

The Effect of Teaching Style and E-learning Use on Academic Achievement of Students of Catholic University of Timorese

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Abstract—Students' academic achievement is determined by various factors, including teaching style and the use of e-learning resources. This study aims to analyze the effect of teaching style and e-learning on the academic achievement of students enrolled in the Catholic Religious Education Program at the Catholic University of Timorese (UCT) of Saint John Paul II. A quantitative correlational research approach was adopted, involving 77 respondents randomly selected from a population of 177 students. Data were collected through a self-administered questionnaire and analyzed using multiple linear regression with the support of JASP and SPSS software. The findings indicated that teaching style had a positive and significant effect on students' academic achievement (p -value = $0.001 < 0.05$), while e-learning's independent contribution was positive but statistically non-significant (p -value = $0.053 > 0.05$). However, when combined, both variables have a positive and significant impact (p -value = $0.000 < 0.05$), explaining 41.3% of the variance in students' academic achievement. These findings highlight e-learning's pedagogical value, which emerges when integrated with appropriate teaching styles, serving as a complement rather than an independent determinant of academic achievement. The study provides theoretical and practical insights for optimizing the use of digital technology in higher education to improve teaching quality and students' academic achievement.

Keywords—teaching style, e-learning, academic achievement, Timor-Leste

I. INTRODUCTION

Education is a fundamental human need, yet meeting students' diverse learning needs in a rapidly changing environment remains a challenge. Traditional, lecturer-centered teaching methods often fail to fully engage students and optimize their academic achievement. Consequently, Higher Education Institutions (HEIs) are required to adopt innovative teaching approaches, including the integration of e-learning tools, to encourage effective and meaningful learning experiences and enhance students' academic achievement. According to Kunle [1], students' academic achievement refers to the level of learning performance attained in relation to predetermined learning objectives. This encompasses the ability to acquire, comprehend, and apply knowledge, as evidenced by grades, class participation, and overall competence development, and is influenced by various internal and external factors [1, 2]. Internal factors originate from within the student, including intelligence, persistence, self-efficacy, learning motivation, study habits, physical and mental health, interest in the subject, and self-confidence [1, 2]. External factors, on the other hand, originate from outside the student, such as school-related, economic, and sociocultural factors [2]. Among these, pedagogical factors, namely performance and

instructional strategies, play a crucial role in students' academic achievement, as well as motivation, effective communication, and the promotion of ethical values and institutional goals [2]. Previous studies have highlighted that factors such as learning environment, teaching methods, the use of instructional media, and student motivation significantly affect academic achievement.

In recent years, the use of appropriate teaching styles and e-learning has emerged as a pivotal pedagogical aspect in enhancing students' academic achievement, especially in higher education [3]. Research suggests that both teaching styles and e-learning use positively and significantly influence students' academic achievement. When used effectively and innovatively, these elements foster greater engagement, interest, and understanding, thereby improving students' academic achievement.

Teaching style significantly determines teaching and learning effectiveness. According to Ardika *et al.* [3], active, participatory, and problem-based teaching styles help optimize students' academic achievement. Therefore, choosing an appropriate teaching style helps promote student engagement, interest, and understanding in the learning process.

In the 21st century's digital era, technological advancements have significantly propelled the development of science and technology [4–7]. This has led to the rapid integration of educational digital technology, particularly in HEIs, especially in developing countries, since the outbreak of the COVID–19 pandemic [6–10]. Since then, lecturers have been required to adopt instructional models of technological tools [9, 11] as digital media in the teaching-learning process. These tools not only support knowledge diffusion but also contribute to effective learning and sustained engagement in learning activities [5], promoting meaningful learning experiences and, consequently, contributing to students' understanding and improved academic achievement [9, 12].

However, the effectiveness of teaching styles and e-learning use largely depends on lecturers' ability to integrate technology into pedagogical practices. This integration requires strong pedagogical competence and the capacity to design contextual and engaging digital learning models [13]. This ideal condition has not yet been fulfilled in many developing countries, where traditional teacher-centered approaches still dominate. These methods often fail to stimulate students' involvement, creativity, and critical thinking, partly due to limited access to innovative pedagogical training. Moreover, many HEIs in developing countries have yet to fully integrate e-learning media into

their teaching–learning process due to several limitations, such as inadequate Information and Communication Technology (ICT) infrastructure, insufficient access to electronic devices, lack of technical support [5, 7, 9, 13, 14], and a low level of digital literacy among lecturers and students [9, 13]. In this context, Alam *et al.* [15] associated e-learning as a “double-edged sword”, with the potential to either enhance or limit academic achievements of university students in developing countries. Similar challenges persist in Timor-Leste, particularly regarding technological infrastructure (i.e., internet access and ICT devices), educators’ digital literacy, access to digital resources, and institutional collaboration, which constrain the effectiveness of e-learning on students’ academic achievement [16]. Nenotec *et al.* [17] reported that areas bordering Timor-Leste and West Timor (Indonesia) have not yet effectively integrated educational platforms into teaching and learning practices. To address these gaps, since the COVID-19 pandemic, the United Nations, through its agencies, has supported the integration of digital education in this country by providing ICT infrastructure and digital competency training across educational institutions. While these initiatives are expected to expand access to learning and improve teaching quality, the extent to which e-learning has been effectively integrated and its impact on student achievement in Timor-Leste remain unclear, particularly in a specialized context such as religious education.

Therefore, this study aims to address this gap by examining the influence of teaching styles and e-learning integration on students’ academic achievement in the Catholic Religious Education program at Catholic University of Timorese (UCT). Given the urgent need for educational transformation in Timor-Leste, a small, developing, and emerging nation in Southeast Asia, the findings of this study will contribute to the development and effectiveness of pedagogical models suited for digital era. Furthermore, this study will provide valuable insights to the academic literature on how the integration of e-learning into pedagogical practices can optimize learning outcomes. It also offers practical guidance for the academic community, policymakers, HEIs, and development partners in designing effective and contextual teaching-learning models, as well as technical support mechanisms to improve the quality of higher education in Timor-Leste.

II. LITERATURE REVIEW

A. Academic Achievement

Students’ academic achievement expresses their learning performance, which is presented through grades, numbers, scores, or performance indicators. According to Maharani *et al.* [16], academic achievement represents a parameter of success in the learning process, which subsequently provides valuable feedback for educators to conduct further evaluation of the learning process.

Furthermore, Simanjuntak *et al.* [18] and Maharani *et al.* [16] emphasize that the measurement of academic achievement involves three interrelated aspects: cognitive, affective, and psychomotor. The cognitive aspect includes observation, memory, understanding, analysis, and synthesis. Meanwhile, the affective aspect relates to feelings,

agreement, appreciation, internalization, and character traits. Lastly, the psychomotor aspect concerns the ability to perform actions, including both verbal and non-verbal expression. It is important to note that academic achievement is not only measured through quantitative and qualitative scores presented in academic reports but also through the extent to which the learning process contributes to students’ ability to comprehend, develop, and apply knowledge in real-life social contexts.

In the learning process, students’ academic achievement is influenced by both internal and external factors. According to Sutikno [19], internal factors are related to students’ physical and psychological conditions, such as intelligence, motivation, interest, and readiness to learn. External factors involve the family environment (e.g., parenting style and economic conditions), the school environment (curriculum and pedagogical aspects), and the broader community (e.g., social relations). More specifically, Respati *et al.* [2] emphasize that students’ ability to master learning materials is determined not only by internal motivational elements, such as self-confidence and personal goals, but also by external motivation, including teaching style and family support.

Finally, optimal learning outcomes can be achieved when lecturers create an engaging teaching style by fostering a creative and innovative learning atmosphere, complemented by the use of digital media to enhance students’ interest and motivation in the learning process. The relationship between these elements will be further elaborated in the following section.

B. The Effect of Teaching Style on Academic Achievement

Teaching style is closely associated with the teaching and learning process in an educational setting, as it reflects a teacher’s ability to carry out their professional responsibilities, fulfilling the noble mission of education: to instruct, guide, and evaluate students. This role becomes more effective when lecturers possess strong competencies that enable them to perform their duties effectively and sustainably.

According to Ardika *et al.* [3], students’ interest and motivation to engage in the learning process are influenced by the teacher’s ability to develop an attractive and varied teaching style, which in turn fosters reciprocal interaction between lecturers and students. Granero-Galego *et al.* [20] found that a teaching style that promotes autonomy support and encouragement of academic engagement can enhance the self-confidence and learning quality of prospective educators.

In the same perspective, Prayogi [21] argues that an interactive teaching style reduces learning boredom and stimulates students’ enthusiasm during the learning process. The presence of motivation and a high-quality learning process helps foster self-confidence and creativity, which in turn improves students’ academic achievement [2, 22, 23]. Xiong [24] highlights that teaching styles have a significant positive relationship with students’ academic success by enhancing motivation and students’ engagement in the learning process. Furthermore, Gordeeva and Sychev [25] demonstrate that teachers’ instructional styles have a significant impact on students’ academic achievement by

improving their motivation and persistence in learning. The autonomy-structured model is positively associated with academic achievement, whereas the controlling-chaotic style shows the opposite effect. Ardika *et al.* [3] also reported that a lecturer's teaching style has a positive and significant effect on student academic achievement, meaning that an improved teaching style leads to better students' academic achievement.

Based on these empirical findings, the following hypothesis is proposed:

H₁: Teaching style has a positive and significant effect on students' academic achievement.

C. The Effect of Media E-learning Use on Academic Achievement

Digital media serve as technological tools that play a crucial role in the virtual learning process, particularly through the promotion and adaptation of e-learning. E-learning is associated with a learning system that facilitates knowledge transfer and diffusion through electronic devices such as computers, tablets, and smartphones, supported by telecommunication technology [6, 9, 26–28], and may take the form of audio media (delivering information through sound), visual media (presenting content via images, animation, and videos), and audiovisual media, which combines both sound and visuals [29]. This system offers flexible learning regarding time, location, content delivery, self-directed learning management, and reviewing the content at any time [6, 9, 30, 31], facilitates real-time communication, group discussion, problem-solving, and flexible assignment [14], mediating reciprocal interactions among students, lecturers, and learning materials [6, 14]. The use of e-learning media not only enhances students' motivation and creativity but also enables lecturers to deliver content more effectively and promotes independent and efficient student learning [14, 29, 32]. A similar finding by Lao *et al.* [33], shows that effective and appropriate utilization of digital media fosters a proactive, enjoyable, and interactive learning environment, which ultimately improves students' academic achievement.

Naicker and Wyk [34], Arumugan *et al.* [35], and Almas *et al.* [31] assert that e-learning has proven to be an innovative, effective, and efficient instructional method, capable of not only creating enjoyable learning experiences but also enhancing student engagement, facilitating meaningful lecturer-student interactions, simplifying evaluation and feedback processes, improving content comprehension, and fostering digital literacy skills. Additionally, Nuryatin *et al.* [36] found that adapting the learning process through e-learning media improves student satisfaction, independence, and flexibility in content access and assignment completion, which in turn contributes to better academic achievement.

Tomma *et al.* [37] emphasized that the use of e-learning—leveraging features such as flexible access, easy content acquisition, and streamlined evaluation—makes the learning process more engaging and adaptable, consequently enhancing students' academic achievement.

From a pedagogical perspective, e-learning is positioned as a complementary instrument in maximizing autonomous and structured learning [38] by facilitating dynamic

interaction [39], thereby enhancing student engagement and learning motivation, which lastly contributes to improved students' academic achievement [40]. Consistent with this view, Salami and Spangenberg [41] emphasize that e-learning serves a complementary function, strengthening teaching styles rather than replacing them.

Although the use of e-learning has the potential to support the learning process to enhance students' academic achievement, its effectiveness largely depends on the strategy to address challenges that limit students' engagement [42]. The effectiveness of e-learning is strongly influenced by users' digital literacy and adequate ICT infrastructure. This system becomes effective only when both the lecturer and students possess competencies beyond basic IT skills, namely the pedagogical competencies in using e-learning platforms [17].

Empirical evidence further shows that Elshareif and Mohamed [43], discovered a positive and significant relationship between e-learning and students' motivation in terms of content learning and assignment completion. However, they also noted that e-learning is less effective for discussion, evaluation and feedback. Similarly, Hamad *et al.* [28], Delita *et al.* [11], and Mehrvarz *et al.* [12] found that e-learning enhances students' interaction, motivation, self-efficacy, participation, and attention, which in turn contributes to their academic achievement.

Moreover, Zafeer *et al.* [44], as well as Ziden *et al.* [45] discovered a positive and significant relationship between e-learning use and student achievement. Finally, Erdawati *et al.* [46], Malkawi and Mohailan [27], Mothibi [47], Wong *et al.* [48], and Murni and Harimurti [49] concluded that the use of e-learning in higher education has a positive and significant impact on students' academic achievement.

Based on the theoretical and conceptual information about e-learning's effect on academic achievement, the following hypothesis is proposed:

H₂: The use of e-learning has a positive and significant effect on students' academic achievement.

D. The Effect of Teaching Style and E-learning Use on Academic Achievement

Student academic achievement is influenced by multiple factors, including the lecturer's ability to manage the teaching process and effectively utilize digital technology. Numerous studies have reported the improvements in students' academic achievement due to attractive teaching styles and digital technology use.

Arumsari [50], in his research, reported that the use of e-learning media and classroom management skills has a positive and significant effect on students' academic achievement, with classroom management being the dominant factor. Similarly, Simanjuntak *et al.* [18] and Ardika *et al.* [3] also reported that variations in teaching strategies and the use of audiovisual media have a significant and positive effect on students' academic achievement.

In the same vein, Hutabarat and Nura [51], as well as Ardika *et al.* [3] found that both teaching style and the ability to use ICT-based media platforms positively and significantly influence students' academic achievement, and that improvements in teaching style and e-learning use tend

to improve students' academic achievement.

Based on the above empirical findings, the following hypothesis is proposed:

H₃: Teaching style and the use of e-learning have a positive and significant effect on students' academic achievement.

E. Conceptual Research Framework

Based on the theoretical and conceptual review presented in the literature review, the conceptual research framework is developed to explain the effects of lecturers' teaching styles (X_1) and the use of e-learning media (X_2) on students' academic achievement (Y). The relations among these three variables are illustrated in Fig. 1.

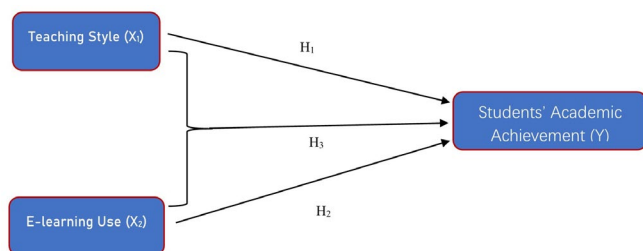


Fig. 1. Conceptual research framework.

III. RESEARCH METHODS

The research method employed in this study is quantitative correlational, which is used to analyze the effect of variables through statistical procedures in a systematic and structured manner. This quantitative approach is grounded in the positivist paradigm [52–55], which views reality as a single truth [56], and involves the process of collecting, interpreting, and presenting results based on numerical values [57, 58].

The data were collected using a survey design at the UCT of Timor-Leste, between September and December of 2025, involving 77 respondents randomly selected from the population of 177, representing a 44% of the population. Hair *et al.* [59] suggests that if the population consists of only 200-300 individuals, an acceptable sample size may be as small as 30%.

The primary instrument used for data collection was a questionnaire [55], developed using a five-point Likert scale ranging from 5 “strongly agree” to 1 “strongly disagree” [57, 60], and consisted of 36 items. The instrument comprised four main sections. The first section captured respondents' sociodemographic profiles. The second section assessed teaching style, adapted and modified from Vargas and Camino [61] and Gordeeva and Sychev [25], covering interactive-participatory, structured-rational, autonomy-supportive, and controlling styles. It included sample items like “The lecturer encourages students to ask questions and participate actively in class”. The third section measured e-learning use, adapted and modified from Hasibuan *et al.* [62], consisting of e-learning media, e-learning content, and the interaction dimension. It included sample items like “E-learning media used by lecturers makes learning more engaging.” The last section measured students' academic achievement by using a self-reporting evaluation of the academic achievement scale. This scale was adapted and modified from Qian *et al.* [63], based on Bloom's Taxonomy of educational objectives, which consists of three dimensions:

subject knowledge and skill, research capabilities, and professional effectiveness. It included sample statements like “Students have solid knowledge of the concept and apply it to solve real problems”. Likert Self-reporting of students' achievement was adapted as it is easily accessible, has reasonable accuracy in reflecting actual grades, and is suitable for explanatory correlational study [64–67].

Before being applied, the draft survey instruments were pilot-tested on a small sample, providing feedback for instrument improvement. The pilot data were statistically validated using an internal consistency or reliability test [57], with a Cronbach's Alpha threshold of 0.7 [57]. The reliability test showed Cronbach's Alpha values of 0.739 for lecturer teaching style, 0.823 for e-learning use, and 0.767 for students' academic achievement, indicating that the instrument's reliability is acceptable because the Cronbach Alpha values are superior to 0.7 threshold [57].

The data analysis in this study used both descriptive and inferential statistical techniques, with the assistance of JASP and SPSS software. Descriptive statistics were applied to summarize the respondents' demographic profiles [57] and to calculate the central tendency and variability of the sample. For hypothesis testing, parametric statistics of multiple linear regression analysis were used to examine whether there was an impact of teaching style and e-learning use on students' academic achievement. Prior to regression tests, several classical assumptions were conducted, namely normality, linearity, heteroskedasticity, autocorrelation, and multicollinearity [57].

The multiple linear regression model was used to examine the effect of teaching style and e-learning use on students' academic achievement [57], with the regression equation model applied being $Y = a + b_1X_1 + b_2X_2 + e$, where Y = academic achievement; a = Constant; b_1 = Coefficient of teaching style, X_1 = Variable of teaching style, X_2 = variable of e-learning use; b_2 = Coefficient e-learning use; and e = Standard error. Additionally, the coefficient of determination (R_{Square}) was used to assess the extent to which the independent variables explain the variance in students' academic achievement. Finally, hypothesis testing was performed to analyze the partial and simultaneous effects of the independent variables on the dependent variables [57]. The criteria used were as follows: if the p -value of the T-test is less than 5%, then H_1 and H_2 are accepted; and if the p -value of the F-test is less than 5%, then H_3 is accepted.

Research integrity was upheld from data collection to analysis, with an emphasis on informed consent, anonymity, and authenticity of data. The respondents were assured that the information would remain confidential and be used exclusively for academic purposes [12].

IV. RESULT AND DISCUSSION

A. Survey Results and Analysis

In this study, all questionnaires distributed to the 77 respondents were successfully returned, resulting in a 100% response rate. Upon verification, all returned questionnaires were deemed valid and were subsequently processed to data tabulation and analysis.

A descriptive analysis was performed to describe the demographic profile of the respondents, as seen in Table 1.

Table 1. Profile of respondent

Variable	Category	Student	
		Frequency	Percentage
Sex	Male	29	37.7%
	Female	48	62.3%
Age	19–24	48	62.3%
	25–30	24	31.2%
	>30	5	6.5%
Semester	<5	20	26%
	5–7	31	40.3%
	>7	26	33.7%
Local	Cisto-Rei	20	26%
	Dom-Aleixo	18	23.4%
	Nain-Feto	17	22.1%
	Vera-Cruz	22	28.6%

Source: Output JASP

Of the 77 respondents, 48 (62.3%) were female and 29 (37.7%) were male. The majority of respondents (48 or 62.3%) were aged below 24 years, 24 (31.2%) were aged 25–30 years, and 5 (6.5%) were aged over 30 years. Among the 77 students, 20 (26%) were semesters 1 to 4, 31 (40.3%) were semesters 5–7, and 26 (33.7%) were in their final semester. The respondents were evenly distributed across the four administrative zones: Cristo-Rei (20 or 26%), Dom-Aleixo (19 or 23%), Nain-Feto (17 or 22%), and Vera-Cruz (22 or 29%).

Subsequently, classical assumption tests were conducted, including normality, linearity, multicollinearity, autocorrelation, and heteroscedasticity, as prerequisites for multiple linear regression analysis [57]. The results of the normality test showed that the data were normally distributed, as the p-value of the One-Sample Kolmogorov-Smirnov Test (0.200) exceeds the significance threshold of 0.05.

Next, a linearity test was conducted to determine whether the relationship between the independent and dependent variables is linear [57]. The test shows that both teaching style and e-learning use have a linear relationship with students' academic achievement, as indicated by *p*-values of 0.000, which are below the 0.05 significance level, confirming that the linearity assumption is satisfied. The Linearity is also indicated by the Q-Q plot, as presented in the following figure.

Based on Fig. 2, the data points in the Q-Q plot of standardized residuals follow the diagonal line, indicating that the relationship between the independent variables and the dependent variable is linear.

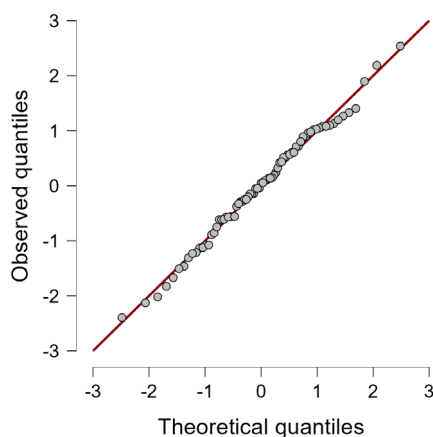


Fig. 2. Linearity test of Q-Q plot.

Fig. 3 demonstrates that the regression model is free from heteroscedasticity, as the data points in the scatterplot are

evenly distributed above and below zero on the Y-axis. Therefore, it can be concluded that the regression model is robust and does not suffer from heteroscedasticity [57].

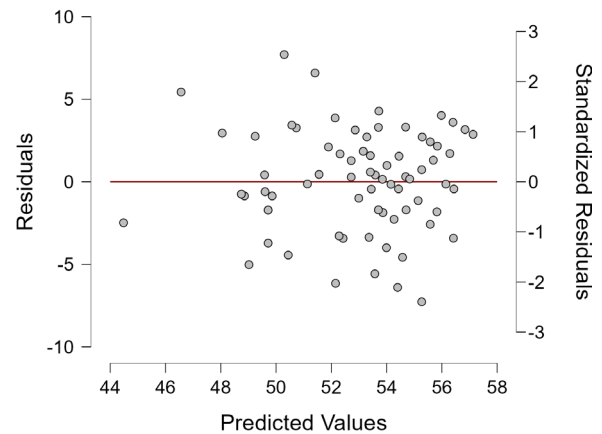


Fig. 3. Heteroskedasticities residual-predicted test.

Furthermore, the multicollinearity test found that the Variance Inflation Factor (VIF) value (1.324) is less than 10, and the tolerance value is 0.756 (Table 2), indicating that it is free from multicollinearity issues.

Finally, the autocorrelation test, indicated by the Durbin-Watson (DW) value, resulted in a score of 1.958 (Table 3). According to the DW table at a 5% significance level with two independent variables ($k = 2$), the critical value is $dU = 1.63$. Since the obtained DW value satisfies the condition $dU < DW < 4 - dU$ ($1.63 < 1.958 < 2.37$), it can be concluded that the regression model is free from autocorrelation [57].

1) The partial effect of teaching style and e-learning use on academic achievement

A multiple linear regression test was conducted to determine the partial effects of each independent variable on the dependent variable. Additionally, this analysis provides key data for constructing a multiple regression equation model for predictive purposes. The following table presents the results of the partial t-test and the coefficients of the multiple regression equation.

Based on Table 2, the estimated multiple linear regression equation is “ Y (Academic Achievement) = $15.903 + 0.564 X_1$ (Teaching Style) + $0.134 X_2$ (E-Learning)”. This model showed that teaching style had a significant positive impact on students' academic achievement with a regression coefficient of 0.564 ($p < 0.05$), indicating that a one-unit improvement in teaching style corresponds to a 0.564-point increase in academic achievement. Similarly, e-learning use has a regression coefficient of 0.134 ($p < 0.05$), indicating a one-unit improvement in e-learning use is associated with a 0.134-point increase in academic achievement. Furthermore, the standardized beta coefficient of teaching style (0.504) is higher than that of e-learning use (0.210), indicating that teaching style has a more dominant effect on students' academic achievement.

Next, the partial hypothesis testing results regarding the influence of teaching style (X_1) and e-learning use (X_2) on academic achievement (Y) are presented. The regression analysis in the above table indicates that teaching style (X_1) has a t-count value (4.713) $>$ t-table (1.993) with a significance level of $0.001 < 0.05$, so reject H_0 and accept H_1 .

With these results, it is stated that teaching style has a positive and significant effect on students' academic achievement. Therefore, the first hypothesis (H_1): "Teaching style has a positive and significant effect on students' academic achievement" is accepted. On the other hand, the e-learning use variable has a t-count value ($1.967 < t\text{-table}$

(1.993) with a significance level of $0.053 > 0.05$, so accept H_0 and reject H_1 . It is stated that e-learning use has a positive but non-significant effect on students' academic achievement. Thus, the second hypothesis (H_2): "E-learning use has a positive and significant effect on students' academic achievement" is rejected.

Table 2. Results of partial hypothesis testing (t-test)

Model		Unstandardized	Standard Error	Standardized	T	P	Collinearity Statistics	
							Tolerance	VIP
M ₀	(Intercept)	53.111	0.472	-	112.611	<0.001	-	-
M ₁	(Intercept)	15.903	5.700	-	2.790	0.007	-	-
X ₁		0.564	0.120	0.504	4.713	<0.001	0.756	1.324
X ₂		0.134	0.068	0.210	1.967	0.053	0.756	1.324

Source: Output JASP

2) The simultaneous effect of teaching style and e-learning use on academic achievement

The regression analysis also provides insights into the combined contribution of both independent variables to the dependent variable, as presented in the following table.

Table 3. R square test results

Model	R	R ²	Adjusted R ²	RMSE	Durbin-Watson		
					Autocorrelation	Statistic	P
M ₀	0.000	0.000	0.000	4.024	0.116	2.187	0.409
M ₁	0.643	0.413	0.397	3.124	0.008	1.958	0.836

Source: Output JASP

Table 3 shows that there is a positive and strong correlation between teaching style (X_1), e-learning use (X_2), and academic achievement (Y), with a correlation coefficient (R) of 0.643. The analysis also revealed the value of the coefficient of determination (R square) is 0.413, indicating that 41.3% of the variation in the students' academic achievement can be explained by teaching style and e-learning use, while the remaining 58.7% is explained by other variables.

Furthermore, the multiple linear regression analysis for testing the simultaneous effect of teaching style (X_1) and e-learning use (X_2) on students' academic achievement yielded positive and significant results. The results of the simultaneous hypothesis testing are shown in the following table.

The regression analysis in Table 4 indicates that teaching style and e-learning use have a positive and significant effect on students' academic achievement, as evidenced by the F-value ($23.32 > F\text{-table}$ (3.12)) with a p -value of 0.001, which is less than the significance threshold of 0.05. Therefore, the third hypothesis (H_3): "Teaching style and e-learning use have a positive and significant effect on students' academic achievement" is accepted.

Table 4. Results of simultaneous hypothesis testing (f-test)

Model	Sum of Square	df	Mean Square	F	P
Regression	458.7	2	229.331	23.32	<0.001
M ₁ Residual	678.4	74	9.833		
Total	1137.1	76			

Source: Output JASP

B. Discussion

The results of this study found that lecturers' teaching style (X_1) has a positive and significant effect on students' academic achievement (Y). This finding is in line with the

perspective of Ardika *et al.* [3], which emphasizes that a good and varied teaching style contributes to improving students' academic achievement. Effective teaching styles help reduce student boredom, thereby fostering enthusiasm and participation in class, as mentioned by Usman, cited in Prayogi [21], and enhance students' diligence to study and facilitate deeper understanding, as defended by Granero-Galego *et al.* [20], as well as Prayogi [21].

In contrast, the use of e-learning media (X_2) shows a positive but statistically non-significant effect on students' academic achievement (Y). The lack of significance reflects that the integration of technology alone does not necessarily lead to improved academic achievement. Instead, e-learning functions as a complementary learning tool, rather than a primary driver of academic performance [38, 41, 42]. This finding is in line with the findings of Ullah *et al.* [38], Maharani *et al.* [16] and Alam *et al.* [15] and contradicts some findings by Lao *et al.* [33], Nuryatin *et al.* [36], Malkawi and Mohailan [27], Chikileva *et al.* [26], Murni *et al.* [49], and Mothibi [47]. This finding emphasizes that the effectiveness of e-learning use to enhance academic achievement [68], strongly depends on several factors, including ICT infrastructure, institutional support, and digital literacy users [5, 7, 9, 14, 15]. E-learning is more effective when it is pedagogically integrated into the teaching-learning process; conversely, its use in isolation without sufficient pedagogical support and infrastructure tends not to produce a significant impact on academic achievement. Field observations further support this finding that digitalization in Timorese education is often limited to the basic use of ICT tools, without optimal utilization of technology-based e-learning platforms, as well as Internet connectivity issues, is consistent with Nenotek *et al.* [17], who reported the lack of ICT facilities in several educational institutions located in border zones between Timor-Leste and West Timor (Indonesia), including limited devices, low digital literacy, and restricted internet access.

Although e-learning did not show a significant effect, this study found that teaching style (X_1) and e-learning use (X_2) simultaneously have a positive and significant effect on students' academic achievement (Y). This finding confirms that e-learning should not be positioned as an independent instructional driver. Instead, its effectiveness lies in its complementary role, strengthening lecturers' teaching styles and enhancing student engagement. Technological tools alone are insufficient to enhance learning outcomes without integration with lecturers' pedagogical competencies. This

result is consistent with previous studies [3, 18, 42, 50, 51, 69], which showed that learning approaches that combine engaging teaching styles with appropriate use of digital media lead to more effective learning and improved students' academic achievement. Based on these findings, improving the quality of lecturers' teaching styles should be a priority in strategies to enhance higher education quality. Meanwhile, the use of e-learning should be oriented towards functional and pedagogical integration, as pedagogically integrated components within a systematic and active learning strategy.

V. CONCLUSION

Based on the research findings and discussion, several conclusions can be drawn, supported by empirical data. These conclusions lead to theoretical and practical recommendations, as well as acknowledge limitations and suggest future research directions.

Teaching style is the principal determinant of students' academic achievement, as it shows a positive and statistically significant effect (p -value < 0.05). While e-learning contributes positively, but non-significant effect independently on academic achievement (p -value $0.053 > 0.05$). However, both factors, simultaneously, have a positive and statistically significant influence on students' academic achievement (p -value $= 0.000 < 0.05$), explaining 41.3% of the variance in students' academic achievement.

This finding highlights the complementary pedagogical role of e-learning, suggesting its effectiveness depends on its integration with lecturers' teaching styles, pedagogical competence, and contextual conditions. E-learning is effective when it aligns with effective teaching styles, serving as pedagogical support rather than an independent instructional driver. Technological tools support academic achievement if supported by lecturers' pedagogical competence. Among them, teaching style exerts a more dominant influence than e-learning use.

The results theoretically support constructivist learning and the contextualized use of digital technology based on digital literacy, lecturers' competencies, and the availability of ICT infrastructure. Practically, the study emphasizes the importance of improving lecturers' pedagogical competencies and balancing institutional policy between investment in digital technology and the development of teaching capacity. This approach will ensure that the integration of digital technology in higher education is more effective, focusing on quality teaching and the enhancement of students' academic achievement.

This study's findings provide the following useful recommendations. Firstly, to maintain and improve the quality of lecturers' teaching styles, HEIs should develop faculty development programs, particularly in pedagogical training and content knowledge enhancement, which can further contribute to student academic success. Secondly, recognizing the limited impact of e-learning on student achievement, HEIs, the Ministry of Higher Education, and development partners should provide technical support and ICT facilities, including infrastructure, internet connectivity, and digital literacy training. These efforts will promote more intensive and broader use of the e-learning ecosystem by academic communities, in turn contributing to enhanced

teaching quality and e-learning and optimized students' academic achievement.

Despite its novel contributions, this study has several limitations. The respondents were limited to a single department and a single higher education institution, raising questions about generalizability. Therefore, future research is encouraged with a broader scope, involving diverse HEIs with samples from different courses to produce more rigorous and generalizable results. Methodologically, the results would be stronger and more insightful if investigated from a broader perspective, combining quantitative and qualitative approaches to generate more robust and comprehensive findings. Finally, this study examined only the direct effect of teaching styles and e-learning on self-reported academic achievement, a measurement approach potentially subject to response bias, as well as the reduction of the observed relationship's strength. Future research should incorporate intervening variables and objective performance measures, such as Grade Point Average (GPA).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

M.L.S. devised the project and its main conceptual ideas, drafted the initial manuscript sections for the background, literature review, and methods, including data acquisition and organization. M.B. performed the data analysis, wrote the abstract, findings, discussion, and conclusion, and critically revised the entire manuscript. Both authors contributed to the content of the manuscript and approved the final version.

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