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Enhancing Learning Outcomes: A Study of Key Educational Method Drivers

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Abstract: The effectiveness of learning methods continues to face numerous challenges, particularly in the rapidly evolving digital era. This study aims to analyze the factors influencing the effectiveness of learning methods within the context of higher education. A quantitative approach was employed through a survey, with data collected using questionnaires distributed to 114 students from the Culinary Management Department. The data were analyzed using the Structural Equation Modeling - Partial Least Squares (SEM-PLS) method with SmartPLS version 4.0 software. The prerequisite analysis confirmed that the measurement model met the criteria for validity and reliability. The research findings indicate that student characteristics have a positive but statistically insignificant influence on the effectiveness of learning methods, although the small effect size still holds some relevance. Similarly, the quality of learning exhibits a positive yet non-significant relationship with learning effectiveness, with a relatively greater effect size than student characteristics. Conversely, the learning environment shows a negative and negligible correlation with learning effectiveness, marked by a very minimal effect size. In contrast, learning technology emerges as a key factor, showing a significant and positive impact on the effectiveness of learning methods, supported by a relatively substantial effect size. In conclusion, learning technology plays a critical role in enhancing the effectiveness of learning in the digital era, while other factors may require reevaluation or strategic integration to better support educational outcomes.

Keywords: Learning Method; Learning technology; Student Characteristics

Introduction

The landscape of education has been significantly reshaped in the digital era through the integration of technology-enabled learning models. As students increasingly engage with information in fluid and diverse ways, assessing the relevance and success of digital learning strategies has become essential (Magagula & Awodiji, 2024). The widespread use of digital tools—ranging from e-learning platforms to interactive simulations and mobile applications—has improved both access and learner participation. A critical examination of these tools reveals the extent to which technology supports learning goals, fosters student motivation, and equips learners with future-relevant competencies (Haleem et al., 2022; Qazi et al., 2024; Verstraeten et al., 2025).

Within the broader context of globalization and technological advancement, understanding the dynamics that influence digital learning effectiveness is vital—not only for educators, but also for policymakers and curriculum developers (Chan, 2023). While the adoption of educational technology introduces fresh pedagogical possibilities, it also demands an awareness of the social, cultural, and psychological dimensions that shape the learning experience (Oke & Fernandes, 2020). A nuanced understanding of these aspects allows educators to craft flexible, personalized, and inclusive learning environments that respond to the needs of contemporary learners (Ballesteros et al., 2021; Nagel et al., 2023).

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Maximizing the impact of technology in education depends on aligning digital tools with adaptive teaching methods. The effectiveness of instructional approaches hinges on choosing platforms and applications that resonate with students' contexts and curricular needs (Megahed & Hassan, 2022; Shonfeld et al., 2021). Reliable internet connectivity, engaging and relevant digital content, and consistent educator involvement are all core to sustaining meaningful digital learning. Moreover, the creation of digital spaces that encourage creativity and collaborative engagement plays a central role in fostering deep learning outcomes (Bonfield et al., 2020; Butcher et al., 2024; Martzoukou, 2021).

However, the transition to digital learning has revealed substantial equity challenges. Technological infrastructure gaps in many educational institutions limit the reach and inclusivity of online education. Students in underserved regions or from low-income backgrounds often face inconsistent internet access and a lack of personal devices—creating a digital divide that inhibits equitable participation (Lembani et al., 2020). Inadequate digital literacy and limited professional development opportunities for educators also hinder the effective delivery of online content (Falloon, 2020). Furthermore, digital learning raises concerns related to data security and user privacy, which can interrupt instructional continuity and compromise student safety (Dwivedi et al., 2020). Addressing these inequalities requires collective effort from governmental bodies, educational leaders, and community stakeholders to build a more just and accessible digital education ecosystem (Barra et al., 2024; Jaggars et al., 2021).

The need to analyze various factors or variables that potentially influence the improvement of the effectiveness of learning methods in the Digital Era is evident. Diligent research on technological factors, including infrastructure, internet accessibility, and devices, is crucial in determining the success of implementing online learning (Maghaydah et al., 2024; Mahlangu & Makwasha, 2023). The availability of adequate hardware and software in educational institutions, coupled with stable internet connectivity, forms the primary foundation. Additionally, assessing the digital skills of both teachers and students is a crucial element, considering that the ability of teachers to manage technology and the proficiency of students in using online learning platforms impact overall interaction and learning effectiveness (Turnbull et al., 2021). Psychosocial and motivational aspects also have significant impacts, with an analysis of students' motivation levels, their perceptions of the utility of technology in learning, and the social support they receive shaping the overall learning experience (Barratt & Duran, 2021; Chiu et al., 2021). Evaluating the readiness of educational institutions to adapt to the changing paradigm of teaching is also highly relevant, and a profound understanding of all these factors is key to designing appropriate strategies, ensuring that teaching methods in the digital era are genuinely effective and aligned with the needs of students and technological advancements (Miranda et al., 2021).

This research plays a crucial role in conducting an analysis of the effectiveness of learning methods in the rapidly evolving Digital Era. Alongside technological revolution, the educational landscape has undergone substantial changes, particularly with the dominance of digitally-based teaching methods (Lester & Crawford–Lee, 2023). The primary focus of this research is to attain a profound understanding of the extent to which digital teaching methods contribute to the achievement of learning objectives, student responses, and the development of relevant skills within the context of this paradigm shift. Through meticulous analysis, the research aims to provide insights into the successes and potential constraints in implementing teaching methods in the digitally laden and complex era (Fang et al., 2024; Valsaraj et al., 2021). The study will investigate various dimensions of effectiveness, encompassing technical aspects such as platform usage, technological integration, and accessibility. Additionally, it will evaluate psychosocial factors, including student motivation, perceptions of digital learning, and the interaction between teachers and students in the context of online learning (Dubey et al., 2023). By integrating these aspects, the research strives to offer a holistic view of the effectiveness of learning methods in the Digital Era. It is anticipated that this will assist policymakers, educators, and education practitioners in comprehending the intricate dynamics within the modern learning environment (Carvalho et al., 2020; Ifenthaler et al., 2021).

This study seeks to investigate the driving factors that shape the success of instructional strategies within today's digital learning landscape. By synthesizing insights from technological advancements, pedagogical best practices, and the pressing challenges inherent to digital education, the research aims to generate a nuanced perspective on how instructional approaches can be restructured and refined. The ultimate goal is to support the development of effective, adaptive learning environments that are capable of meeting the demands of a rapidly changing educational ecosystem.

This study uniquely integrates technological infrastructure, digital literacy, motivation, and institutional readiness to comprehensively analyze factors affecting learning effectiveness in the digital era. Unlike prior research focusing on isolated elements, it balances opportunities and challenges, especially equity issues like the digital divide. The research also

explores the dynamic link between student motivation, perceptions, and technology use, offering practical insights for educators and policymakers. Additionally, it highlights emerging digital competencies vital for preparing learners for the Fourth Industrial Revolution, making it a timely contribution to current educational transformations.

Method

Research Design

To investigate the variables associated with collaborative competence, this research adopts a quantitative methodology grounded in the use of structured questionnaires. This method is particularly advantageous when engaging with large sample groups, as it facilitates systematic data gathering and enables precise quantification of responses. The survey technique offers a reliable mechanism for capturing measurable indicators and patterns of behavior, which can then be analyzed statistically to identify relationships and generate generalizable insights. This methodological choice is intentionally aligned with the study's focus on understanding the dynamics of collaboration within educational contexts, where empirical evidence is key to uncovering underlying factors and informing future interventions.

Population and Sample

The determination of the study population was guided by pragmatic factors, particularly the relatively small and accessible size of the target group. In research design, it is essential to weigh the trade-off between achieving representativeness and managing practical constraints such as time, resources, and data processing capacity. In this context, the entire cohort of 114 students from the Culinary Management Department, Batam Tourism Polytechnic, was selected. Since the total number of students falls below the threshold of 500, the study employed a census approach rather than sampling. This decision not only simplifies the data collection process but also strengthens the robustness of the analysis by ensuring comprehensive coverage, thereby enhancing the credibility of conclusions drawn about students' collaborative competence.

Instrument

The research instrument was developed based on indicators for each variable. The variables to be analyzed in this research include student characteristics (SC), Teaching quality (TQ), learning environment (LE) as exogenous variables, as well as the effectiveness of learning methods effectiveness (LME), as an endogenous variable. This research will also analyze learning technology (LT) positioned as a mediator variable. These variables were subsequently broken down into several statement items designed to measure their respective conditions. The five variables to be analyzed in this study were converted into 50 questionnaire items included in the research instrument. The instrument's blueprint can be observed in the following table:

Table 1. Research Instrument

No	Indicators	Item
Learning Method Effectiveness (LME)		
1	Alignment with learning objectives	1, 2,
2	Encourages active participation	3, 4,
3	Promotes critical thinking	5, 6,
4	Adapts to learning styles	7, 8,
5	Improves learning outcomes	9, 10
Student Characteristics (SC)		
6	Learning motivation	11, 12
7	Prior knowledge	13, 14
8	Learning style	15, 16
9	Self-regulation skills	17, 18
10	Learning engagement	19, 20
Teaching Quality (TQ)		
11	Clarity of instruction	21, 22
12	Variety of methods	23, 24
13	Constructive feedback	25, 26
14	Effective communication	27, 28
15	Classroom management	29, 30
Learning Environment (LE)		
16	Classroom conditions	31, 32
17	Peer and teacher support	33, 34
18	Safe and inclusive climate	35, 36
19	Access to resources	37, 38
20	External distractions	39, 40
Learning Technology (LT)		
21	Device availability	41, 42
22	Platform accessibility	43, 44
23	Relevance to learning	45, 46
24	User competence	47, 48
25	Impact on outcomes	49, 50

Measurement and Structural Model

The measurement and structural model delineates the functions of individual questionnaire items within the variables and elucidates the intricate web of connections among exogenous, endogenous, and mediator variables. The measurement and structural models are presented as follows Figure 1.

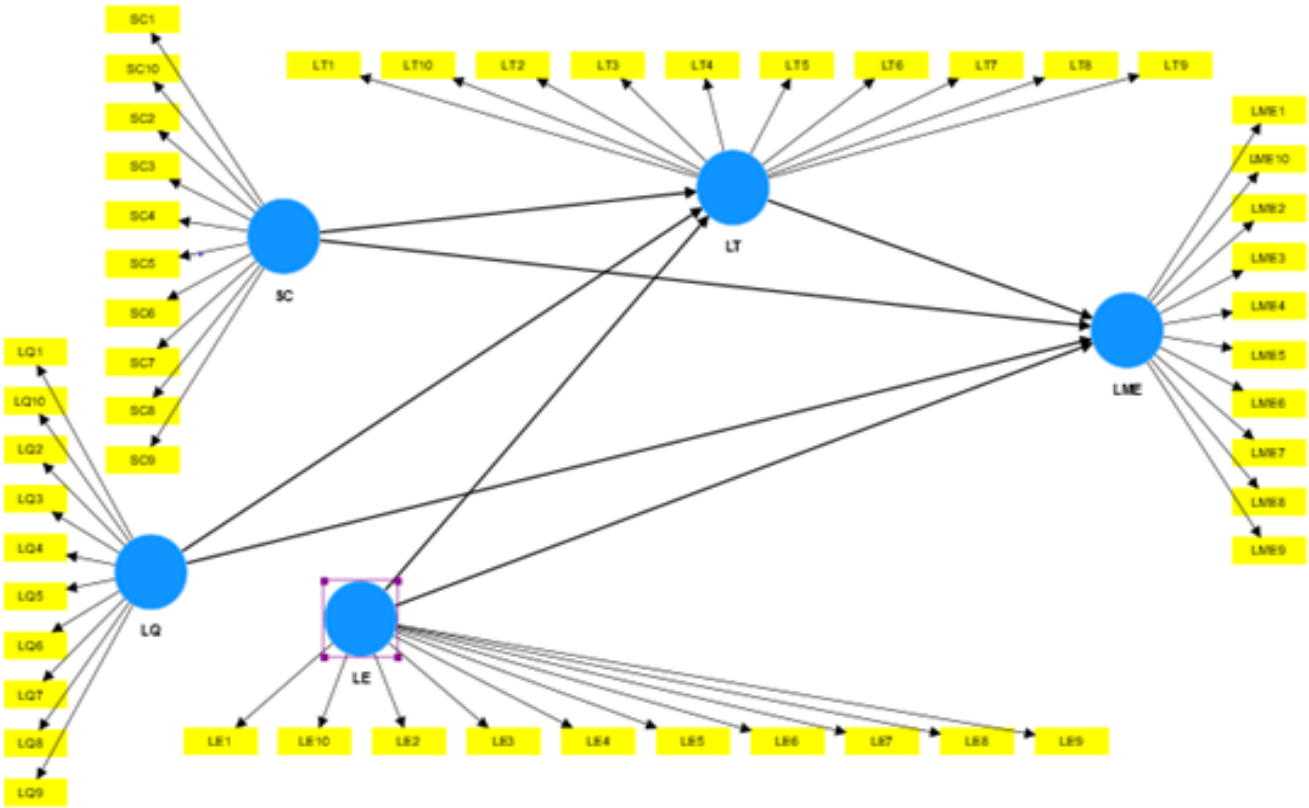

Figure 1. Measurement and structural model

Collection and Analysis of Data

This research utilized a dual-source data collection strategy, with primary data gathered through the administration of structured questionnaires, and secondary data obtained via an extensive review of existing literature. The supporting literature included scholarly journal publications and authoritative texts relevant to the study's thematic focus. To analyze the primary data, the study employed SmartPLS 4.0, a statistical tool selected for its methodological compatibility with the study's analytical needs. SmartPLS offers robust capabilities for exploring both predictor and mediator variables that influence the effectiveness of learning methods. In addition, it facilitates an efficient evaluation of measurement models and structural relationships within the dataset. Its capacity to reliably test complex hypotheses involving both direct and indirect effects further underscores its appropriateness for this research context.

Result

Results of Measurement Model Evaluation

Validity

Convergent Validity and Discriminant Validity are utilized to evaluate the validity. Convergent validity examines the validity by assessing the Loading Factor and Average Variance Extracted (AVE) values. The measurement model's validity is affirmed when the Loading Factor surpasses 0.7, and the AVE is higher than 0.5.The Loading Factor analysis results indicate that all items in the instrument are valid across all variables, which are Learning Method Effectiveness, Student Characteristics, Teaching Quality, Learning Environment, and Learning Technology. Furthermore, the tabulated data below shows the results of the AVE analysis.

Table 2. Result of AVE

Parameters	Average variance extracted (AVE)	Validity
Learning Environment	0.768	Valid
Learning Method Effectiveness	0.675	Valid
Teaching Quality	0.759	Valid
Learning Technology	0.754	Valid
Student Characteristics	0.713	Valid

According to the test results provided earlier, it is clear that all values surpass 0.5. This signifies that all variables can be affirmed as valid. Additionally, the discriminant validity test involves the Fornell Larcker Criterion and Cross Loading values. A variable achieves validity when its core correlation with other variables exceeds the correlation value of that variable

with other variables. The test outcomes are as follows Table 3.

The aforementioned test results indicate that the validity of all variables can be affirmed. This determination is grounded in the fact that the core correlation value of each variable surpasses its correlation with other variables.

Table 3. Result of fornell larcker criterion

Parameters	LE	LME	TQ	LT	SC	Result
Learning Environment	0.87					Valid
Learning Method Effectiveness	0.87	0.82				Valid
Teaching Quality	0.94	0.87	0.87			Valid
Learning Technology	0.93	0.89	0.89	0.86		Valid
Student Characteristics	0.89	0.86	0.89	0.88	0.84	Valid

Reliability

Tests for reliability are conducted through an examination of both the Composite Reliability and Cronbach's Alpha scores. Variables and indicators can be considered reliable if both the Composite Reliability and Cronbach's Alpha exceed 0.7. The results of the tests are presented in Table 4.

Table 4. Result of composite reliability and crobach's alpha

Parameters	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Result
Learning Environment	0.966	0.967	0.971	Reliable
Learning Method Effectiveness	0.946	0.948	0.954	Reliable
Teaching Quality	0.965	0.966	0.969	Reliable
Learning Technology	0.964	0.964	0.968	Reliable
Student Characteristics	0.955	0.957	0.961	Reliable

The results presented above provide information that the scores for both Composite Reliability and Cronbach's Alpha exceed 0.7 for all variables. This suggests the reliability of the variables, indicators, and items under investigation in this study.

Result of Structural Model Assesment

Correlation Test

The correlation analysis involves assessing the R-Square value to determine the extent to which endogenous variables can be predicted by exogenous variables. The outcomes are presented in the subsequent table:

Table 5. Result of R Square

Parameters	R-square	Predictability
Learning Method Effectiveness	0.829	82.9 %
Learning Technology	0.889	88.9 %

The findings indicate that the Learning Technology variable functions as a pivotal mediator, assuming dual roles within the model—as both an endogenous and an exogenous component. When positioned as an endogenous variable, Learning Technology is significantly influenced by its predictors, with an explanatory power reaching 88.9%. On the other hand, when examining Learning Method Effectiveness , the model demonstrates that 82.9% of its variance can be accounted for by exogenous variables, including Learning Technology. To gain deeper insight into the dynamics of these relationships, further path analysis was conducted. This analysis assessed whether the interactions between variables are constructive or adverse by evaluating the directionality of the path coefficients. A positive coefficient (greater than 0) suggests a supportive relationship, whereas a negative value would indicate the opposite. The detailed results of this path analysis are outlined in Table 6.

Table 6. Result of Path Coefficients

Parameters	Path Coefficients	Correlation
Learning Environment->Learning Method Effectiveness	-0.042	Negative
Learning Environment -> Learning Technology	0.703	Positive
Teaching Quality -> Learning Method Effectiveness	0.329	Positive
Teaching Quality -> Learning Technology	0.027	Positive
Learning Technology->Learning Method Effectiveness	0.464	Positive
Student Characteristics->Learning Method Effectiveness	0.192	Positive

Student Characteristics -> Learning Technology	0.232	Positive

The Table 6 provides an overview of path coefficient values for various inter-variable correlations. Data analysis reveals that one path coefficient is negative, while the others are positive.

Significance Test

The significance test is subject to analysis through the computation of the statistical T value. It is considered that there is a significant influence between variables if the T Statistic score exceeds 1.96. The results of the test are presented in Table 7.

Table 7. Result of T Statistic

Parameters	T statistics	Result
Learning Environment->Learning Method Effectiveness	0.236	Insignificant
Learning Environment -> Learning Technology	4.644	significant
Teaching Quality -> Learning Method Effectiveness	1.591	Insignificant
Teaching Quality -> Learning Technology	0.158	Insignificant
Learning Technology->Learning Method Effectiveness	4.032	significant
Student Characteristics->Learning Method Effectiveness	1.675	Insignificant
Student Characteristics -> Learning Technology	0.232	Positive

The test results mentioned indicate that there are four non-significant influences between variables, namely the influence of Learning Environment on Teaching Method Effectiveness, Teaching Quality on Teaching Method Effectiveness, Teaching Quality on Learning Technology, and Student Characteristics on Teaching Method Effectiveness. Meanwhile, the influence between other variables is declared as significant.

Size Effect

This research separates the effect size analysis into two distinct components: the direct effect size and the indirect effect size that operates through mediating variables. The direct effects are evaluated by calculating the F-square values using SmartPLS software, while the indirect effects are quantified by applying the Upsilon V formula derived from the outputs provided by SmartPLS. The detailed results of this dual approach to effect size measurement are summarized as follows:

Direct Effect Size

The direct effect size is examined by assessing the F Square value. This value is subsequently juxtaposed with the established category thresholds designating the direct effect as either low (0.005), moderate (0.01), or high (0.025). The outcomes of this analysis are presented below:

Table 8. Result of Square

Parameters	LME	Direct Size
Learning Environment	0.001	Low
Learning Method Effectiveness	0.062	High
Teaching Quality	0.14	High
Learning Technology	0.034	High

From the above analysis, it can be concluded that three variables (LQ, LT, and SC) have a high effect size on the Learning Method Effectiveness variable. Meanwhile, the LE variable has a low effect size on the Learning Method Effectiveness variable.

Indirect Effect Size

The analysis of indirect effect size involves the computation of SmartPLS output values using the Upsilon V formula. The SmartPLS output detailing the effect size among variables is presented in Figure 2.

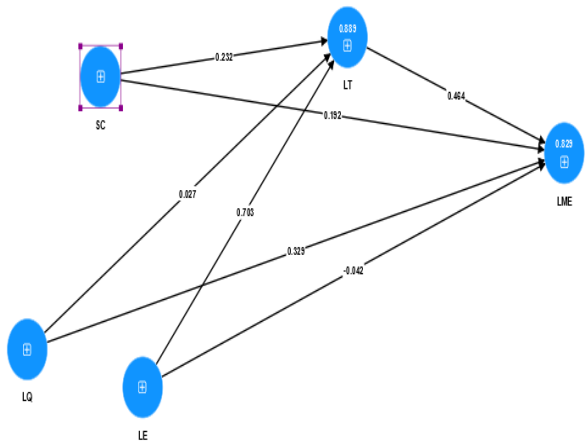

Figure 2. Output of SmartPLS related effect size

The value above is subsequently computed employing the Upsilon V formula as delineated by the equation β2. MX.β2YM.X. The resulting computation is subsequently juxtaposed with the predetermined standard categories, which classify the indirect effect size as either low (0.01), moderate (0.075), or high (0.175). The computed outcome is presented by Table 9.

The analysis results indicate that the indirect effects among the variables fall into different categories. Specifically, the effect of "Student Characteristics on Learning Method Effectiveness

through Learning Technology" is categorized as moderate; "Teaching Quality on Learning Method Effectiveness through Learning Technology" falls into the low category; and "Learning Environment on Learning Method Effectiveness through Learning Technology" is classified as high. These findings suggest that the presence of Learning Technology as a mediating variable significantly alters the strength of the relationships between the exogenous variables (Student Characteristics, Teaching Quality, and Learning Environment) and the endogenous variable (Learning Method Effectiveness). To further evaluate the mediating role of Learning Technology, a comparison was conducted between the direct and indirect effect sizes. The results of this comparison are presented by Table 10.

Table 9. Result of Indirect Effect Size

Parameters			Indirect Effect Size	Category
Student Characteristics-Learning Technology- Learning Method Effectiveness	0.23	0.46	0.0115	Moderate
Teaching Quality - Learning Technology - Learning Method Effectiveness	0.02	0.46	0.0001	Low
Learning Environment-Learning Technology - Learning Method Effectiveness	0.70	0.46	0.1064	High

Table 10. Role of Mediator Variable

Parameters	Direct Effect	Indirect Effect Through mediator variable (SM)	Mediation Role
Student Characteristics - Learning Method Effectiveness	High	Moderate	Full Mediation
Teaching Quality - Learning Method Effectiveness	High	Low	Full Mediation
Learning Environment - Learning Method Effectiveness	Low	Moderate	Full Mediation

The findings highlight learning technology as a pivotal mediator within the model. The analysis confirms that learning technology serves as a complete mediator linking Student Characteristics, Teaching Quality, and Learning Environment to Learning Method Effectiveness. Notably, the influence of this mediating variable differs across relationships: it notably enhances the connection between Learning Environment and Learning Method Effectiveness, strengthening the impact of the learning context through technological integration. This suggests that learning technology not only bridges these factors but also amplifies the effect of the environment on how effective learning methods become.

Discussion

Student Characteristics on Learning Method Effectiveness

The results of the Path Coefficient analysis (0.192) paired with a t-value of (1.675) suggest that student characteristics exert a positive yet statistically non-significant effect on the effectiveness of learning methods. The effect size calculated at 0.034, while categorized as small, indicates some degree of practical relevance.

This study aligns with earlier research highlighting the nuanced but meaningful influence of student attributes on learning outcomes. Prior investigations have shown that characteristics such as motivation, learning preferences, and cognitive abilities can enhance students' engagement with educational methods, although these effects may not always reach statistical significance (Malmia et al., 2019). Consistent with these findings, this research suggests that student characteristics contribute generally to improving learning method effectiveness, even if the measurable impact is modest.

Key elements explaining this positive influence include factors like student motivation, preferred learning styles, foundational skills, social interaction capabilities, critical thinking, and personality traits (Chasanah & Usodo, 2020; Nurbekova et al., 2020). For instance, learners who exhibit high motivation and whose learning styles are well-matched with instructional approaches tend to experience more effective learning (Lauermann & Berger, 2021; Maharajan et al., 2025). Additionally, variables such as prior knowledge, academic background, and skillsets play important roles in how students adapt to and benefit from different learning methods (Akpur, 2025; Liu et al., 2019). These insights offer a richer understanding of how student characteristics subtly shape the efficacy of teaching strategies and open pathways for further exploration in educational research.

Learning Quality on Learning Method Effectiveness

The analysis of the Path Coefficient (0.329) and the corresponding t-value (1.591) suggests that Learning Quality exerts a positive, though statistically non-significant, effect on the effectiveness of learning methods. Moreover, the effect size of 0.062, classified within a moderate range, points to a meaningful practical influence despite the lack of statistical significance.

These findings reinforce earlier studies emphasizing the vital contribution of teaching quality

in improving how learning methods perform (Erdogan et al., 2022). By integrating effect size analysis, this research offers a more nuanced perspective, indicating that the real impact of Learning Quality on the success of instructional approaches might be underappreciated when relying solely on traditional significance testing. In fact, the substantive influence of teaching quality appears stronger than what conventional statistics alone might reveal.

Learning Quality encompasses diverse components, including the relevance and appropriateness of course materials, effectiveness of instructional delivery, the quality of teacher-student interactions, varied pedagogical techniques, integration of technology, engagement of learning resources, clarity in presenting content, and the provision of constructive feedback and assessments (Megavitry et al., 2023; Tripon et al., 2023). Together, these elements contribute significantly to fostering a learning atmosphere that nurtures student comprehension, enthusiasm, and motivation (Dörnyei & Muir, 2019). Placing emphasis on these facets of teaching quality is especially important in collaborative learning contexts, where interactive and dynamic engagement amplifies learning outcomes. Therefore, Learning Quality stands as a foundational factor in crafting effective, rewarding educational experiences for learners.

Learning Environment on Learning Method Effectiveness

The Path Coefficient analysis result of (-0.042) along with a t-value of (0.236) indicates that the Learning Environment has a slight negative effect on the effectiveness of learning methods, but this influence is statistically insignificant. Additionally, the effect size of 0.001 is categorized as very small, suggesting minimal practical impact.

Despite these quantitative findings, the study highlights the crucial, multifaceted role the Learning Environment plays in shaping how effective learning methods are. Key components include students' physical and psychological comfort, which are essential for maintaining attention and engagement during learning activities (Eloff et al., 2022). The availability of sufficient infrastructure and accessible learning support resources also enhances comprehension and participation (Alismail, 2023). Moreover, dynamic social interactions—both peer-to-peer and between students and instructors—along with adaptable classroom layouts and environments that foster creativity, contribute meaningfully to richer and more effective educational experiences (Borba et al., 2020). This underscores that, although the statistical correlation may be weak, environmental factors are foundational to facilitating successful and engaging collaborative learning settings.

These insights corroborate previous studies recognizing the learning environment's impact on educational effectiveness. The seemingly modest statistical relationship is complemented by effect size analysis, providing a more complete picture of its actual influence. As such, this research offers valuable perspectives that deepen the understanding of how learning environments affect teaching outcomes and encourages further investigation to explore these impacts with greater detail and nuance.

Learning Technology on Learning Method Effectiveness

The Path Coefficient analysis results (0.464) along with a t-value of (4.032) confirm that Learning Technology exerts a strong and statistically significant positive effect on the effectiveness of learning methods. Moreover, the calculated effect size of 0.14 categorizes this impact as substantial, underscoring the pivotal role technology plays in modern education.

Recent studies have emphasized the expanding integration of technology within educational settings and its growing importance in shaping student interactions (Grassini, 2023). Technology-driven tools, such as specialized software and digital learning platforms, have been shown to transform the ways students collaborate and communicate (Santos et al., 2019). Features like virtual discussion boards, video calls, and shared document editing allow learners to actively engage in group discussions and joint projects regardless of physical location. This study specifically explores how technology enhances students' collaborative skills, particularly within distance learning frameworks. The evidence suggests that technological tools foster a more connected learning environment, promoting smoother communication and cooperative efforts that directly contribute to more effective learning methods.

In addition, the research delves into how technology influences students' participation in collaborative assignments, a key element of group-based learning activities. Findings indicate that digital platforms enable greater accessibility and flexibility, facilitating real-time collaboration and shared editing of project materials. This increased ease of collaboration allows students to engage more efficiently and contribute more meaningfully to group outcomes. Consequently, this study provides valuable insights into the facilitative role of technology in promoting student collaboration and improving the overall effectiveness of learning strategies, especially in contexts where remote learning is prevalent.

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Conclusion

The findings of this study indicate that student characteristics and learning quality show positive trends in relation to the effectiveness of learning methods; however, these effects are statistically insignificant and relatively small in magnitude. The learning environment, on the other hand, exhibits a very small and statistically insignificant negative effect, suggesting it does not meaningfully support the effectiveness of instructional methods in this context. In contrast, learning technology demonstrates a statistically significant and substantial positive impact, underscoring its critical role in enhancing learning outcomes in the digital era. These results suggest that while learning technology should be prioritized in educational development strategies, further research is needed to better understand the limited and non-significant roles of student characteristics, learning quality, and the learning environment—particularly in how these variables might interact with technological factors or be strengthened through targeted interventions.

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Author Contributions

This article was authored by two contributors. S.R. was responsible for conceptualizing the research design, developing the theoretical framework, and drafting the initial version of the manuscript. T.A.W. contributed to the data collection process, conducted the statistical analysis using SEM-PLS, and assisted in interpreting the results. Both authors were actively involved in reviewing and revising the manuscript and approved the final version for submission.

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Conflicts of Interest

The authors declare no conflict of interest.

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