels of engagement overall. Technology Accessibility and Use recorded a slightly lower mean of 1.55 (SD = 0.99), with scores starting from 0.00 to 4.00, demonstrating the use of technology by students both in-person and online. Instructional Design and Content Delivery yielded a mean of 1.19 (SD = 0.88), suggesting relatively low perceptions of content delivery effectiveness across the sample. Similarly, Teacher Support and Interaction had a mean of 1.16 (SD = 0.87), indicating modest levels of perceived teacher engagement and support. Student Self-Regulation and Motivation exhibited the highest mean among the variables at 1.71 (SD = 0.91), with scores of 0.00 to 4.00, highlighting varying degrees of individual motivation and self-management in learning activities.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Student Engagement	384	0.00	3.80	1.6760	0.77267
Technology Accessibility and Use	384	0.00	4.00	1.5521	0.99008
Instructional Design and Content Delivery	384	0.00	3.80	1.1911	0.88067
Teacher Support and Interaction	384	0.00	3.60	1.1573	0.87354
Student Self-Regulation and	384	0.00	4.00	1.7135	0.91453

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Motivation					
Valid N (listwise)	384				

The correlation analysis, presented in **Table 3,** demonstrates that all relationships between study variables are not only strong but also statistically significant ($p < 0.01$). Student Engagement demonstrated high correlations with Technology Accessibility and Use ($r = 0.78$), Instructional Design and Content Delivery ($r = 0.82$), Teacher Support and Interaction ($r = 0.82$), and Student Self-Regulation and Motivation ($r = 0.81$). Furthermore, Technology Accessibility and Use were highly correlated with Instructional Design and Content Delivery ($r = 0.97$), Teacher Support and Interaction ($r = 0.96$), and Student Self-Regulation and Motivation ($r = 0.98$). Instructional Design and Content Delivery showed robust associations with Teacher Support and Interaction ($r = 0.99$) and Student Self-Regulation and Motivation ($r = 0.97$). Similarly, Teacher Support and Interaction were strongly correlated with Student Self-Regulation and Motivation ($r = 0.97$).

Table 3. Correlations

		Student Engagement	Technology Accessibility and Use	Instructional Design and Content Delivery	Teacher Support and Interaction	Student Self-Regulation and Motivation
Student Engagement	Pearson Correlation	1	0.781**	0.816**	0.823**	0.814**
	Sig. (2-tailed)		0	0	0	0
	N	384	384	384	384	384
Technology Accessibility and Use	Pearson Correlation	0.781**	1	0.970**	0.957**	0.976**
	Sig. (2-tailed)	0		0	0	0
	N	384	384	384	384	384
Instructional Design and Content Delivery	Pearson Correlation	0.816**	0.970**	1	0.989**	0.965**
	Sig. (2-tailed)	0	0		0	0
	N	384	384	384	384	384
Teacher Support and Interaction	Pearson Correlation	0.823**	0.957**	0.989**	1	0.966**
	Sig. (2-tailed)	0	0	0		0
	N	384	384	384	384	384
Student Self-Regulation and Motivation	Pearson Correlation	0.814**	0.976**	0.965**	0.966**	1
	Sig. (2-tailed)	0	0	0	0	
	N	384	384	384	384	384

***. The correlation is significant at the 0.01 level (two-tailed).*

Reliability

Scale: Student Engagement

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The analysis revealed that the scale used in the study demonstrated reliable internal consistency, with a Cronbach's alpha coefficient of 0.842 for the five items. The correlation exceeds the generally accepted threshold of 0.70, indicating that the scale items reliably measure the underlying constructs of hybrid-based learning and student engagement. The high-reliability coefficient helps supplement confidence in the consistency and dependability of the data collected from the study (**Table 4)**.

Table 4. Reliability Statistics

Cronbach's Alpha	N of Items
0.842	5

Scale: Technology Accessibility and Use

The reliability analysis of the measurement instrument revealed an exceptionally high Cronbach's alpha coefficient of 0.985 for the five items. This indicates that the scale measures reliability and is trustworthy to a level beyond the minimum standard of a correlation of 0.70. A high alpha value indicates that items can be used to measure theoretically intended hybrid-based learning and student engagement constructs, as these items have consistently measured the constructs dependably and reliably. The high reliability of these outcomes provides valid support for subsequent analyses as well as further assurance of the overall significance of the study as a whole (**Table 5)**.

Table 5. Reliability Statistics

Cronbach's Alpha	N of Items
0.985	5

Scale: Instructional Design and Content Delivery

The findings revealed that the Cronbach's alpha for the five items was very high, at 0.978. The value exceeds the generally recognized standard value of 0.70, which proves that the scale items consistently and reliably measure the constructs associated with hybrid-based learning and student engagement. The dependability of the instrument is confirmed by the high reliability coefficient, which in turn increases the confidence that the findings accurately reflect the state of the data (**Table 6**).

Table 6. Reliability Statistics

Cronbach's Alpha	N of Items
0.978	5

Scale: Teacher Support and Interaction

All the items in the survey were examined for consistency using a Cronbach's alpha statistic of 0.979. The value of 0.94 is well above the accepted threshold value of 0.70, which attests to the highly reliable and consistent measurement of the constructs of hybrid-based learning and student engagement on the scale. Such a strong reliability coefficient underscores the robustness of the instrument and supports the credibility and validity of the data gathered here (**Table 7**).

Table 7. Reliability Statistics

Cronbach's Alpha	N of Items
0.979	5

Scale: Student Self-Regulation and Motivation

The use of Cronbach's alpha yields a reliability coefficient for the measurement scale, which results in a value of 0.980 for the five items, indicating significant internal consistency. This value far exceeds the generally accepted threshold of 0.70, indicating the instrument reliably and consistently measures the constructs on hybrid-based learning and student engagement. This exceptionally high reliability coefficient supports the high degree of accuracy in the scale and consequently substantiates whether the data are reliable; therefore,

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this enhances the overall credibility of the study's findings (**Table 8**).

Table 8. Reliability Statistics

Cronbach's Alpha	N of Items
0.980	5

REGRESSION

The summary for the regression model, as shown in **Table 9**, indicates a strong overall fit of the predictors to the Student Engagement variable. The results include a multiple correlation coefficient (R) of 0.834, demonstrating a substantial level of predictive strength, as all the predictors work together to achieve this outcome—Student Self-Regulation and Motivation, Instructional Design and Content Delivery, Technology Accessibility and Use, Teacher Support and Interaction, and student engagement. The coefficient of determination (R^2) was 0.696, showing that the predictors explain nearly 70% of the variation in student involvement. The adjusted R^2 value of 0.693, combined with the definition of the predictors, makes it clear that the results are reliable and broadly applicable. Additionally, this measure is known as the standard error of the estimate, which indicates that each predicted value is, on average, 0.428 units away from the observed ones.

Table 9. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.834[a]	0.696	0.693	0.42844

a. Predictors: (Constant), Student Self-Regulation and Motivation, Instructional Design and Content Delivery, Technology Accessibility and Use, Teacher Support and Interaction

The ANOVA results provided in **Table 10** indicate that student engagement shows significant results. The regression sum of squares for the model is 159.089, and it has 4 degrees of freedom. Meanwhile, the residual sum of squares is 69.570, with 375 degrees of freedom. The calculated F-statistic of 216.669, associated with the four predictors—Student Self-Regulation and Motivation, Instructional Design and Content Delivery, Technology Accessibility and Use, and Teacher Support and Interaction —stood out as significant at the $p < 0.001$ level. The model appears to explain the data well, and the collected predictors play a significant role in explaining student engagement.

Table 10. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	159.089	4	39.772	216.669	0.000[b]
	Residual	69.570	379	0.184		
	Total	228.660	383			

a. Dependent Variable: Student Engagement
b. Predictors: (Constant), Student Self-Regulation and Motivation, Instructional Design and Content Delivery, Technology Accessibility and Use, Teacher Support and Interaction

The regression coefficients for the model predicting Student Engagement are demonstrated in **Table 11**. The overall significance of the change was confirmed by statistics ($B = 0.641$, $p < 0.001$), which refers to the level of engagement that exists when every predictor is set to zero. Some of the significant predictors, Technology Accessibility and Use, exhibited a negative influence on student participation ($B = -0.503$, $\beta = -0.645$, $t = -4.055$, $p < 0.001$), suggesting that increased accessibility and use of technology were unexpectedly associated with lower engagement levels. Instructional Design and Content Delivery showed that these findings are significant and positive in terms of student engagement ($B = 0.426$, $\beta = 0.485$, $t = 2.016$, $p = 0.045$), indicating

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that more effective instructional design contributes to higher engagement. Student Self-Regulation and Motivation also had a strong positive effect (B = 0.602, β = 0.712, t = 4.663, p < 0.001), focusing on the benefits of allowing students to be self-sufficient and on fostering motivation to engage. On the other hand, students' engagement levels were not found to be significantly affected by Teacher Support and Interaction in this model (B = 0.240, β = 0.272, t = 1.247, p = 0.213).

Table 11. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.641	0.064		10.020	0.000
	Technology Accessibility and Use	-0.503	0.124	-0.645	-4.055	0.000
	Instructional Design and Content Delivery	0.426	0.211	0.485	2.016	0.045
	Teacher Support and Interaction	0.240	0.193	0.272	1.247	0.213
	Student Self-Regulation and Motivation	0.602	0.129	0.712	4.663	0.000

a. Dependent Variable: Student Engagement

DISCUSSION

This study aimed to investigate the impact of various hybrid-based elements on student engagement in high school. By using data from 384 participants across various school settings, this study explores the connections between instruction, technology, social relationships, and student motivation in detail [22, 27, 28].

This research employs an integrated, novel approach to examine various key factors that influence student engagement in secondary hybrid education. Prior studies have mostly examined individual aspects or institutions of higher education, whereas this extensive research explores how several elements, including technology, instruction, teacher assistance, and student motivation, interact in this unique context.

Among all possible predictors, Student Self-Regulation and Motivation had the strongest beneficial effect on engagement (β = 0.712, p < 0.001) [29, 30]. This demonstrates that maintaining organization, setting goals, and being self-motivated is more vital for active learning than anything else. The concept is rooted in Self-directed study, as students' drive to learn primarily stems from their autonomy and the ability to monitor their learning progress [23, 31, 32]. Since the scale's reliability was high (α = 0.980), it greatly influenced the way people learned in hybrid classes. This highlights that students' motivation should be built at the same time as the curriculum is given to them [33].

However, the results from the Technology Accessibility and Use variable showed a strong negative relationship with student engagement [34, 35]. Although technology is widely praised for enhancing learning, this result suggests that its educational value may be limited when used without a focused plan for teaching [36, 37]. Excessive use of digital tools, especially without proper guidance, can cause someone to become disconnected, feel tired, or get distracted. Additionally, because the variables are highly correlated, the typically clear positive effect observed in a correlation (r = 0.781) was not evident; instead, a more complex situation was revealed when statistically controlling for other variables [27].

The results suggest that Instructional Design and Content Delivery are linked to a better level of student engagement (β = 0.485, p = 0.045), indicating that when content is well-organized and pedagogically sound, engagement is likely to increase [38-40]. Furthermore, Study results demonstrate that students' opinions on

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teaching quality play a big role in engaging them and helping them learn while using blended methods [41]. This aligns with the Community of Inquiry framework, indicating that effective teaching design is necessary to maintain student interest [42, 43].

Teacher Support and Interaction were highly related to student engagement, but they did not significantly predict engagement in the regression analysis [44-46]. Apart from the help of teachers, mentoring programs among students are recognized as useful strategies to help students succeed in university [47]. The way teachers perceive virtual reality and other modern approaches influences their approach to utilizing digital tools, resulting in changes in student involvement in hybrid classrooms [48]. In hybrid learning, the way teachers view and prepare for using technology significantly impacts the delivery of lessons and support to students, as well as the level of student involvement [49]. The results indicate that while students value their teacher's engagement, this factor alone may not be enough to keep students interested if they are not motivated and learning from effective teaching. The conclusion aligns with the findings of more recent studies on teachers' shifting role from distributing information to facilitating student learning in hybrid classes [7, 50, 51].

The model was able to explain approximately two-thirds of the variation in student engagement ($R^2 = 0.696$). This result demonstrates a more predictive effect than past studies in blended learning settings, likely due to the consideration of four factors simultaneously [52-54]. Still, strong interdependencies among the predictors (for example, between Instructional Design and Teacher Interaction, with a correlation coefficient of $r = 0.989$) could be misinterpreted by statistical models.

The findings also make it clear that hybrid learning systems should be planned as a whole entity. Since predictors are closely interconnected, acting on just one theory may not be as successful as reforms that address multiple areas simultaneously [55, 56]. This means engagement needs to be supported by proper connections among all three domains: curriculum, technology, and psychology [57, 58].

The quantitative design yielded the most precise results, but at times, it obscured how students experienced hybrid learning emotionally. Talking to students or holding discussions with them can help make sense of the statistical findings, particularly for those who are still not engaged with learning despite having access to strong technology and effective teaching.

STUDY LIMITATIONS AND FUTURE IMPLICATIONS

This research provides valuable insights into the factors that influence student involvement in such settings, but also acknowledges some limitations. Since the research design does not follow the same people over time, it is hard to understand how involvement progresses or reacts to set interventions. Besides that, using questionnaire data that people provide about themselves might cause the data to be unreliable, as it may be influenced by their desire to appear favourable and how they interpret the questions. When more than one variable is strongly associated, they may hide what each contributes to the outcome separately. In addition, since the study involved students from diverse backgrounds, the results may vary across different educational contexts.

These challenges aside, the study offers valuable insights for future developments and research. Institutions should focus on teaching programs that align with the curriculum and help students develop self-management skills. Educators should receive training in digital teaching that prioritizes keeping students engaged rather than just handing out information. Policymakers should also focus on ensuring that educators utilize digital tools in a manner that supports effective teaching. This research can be improved by conducting studies that employ multiple approaches and follow students over a period to understand changes in engagement better and gain insight into students' experiences.

CONCLUSION

This research aimed to investigate how hybrid learning is utilized in educational contexts and its impact on

student engagement in high school, considering the effects of technology, lesson planning, teacher involvement, and students' self-regulation abilities. The analysis revealed that every variable and factor had a positive impact on engagement; however, only instructional design and student motivation remained significant predictors in the regression model. On the other hand, fewer virtual learners were found among students who used technology, suggesting that simple access is not enough for effective digital learning. As a result, schools should concentrate on guiding learning and inspiring students as major elements of successful hybrid education. This study supports the design and implementation of hybrid learning models by presenting unique data on secondary education and offering practical advice to enhance student engagement in digital environments.

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