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Cognitive and Interactive Factors Influencing Students' Critical Thinking in Online Distance Learning: The Mediating Role of Student Engagement in Myanmar

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Abstract

This study examines the effects of cognitive and interactive factors on students' critical thinking in online distance learning (ODL) in Myanmar, with a particular focus on the mediating role of student engagement. A quantitative research design was employed, and data were collected from 365 students across different educational levels using a structured questionnaire. Structural equation modeling (SEM) with AMOS was used to analyze the relationships among interaction, analytical skills, problem-solving ability, reflective evaluation, student engagement, and critical thinking. The results indicate that interaction, reflective evaluation, and student engagement have significant positive effects on students' critical thinking, while analytical skills and problem-solving ability do not show direct effects. Reflective evaluation was found to have the strongest influence on critical thinking. Mediation analysis reveals that student engagement fully mediates the effects of analytical skills and problem-solving ability, partially mediates the effect of reflective evaluation, and does not mediate the interaction. These findings highlight the importance of interactive, reflective, and engaging learning environments in enhancing critical thinking in ODL. The study provides theoretical and practical implications for improving online education in Myanmar and similar developing contexts.

Keywords: Online Distance Learning, Critical Thinking, Student Engagement, Cognitive Factors, Myanmar

1. Introduction

In recent years, digital technologies have advanced at a pace that has significantly changed higher education systems around the globe, especially with the growth of online distance learning (ODL). Digital platforms, mobile technologies, and learning management systems have enabled institutions to offer learning opportunities to students at various educational levels in a flexible and accessible way. The COVID-19 pandemic further accelerated this shift by prompting universities to adopt online learning as an alternative mode of instruction. Consequently, ODL has emerged as a vital part of modern higher education. (Dhawan, 2020)

In Myanmar, the tradition of higher education has been based on a distance education system of a higher magnitude, administered through institutions such as the Yangon University of Distance Education and the Mandalay University of Distance Education. Distance education is a significant way of delivering higher education in the country, as these institutions cater to a large number of students at both the undergraduate and postgraduate levels. Distance education in Myanmar has conventionally relied on printed resources, televised lectures, and support at local centers (Bates, 2014). But recent trends have introduced digital tools and online platforms into the learning process, marking a slow shift toward technology-enhanced learning. As a result, the higher education system in Myanmar is now taking on a new form: online distance learning, where students interact with both conventional and digital learning methods. (Bates, 2014; UNESCO, 2020) (World Bank, 2021)

Although ODL is widely embraced, the question of whether it is effective in fostering higher-order thinking skills, especially critical thinking, remains relevant. Critical thinking is commonly considered one of the main outcomes of higher education, a skill that involves the ability to analyze data, to agree or disagree with statements, and to solve



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complex tasks. Nevertheless, online learning environments may make the development of critical thinking difficult due to a lack of interaction and feedback, and differences in student engagement. (Facione, 2015)

In a bid to overcome these issues, recent research has focused on the importance of cognitive and interactive variables in improving learning outcomes. Interaction, analytical ability, problem-solving skills, and reflective assessment are factors that affect the information-processing process and students' involvement in learning activities. These aspects are especially essential in ODL settings, where students must be more active and responsible in the learning process. (Martin & Bolliger, 2018; Tiruneh et al., 2014)

In addition, student engagement has been found to be a major mechanism linking these factors to learning outcomes. Active students will be more willing to engage in learning, will engage with learning material, and will think on a higher level. It has been established in literature that student engagement is an important factor in enhancing both academic success and critical thinking during online learning environments. Thus, it is imperative to know how both the cognitive and interactive mechanisms are involved in engagement, and consequently, critical thinking affects the effectiveness of ODL. Online learning and critical thinking have been discussed across various settings, but very few studies have provided empirical analyses specific to Myanmar. The context-specific study arises from the peculiarities of Myanmar's higher education system, particularly the shift toward technology-enhanced ODL rather than traditional distance learning. (Bond et al., 2021; Dixson, 2015)

This study contributes to the literature by developing an integrated SEM model linking cognitive factors, interaction, and student engagement to critical thinking. It also provides empirical evidence from Myanmar's online learning context, addressing a significant research gap in developing countries. Thus, the conceptual of this paper intends to scrutinize how cognitive and interactive variables, namely, interaction, analytical skills, problem-solving ability, and reflective evaluation, affect the critical thinking of online distance learning students, and especially the mediating effect of student engagement in Myanmar, as shown in the conceptual framework (Figure 1). The results will be useful to the literature and offer practical implications for improving the quality of online education in higher education.

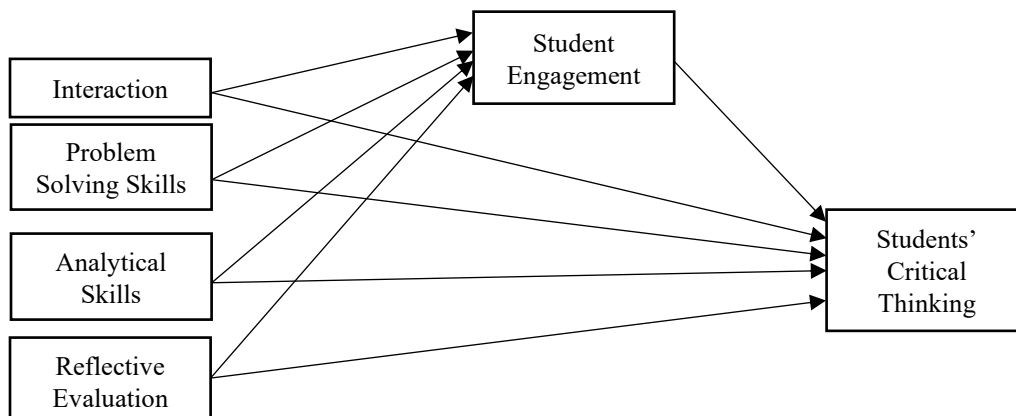


Figure 1. Framework of the Study, Source: Author.

2. Literature Review

This research is based on the constructivist learning theory, which posits that learning is an active process that occurs through interaction and reflection. Online distance learning (ODL) is not a type of study where knowledge is passively delivered to students but rather built through the interaction of digital content, instructors and classmates. This theoretical point of view is especially applicable to describing the role of cognitive and interactive processes in higher-order learning outcomes such as critical thinking (Bower, 2019; Goldie, 2016). In this context, intellectual and interactive variables play a key role in determining students' learning experiences and outcomes in virtual settings.

2.1 Cognitive and Interactive Factors in Online Distance Learning

Online distance learning (ODL) learning is fundamentally dependent on cognitive and interactive factors. In online learning, learners must actively process information, have access to content and talk to instructors and classmates. All these factors have an effect of impacting how learners build knowledge and acquire higher-order learning outcomes. It has been demonstrated that successful online learning does not only rely on delivery of content but also the quality of interaction and cognitive engagement in the learning process (Rasheed et al., 2020). In addition, the combination of the cognitive and interactive elements has been observed to have a great deal of contribution to the engagement and learning results in ODL. The more students actively interact, analyze information, solve problems, and reflect on their learning, the more they will be engaged in meaningful learning activities (Redmond et al., 2018).

Interaction is essential to ODL since it will help establish communication and cooperation between students and instructors. Proper interaction makes the students more active and facilitates learning. In the past, research has indicated that the interaction is very beneficial to the engagement and learning outcomes in online settings (Bond et al., 2021). One of the aspects of ODL is interaction, which helps to provide communication and cooperation between participants. These can be in the form of discussion forums, virtual classes, and group work in the online environment. Research has shown that meaningful interaction improves the participation, motivation, and learning satisfaction of students (Richardson et al., 2017). In addition, interactive learning space allows lessening feelings of solitude and increasing the level of thinking, which is essential towards effective learning outcomes (Lynn et al., 2025).

Interaction, including learner–learner and learner–instructor communication, plays a crucial role in facilitating knowledge construction. Drawing on constructivist theory, interaction supports collaborative learning and meaning-making processes (Vygotsky, 1978). Empirical studies demonstrate that interactive learning environments significantly enhance students’ cognitive engagement and academic performance (Moore, 1989; Bernard et al., 2009). In online education, social presence and communication quality are also linked to improved critical thinking outcomes (Garrison et al., 2010). Nevertheless, the effectiveness of interaction may vary depending on technological infrastructure and cultural learning styles, which remain underexplored in Myanmar.

Other cognitive faculties that promote effective learning include analytical skills and problem solving which in addition to interaction are essential in learning. Analytical skills can help the students assess information, notice patterns, and be able to make rational decisions, whereas problem-solving enables the learner to implement the knowledge into the real-world context. It has been shown that these cognitive processes help students to be more engaged and develop higher-order thinking (Kök & Duman, 2023). According to previous studies, these thinking processes are critical towards the involvement of learners in complicated activities and improvement of learning results in the online space (Jonassen, 2011; Zhu, 2012). These skills are even more significant in ODL settings, where learners often have to study on their own.

The other significant cognitive factor that facilitates learning in on-line environments is reflective evaluation. Through reflection, students are able to investigate their learning experience and to analyze their knowledge and enhance their thinking. Research has indicated that reflective practices aid the development of deeper learning and better academic outcomes by fostering metacognitive awareness (Selwyn, 2016). Self-assessment, feedback, and journaling are reflective activities in online learning that motivate the students to get more actively involved in the learning process (Kember et al., 2000).

Student engagement has been widely conceptualized as a multidimensional construct encompassing behavioral, emotional, and cognitive components (Fredricks et al., 2004). In online learning environments, engagement is a key mechanism through which instructional design and interaction influence learning outcomes. Recent studies confirm that student engagement mediates the relationship between learning inputs (e.g., cognitive and interactive factors) and academic outcomes such as critical thinking and achievement (Kahu, 2013; Bond et al., 2020). Engaged students are more likely to participate actively, reflect deeply, and apply higher-order thinking skills. However, empirical evidence on the mediating role of engagement in developing countries, particularly in online distance learning contexts, remains limited, highlighting a significant research gap addressed by this study.

2.2 Critical Thinking

Higher education is generally perceived as a major outcome of critical thinking and as a vital skill that students should possess in the 21st century. It corresponds to the possibility to interpret the information, assess arguments, and make evidence-based judgments (Facione, 2015). Critical thinking will be highly relevant in online learning systems, as students are expected to engage in independent study and complex cognitive processes.

Critical thinking is generally considered as a learning outcome that is required in higher education since it allows students to process information, assess arguments, and make sound judgment of learning situations that are complex. Within the framework of online distance learning, the emerging critical thinking may become even more vital, as students are usually expected to study themselves, perceive information in digital forms, and resolve issues less closely monitored. Analysis of the recent findings has indicated that with the availing of significant learning tasks to a student, collaborative learning opportunities, and reflective learning activities, online learning environment could support critical thinking. As an illustration, recent findings indicate that active and innovative online pedagogies have the potential to greatly improve the incidence levels of critical thinking and other learning aspects in tertiary education (Bhuttah et al., 2024).

Recent research has highlighted the importance of online learning environments in promoting critical thinking. Online education offers opportunities for discussion, collaboration, and problem-solving, which facilitate the development of higher-order thinking (Bond et al., 2020). Nevertheless, it is also subject to the level of student interaction in learning activities, which determines the effectiveness of ODL in promoting critical thinking.

Critical thinking development is closely connected with cognitive and interactive factors. Having good analytical and problem-solving skills, students can evaluate the information better, and provide logical conclusions. In the same way, interactive learning in a way that fosters communication and feedback improves the critical thinking skills of students (Tiruneh et al., 2018). Reflective evaluation is also very important since learners can evaluate their reasoning process and better their knowledge. Nevertheless, these opportunities notwithstanding, critical thinking development in ODL is a difficult task, especially in situations where technological and pedagogical constraints are exposed. Consequently, one should focus on the influence of cognitive and interactive factors on the development of critical thinking in certain situations, which include Myanmar.

Despite growing global research, there is limited empirical investigation of how cognitive and interactive factors jointly influence critical thinking through engagement in Myanmar's online education system. This study advances prior research by integrating cognitive factors, interaction, and student engagement into a unified SEM-based framework. While previous studies have examined these constructs independently, limited research has explored their combined effects on critical thinking through a mediating mechanism. Furthermore, this study provides empirical evidence from Myanmar's online distance-learning context, which remains underexplored in the existing literature.

3. Hypothesis Development

In online distance learning, interaction plays a significant role in facilitating communication, discussion and sharing of idea and knowledge between students and the teacher. The interactive learning activities will help the students to question the ideas, get feedback and build more understanding, which are all in support of critical thinking. Previous research results indicated that interaction within the online learning space would positively lead to the development of higher-order thinking and critical thinking (Miao & Ma, 2022).

Analytical skills are the skills of students to analyze information with attention, assess the evidence, and make rational conclusions. These are the core competencies of critical thinking since they make learners be able to evaluate the information in a systematic manner and make judgements. Research has consistently shown that analytical skills is strongly related to critical-thinking performance in educational environments (Wang et al., 2025).

One more critical thinking experience that is necessary in the process of development is problem-solving ability. It makes students find problematic situations, find out available solutions and choose the best response based on facts and argumentation. Case studies, projects, and realistic tasks are problem-solving exercises that can be used in the context of online learning to facilitate more profound cognitive processing and enhance the ability to think critically. Empirical research revealed that learning through problem solving can have a substantial positive impact on higher-order thinking of students (Rusmin et al., 2024).

Reflective evaluation refers to the process of evaluating personal learning and analyzing the thought processes and opportunities to enhance the same. It can assist students in realizing the way they think and learn which is crucial to the development of critical thinking. Self-assessment and feedback reflective activities used in online learning settings help students to re-reflect on their level of understanding and render more justified decisions. It has been revealed that reflective learning practices have a positive outcome on the development of critical thinking and more profound learning (Cecilia & Katherine, 2021).

The involvement of students is generally regarded as one of the primary factors of learning results, especially in distance learning conditions. The active students will be more inclined to be active, to address learning materials and to build higher-order thinking skills, including critical thinking. Research has established that student engagement is an effective tool for increasing critical thinking through active learning and more profound cognitive engagement (Li & Xue, 2023).

The student engagement is also one of the key elements in online learning since it indicates how well the students are involved behaviorally, emotionally, and cognitively in the academic activities. Instructional design, interaction opportunities, technological support, and collaborative learning experiences are some of the factors affecting engagement in digital learning environments. New analyses and empirical researches suggest that the more engaged students are, the higher the chances of engaging in the learning process, continuing in the learning tasks, and attaining better academic performance in online learning. This implies that student engagement, besides being a measure of participation, is also a process by which online learning experiences can influence the higher-order thinking of students (Akpen et al., 2024).

In this regard, student engagement can be perceived as a mediator variable between learning factors and critical thinking. Cognitive and interactive experiences in online learning settings do not always automatically impact the development of critical thinking, but the impact is usually realized when students become actively involved in the learning process. Recent research has highlighted the mediating position of student engagement in the exposition of how the support, interaction and learning experiences are converted into meaningful learning outcomes. Online strategies involving reflection and collaboration such as collaborative online courses have been used to enhance engagement and participation which ultimately enhances performance of deeper thinking and learning. Thus, the area of student engagement presents a relevant explanatory route to the concept of the impact of online learning conditions on the development of critical thinking (Kok et al., 2025).

Student involvement is a valuable process of interrelation between cognitive and interactive variables and learning outcomes. In online learning forums, interaction, analytical skills, problem-solving ability, and reflective evaluation can indirectly impact critical thinking through engagement. Students would be in a better position to acquire critical thinking skills when they are actively involved in the learning process. Past studies indicate that engagement mediates the relationship between learning processes and cognitive outcomes (Hu & Xiao, 2025). Based on the previous research and contribution of the framework, the hypotheses are proposed in the following way:

H1: Interaction has a significantly positive effect on students' critical thinking.

H2: Analytical skills have a significant positive effect on students' critical thinking.

H3: Problem-solving ability has a significantly positive effect on students' critical thinking.

H4: Reflective evaluation has a significant positive effect on students' critical thinking.

H5: Student engagement has a significantly positive effect on student critical thinking.

H6: Student engagement mediates the relationship between interaction and critical thinking.

H7: Student engagement mediates the relationship between analytical skills and critical thinking.

H8: Student engagement mediates the relationship between problem-solving ability and critical thinking.

H9: Student engagement mediates the relationship between reflective evaluation and critical thinking.

4. Methodology

4.1 Sample and Data Collection

This is a quantitative cross-sectional study that takes the descriptive research design. Students in Myanmar enrolled in online distance learning (ODL) are the target population, including undergraduates, graduates, and postgraduates.

The sample was selected using judgmental sampling, focusing on students with direct experience in online distance learning to ensure relevance to the study objectives. Therefore, the sample represents online learners with relevant experience, but may not fully reflect the entire student population in Myanmar, particularly those with limited access to digital learning environments. This approach is appropriate for selecting respondents with specific characteristics, although it may limit generalizability and introduce potential sampling bias (Sekaran & Bougie, 2016; Etikan et al., 2016).

Prior to the main data collection, the questionnaire was pilot tested with 30 respondents who had experience in online distance learning to assess clarity, reliability, and content validity. The results indicated acceptable internal consistency, with Cronbach's alpha values exceeding 0.70 for all constructs. Based on participant feedback, minor revisions were made to improve wording, clarity, and item consistency. Conducting a pilot test is essential to enhance the reliability and validity of survey instruments before full-scale data collection (Sekaran & Bougie, 2016; Hair et al., 2013).

Data were gathered using a structured questionnaire covering respondents with past experience in online learning settings. The sampling technique used was the non-probability judgmental, as subjects were chosen based on two criteria: (1) participation in higher learning programs, and (2) experience of online or distance learning platforms. Other researchers claim that structural equation modeling requires a minimum sample size of 200, although the research findings are more reliable with larger samples (Hair et al., 2013). In this, 365 valid answers were collected, which is deemed sufficient for SEM analysis. The data were collected over one month through online surveys and drop-off/pick-up methods to improve response rates and reduce bias.

4.2 Measures

The items used for measurement were based on existing, validated scales. The measure of interaction was according to Martin and Bolliger (2018). Skills of analysis and problem-solving were assessed as in Tiruneh et al. (2018) and Hwang et al. (2019), and reflective evaluation was assessed using the items by Kember et al. (2000). Student engagement was evaluated in accordance with Dixson (2015) and Bond et al. (2020), and critical thinking was assessed using items adapted from Facione (2015). All items were measured on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Moreover, demographic factors, including gender, age, education, and experience in online learning, were gathered.

4.3 Data Analysis Techniques

The hypotheses were tested using SPSS 27 and Structural equation modeling (SEM) in Amos 24. The analysis was carried out in three steps, namely: (1) confirmatory factor analysis (CFA), (2) assessment of reliability and validity, and (3) structural model analysis. The use of SEM was driven by its ability to analyze multiple relationships among variables simultaneously, accounting for measurement error (Kline, 2016; Hair et al., 2013). The mediating effect of student engagement was tested through bootstrapping. In this study, model fit was evaluated using multiple indices, including CFI, TLI, RMSEA, SRMR, GFI, and AGFI, in line with best practices in Structural Equation Modeling. According to Hu and Bentler (1999), acceptable model fit is typically indicated by CFI and TLI values ≥ 0.90 (preferably ≥ 0.95), $RMSEA \leq 0.06-0.08$, and $SRMR \leq 0.08$. Similarly, Hair et al. (2013) emphasize that model evaluation should rely on a combination of fit indices rather than a single statistic.

5. Results and Discussion

5.1 Respondents' Profile

This research was conducted on 365 students in Myanmar (see Table 1). There were 190 males (52%) and 175 females (48%) in the sample. The age distribution indicated that most were 26-30 years (48.2%), followed by 21-25 years (29.6%), 31-35 years (12.6%), 18-20 years (5.5%), and 36 years and older (4.1%). The majority of respondents were graduate students (66.8%), followed by master's (15.1%), undergraduate (12.3%), and Ph.D. students (5.8%). Major-wise, economics accounted for the highest percentage (39.2%), followed by education (29.9%), statistics (15.6%), and accounting (15.3%). In terms of university, most belonged to the University of Economics (49.3%), followed by the

University of Education (28.8%) and the Co-operative University (21.9%). In reference to online learning, 180 respondents (49.3%) indicated they participated in online classes in 1-2 years, 105 respondents (28.7%) in 3-5 years, and 80 respondents in more than 5 years. These findings show that the student sample to be analyzed is heterogeneous.

Table 1: Respondents' profile

Demographic variable	Attribute	Frequency (N= 365)	Percentage
Gender	Male	190	52
	Female	175	48
Age	18-20	20	5.5
	21-25	108	29.6
	26-30	176	48.2
	31-35	46	12.6
	36 and above	15	4.1
Education Level	Undergraduate	45	12.3
	Graduate	244	66.8
	Master	55	15.1
	Ph.D	21	5.8
Major	Accounting	56	15.3
	Economics	143	39.2
	Education	109	29.9
	Statistics	57	15.6
University	Co-operative University	80	21.9
	University of Economics	180	49.3
	University of Education	105	28.8
How many years have the experience in attend the class with online?	1-2 year	180	49.3
	3-5 years	105	28.7
	Over 5 years	80	22

Source- Author

5.2 Correlation Matrix and Descriptive Statistics

According to Table 2, student engagement (SE) had the highest mean (3.99) whereas reflective evaluation (RE) had the lowest (3.88). Student engagement was the most varied in terms of standard deviation (SD = 0.995), which means that responses were more diverse, and interaction (I) was the least varied (SD = 0.874) which means that the pattern was more similar.

Table 2: Correlation analysis of Variables

Variables	I	PS	ASK	RE	SE	CT	Mean	Std Deviation
I	1						3.91	.874
PS	.349**	1					3.90	.968
ASK	.295**	.709**	1				3.92	.919
RE	.468**	.286**	.191**	1			3.88	.823
SE	.394**	.650**	.596**	.374**	1		3.99	.995
CT	.498**	.440**	.390**	.619**	.516**	1	3.89	.799

** . Correlation is significant at the 0.01 level (2-tailed).

Source- Author

The correlation analysis exhibits high positive correlations between the variables that have been tested. There are statistically significant positive correlations between critical thinking (CT) of students and all cognitive and interactive

variables and student engagement. All the correlations are significant at the 0.01 (two-tailed) level, which proves the hypothesized relationships in the research framework. These findings suggest that the major variables have a close connection with critical thinking of the students, which gives internal consistency and theoretical validity to the proposed model.

5.3 Confirmatory Factor Analysis (CFA)

CFA was used to present the measurement model, which demonstrates the associations between the observed items and the underlying constructs. In this study, CFA was used to assess the measurement model's goodness-of-fit and to evaluate the data's reliability and validity. First, the measurement model shows the extent to which the observed variables represent the latent constructs. Second, it evaluates convergent validity and construct reliability. The goodness-of-fit indices indicate how well the items measure the intended constructs (Hair et al., 2013; Ooi, 2013).

CFA was conducted with all latent variable variances fixed at 1.0. The standardized factor loadings for all items exceeded 0.50, with the highest and lowest values being 0.947 (SE5) and 0.688 (CT1), respectively (Table 3). No items were deleted due to low loadings, in line with Hair et al. (2013). The measurement model demonstrated good fit: $\chi^2 = 1495.877$, $df = 384$, $\chi^2/df = 3.89$, $GFI = 0.654$, $AGFI = 0.580$, $CFI = 0.901$, $TLI = 0.888$, $NFI = 0.872$, $RMSEA = 0.089$, and $RMR = 0.068$ (Gaskin & Lim, 2016). In the present study, most key indices (e.g., CFI, TLI, SRMR) fall within acceptable thresholds, indicating an overall satisfactory model fit. Although GFI and AGFI are slightly below 0.90 and RMSEA is near the upper limit, the overall model fit is acceptable based on CFI, TLI, and SRMR, supported by SEM literature (Kline, 2016; Hu & Bentler, 1999). These findings demonstrate the reliability and validity of the CFA measurement model, providing good support for interpreting the effects of cognitive and interactive factors on students' critical thinking in online distance learning in Myanmar.

5.4 Reliability and Validity

The reliability and validity of the constructs were assessed using content, convergent, and discriminant validity approaches. Factor loadings ranged from 0.688 to 0.947, and inter-item correlations reached 0.721, exceeding the recommended threshold of 0.70 and supporting content validity (Kline, 2016). Composite reliability (CR) values were all above 0.70, confirming convergent validity, while average variance extracted (AVE) values above 0.50 met the standard for most constructs, indicating adequate variance explanation (Raykov, 1997). Cronbach's alpha coefficients ranged from 0.894 to 0.952, reflecting strong internal consistency (Arbuckle, 2016). These results demonstrate that the measurement model is both reliable and valid, providing confidence in the accuracy of the constructs used to assess the influence of cognitive and interactive factors on students' critical thinking in online distance learning in Myanmar.

Table 3. Factor Loadings, Cronbach's Alpha, Critical Ratio and AVE of Constructs

Constructs	Items	Factor loadings	Cronbach's α	CR	AVE
Interaction	I1	.899	0.927	0.929	0.725
	I2	.749			
	I3	.842			
	I4	.903			
	I5	.853			
Problem Solving	PS1	.913	0.952	0.925	0.799
	PS2	.860			
	PS3	.871			
	PS4	.918			
	PS5	.906			
Analytical Skill	ASK1	.903	0.936	0.941	0.762
	ASK2	.777			
	ASK3	.870			
	ASK4	.908			

	ASK5	.901			
Reflective Evaluation	RE1	.877	0.932	0.929	0.703
	RE2	.896			
	RE3	.790			
	RE4	.719			
	RE5	.896			
Student Engagement	SE1	.904	0.913	0.949	0.790
	SE2	.793			
	SE3	.843			
	SE4	.946			
	SE5	.947			
Critical Thinking	CT1	.688	0.894	0.901	0.648
	CT2	.689			
	CT3	.839			
	CT4	.881			
	CT5	.900			

Source- Author

5.5 Discriminant Validity and HTMT

Construct distinctiveness was evaluated in the current analysis by examining inter-variable relationships, following the recommendations of Hair et al. (2013), who state that correlations should be below 0.90 and at least 0.10. The observed correlations are between the recommended value and the other constructs, indicating strong inter-construct relationships. Discriminant validity was also tested by comparing the squared root of each construct's average variance extracted (AVE) with the corresponding inter-construct correlation, as recommended by (Hamid et al., 2017). The square roots of AVE values for all constructs—I (0.851), PS (0.894), ASK (0.873), RE (0.839), SE (0.889), and CT (0.805)—exceeded the corresponding inter-construct correlations. These results confirm that each construct is empirically distinct and meets the discriminant validity criteria (Table 4).

Table 4: Discriminant validity of the constructs

	I	PS	ASK	RE	SE	CT
I	0.851					
PS	0.378***	0.894				
ASK	0.319***	0.749***	0.873			
RE	0.502***	0.309***	0.209***	0.839		
SE	0.407***	0.671***	0.611***	0.413***	0.889	
CT	0.526***	0.441***	0.373***	0.683***	0.522***	0.805

Additionally, computed Heterotrait-Monotrait (HTMT) ratios; all of these ratios were lower than the 0.85 threshold proposed by Heseler et al. (2015), lending credence to the claim of discriminant validity. CT reported satisfactory HTMT values and showed strong discriminant validity with respect to all cognitive dimensions. This allows for a strong structural analysis of how cognitive and interactive factors influence students' critical thinking in online distance learning (Table 5), as all of these things prove the constructs' conceptual specificity and show that the measurement model is valid and dependable.

Table 5: HTMT Analysis

	I	PS	ASK	RE	SE	CT
I						
PS	0.368					
ASK	0.313	0.748				
RE	0.505	0.299	0.203			

SE	0.420	0.683	0.633	0.401		
CT	0.544	0.473	0.424	0.681	0.560	

5.6 Assessing the Structural Model

The structural model was used to test the proposed hypotheses and examine the relationships between cognitive factors and students' critical thinking in online distance learning, as shown in Figure 2. The model achieved good fit indices, indicating that it adequately represents the data. Standardized path coefficients, critical ratios, and p-values derived from AMOS were used to assess the hypothesized relationships.

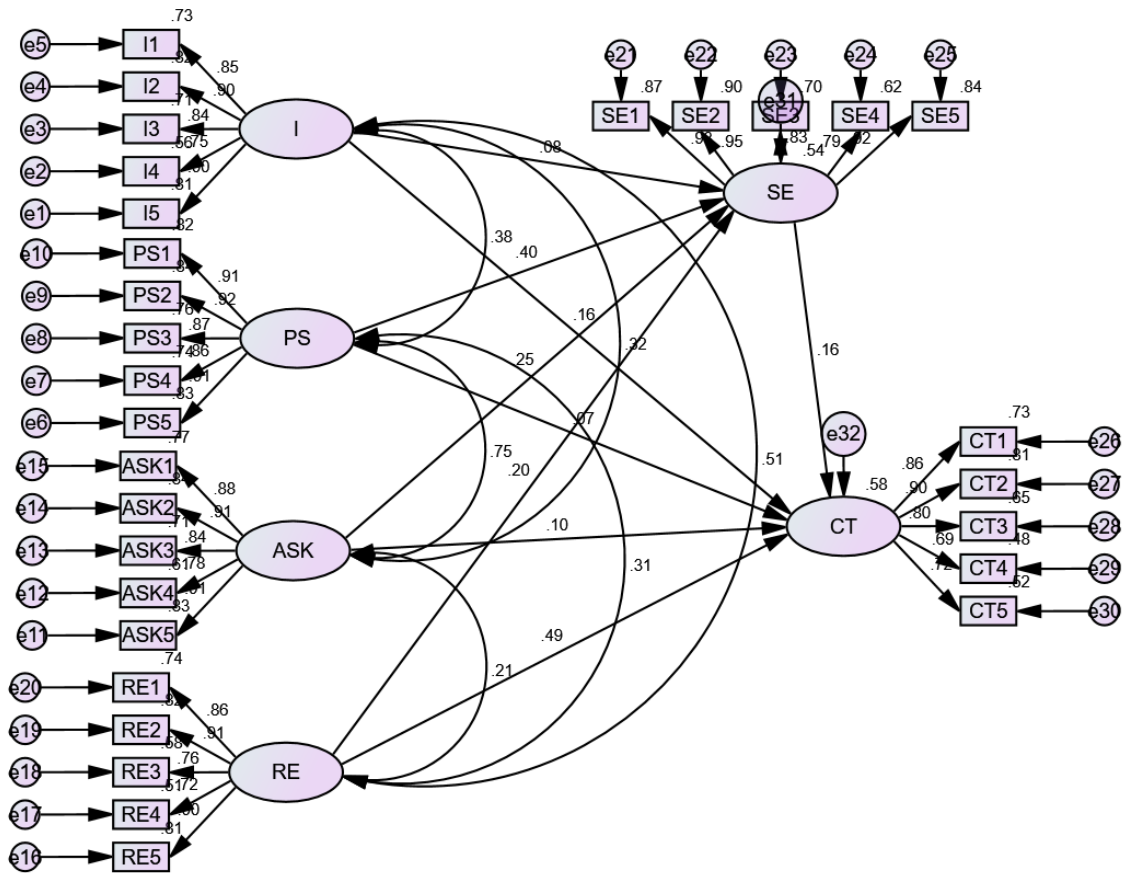


Figure 2. The Hypothesis Testing of the Model, Source – Author

5.6.1 Direct effect

The direct effects of interactive and cognitive factors, and student engagement on students' critical thinking in online distance learning were examined through hypotheses H1–H5 (Table 6).

Table 6: Direct Effects of the Model

Hypothesis	Variables	Standardized Estimation	T Statistics	P Values	Decision
H1	I ->CT	.142	3.156	.002	Accepted
H2	PS -> CT	.054	.919	.358	Rejected
H3	ANK -> CT	.086	1.490	.136	Rejected
H4	RE -> CT	.448	9.312	.000	Accepted
H5	SE -> CT	.133	2.713	.007	Accepted

Source- Author

The hypotheses included H1–H5, which asserted that cognitive and interactive factors, as well as student engagement, significantly impact students’ critical thinking (CT). Empirical examination revealed that the pathways I → CT ($\beta = 0.142, p = 0.002$), RE → CT ($\beta = 0.448, p = 0.000$), and SE → CT ($\beta = 0.133, p = 0.007$) were statistically significant; thus, hypotheses H1, H4, and H5 are supported. In contrast, PS → CT ($\beta = 0.054, p = 0.358$) and ASK → CT ($\beta = 0.086, p = 0.136$) show no significant relationships, leading to the rejection of H2 and H3. The absence of significant direct effects of problem-solving and analytical skills on critical thinking suggests that these cognitive abilities may not independently produce higher-order thinking outcomes in online learning environments. From a constructivist perspective, learning occurs through active engagement, reflection, and interaction, rather than through isolated cognitive skills (Piaget, 1972). Therefore, these skills may require engagement as a mediating process to influence critical thinking. The results indicate that reflective evaluation has the strongest positive effect on students’ critical thinking, followed by interaction and student engagement, while problem-solving ability and analytical skills do not show significant effects.

5.6.2 Mediating Effect of Student Engagement

The mediating effects of student engagement on the relationships between cognitive factors influencing students’ critical thinking in online distance learning were examined through hypotheses H6–H9.

Table 7: Mediating Effect of the Model

Hypothesis	Variables	Standardized Estimate		P Values	Decision
		Lower bound	Upper bound		
H6	CT<---SE<---I	.000	.042	.052	No Mediation
H7	CT<---SE<---PS	.026	.125	.003	Full Mediation
H8	CT<---SE<---ASK	.009	.111	.008	Full Mediation
H9	CT<---SE<---RE	.012	.070	.003	Partial Mediation

Source- Author

As shown in Table 7, the mediating effects of student engagement on the relationships between cognitive and interactive factors and students’ critical thinking were examined through hypotheses H6–H9. The findings show that student engagement does not mediate the relationship between interaction and critical thinking ($\beta = LL = 0.000, UL = 0.042, p = 0.052$); thus, H6 is not supported. This, suggests that interaction alone may not be sufficient to enhance critical thinking through engagement. From a constructivist perspective, learning occurs through meaningful and reflective interaction, not merely the presence of communication (Vygotsky, 1978). If interaction is superficial or lacks depth, it may fail to stimulate engagement and higher-order thinking. Additionally, the Garrison et al. (2010) Community of Inquiry framework emphasizes that effective learning requires the integration of social, cognitive, and teaching presence; therefore, limited instructional support or low-quality interaction may weaken the mediating role of engagement.

However, student engagement fully mediates the relationships between problem-solving ability and critical thinking ($\beta = LL = 0.026, UL = 0.125, p = 0.003$) and between analytical skills and critical thinking ($\beta = LL = 0.009, UL = 0.111, p = 0.008$); thus, H7 and H8 are supported. Furthermore, student engagement partially mediates the relationship

between reflective evaluation and critical thinking ($\beta = LL = 0.012$, $UL = 0.070$, $p = 0.003$); thus, H9 is supported. Overall, the findings indicate that student engagement plays a significant mediating role in explaining how cognitive factors influence students' critical thinking in online distance learning.

6. Discussion

This paper demonstrates that students' critical thinking in distance learning is an important aspect that is influenced by cognitive and interactive elements. The findings substantiate the claims that interaction, reflective evaluation, and student engagement have a positive impact on critical thinking of students. Reflective evaluation is the most significant of these factors, which means that the students who engage in reflective evaluation will be more likely to acquire higher-order thinking skills. The results correlate with the previous research that reflection and communication can stimulate more profound thinking and critical thinking during online learning (Kember et al., 2016; Martin & Bolliger, 2018). Analytical skills and problem-solving ability, on the other hand, do not exhibit any significant direct impact on critical thinking. This means that, despite the significance of these cognitive abilities, they may not be directly converted into critical thinking unless they are actively engaged in the process of learning. The findings here are that mere possession of cognitive skills is not enough unless students are involved in exercising them in an online learning context. The mediation analysis also puts the student engagement in explaining these relations. The effects of problem-solving ability and analytical skills on critical thinking are completely mediated by student engagement, suggesting that these variables have an indirect effect on critical thinking through student engagement. Also, student engagement is one of the partially mediating factors between reflective evaluation and critical thinking, and there is no mediation effect of interaction. These findings indicate that the engagement process is one of the main ways in which the cognitive processes can be converted to the outcome of the critical thinking. Altogether, the results suggest that in the context of the online distance learning, the improvement of critical thinking among students should not be achieved by only developing a set of cognitive and interactive abilities but also by encouraging active involvement. Thus, teachers must be interested in creating engaging, interactive, and reflective learning experiences, which would make students apply their cognitive capabilities, actively engage in learning, and utilize online learning environments effectively. The findings are interpreted through constructivist learning theory, as knowledge is created actively through interactions, thoughts, and experiences. Vygotsky (1978) stated that learners develop their thoughts through social interactions as they participate in the processes of creating meaning. The students' engagement in this study was a significant factor in transforming all the cognitive and interactional input into critical thinking. This indicates that a learner's active participation leads to higher-order learning engagements. Furthermore, the reflection-based type of evaluation is consistent with the principles of constructivism since creating meaning through continued reflection and building of knowledge is how students develop a deeper understanding of their learning (Piaget, 1972). The extent to which measurement and circumstance issues affected the non-significant findings is unknown. From a measurement standpoint, differences in how students understand and interpret the scale used, and the low sensitivity of many Likert-type items, can result in students providing different answers to the same questionnaire items in a cross-cultural context (Hair et al., 2013). From a contextual standpoint, Myanmar's online educational environment is not conducive to students engaging meaningfully, given barriers related to differences in access to technology, levels of preparedness to learn, and the quality of interaction. Therefore, the use of these two constructs is required to meet the needs of effective learning since without having engaged learners within an environment that is conducive for learning to happen, the full effect of the cognitive and interactional factors will be undetectable (Vygotsky, 1978). The findings are influenced by the Myanmar online learning context, where variations in digital access, learning readiness, and teacher–student interaction patterns may shape students' engagement and critical thinking. Limited internet connectivity and unequal access to digital resources may reduce opportunities for active participation, while differences in students' online learning experience may affect their ability to engage deeply. From a constructivist perspective, effective learning requires supportive environments for interaction and reflection. When such conditions are constrained, the development of higher-order thinking skills may be weakened.

7. Implications

7.1 Theoretical Implications

This research paper has contributed to the current literature as it expands the constructivist learning theory to online distance learning. The results show that the critical thinking of students is affected by the cognitive and interactive factors, and reflective evaluation and interaction are important. Specifically, reflective assessment has the most significant impact, which illustrates the significance of self-reflection in building higher-order thinking skills. These findings confirm the opinion that learning can be defined as an active and reflective practice, and students build knowledge by engaging and experiencing (Bower, 2019; Siemens, 2015). Further, the mediating position of student engagement also gives more theoretical understanding of the learning process. The findings reveal that analytical skills and problem-solving ability have an indirect impact on critical thinking by means of engagement, whereas reflection evaluation has both direct and indirect impacts. This is an indication that engagement is a significant process that connects the cognitive processes and learning outcomes. Consequently, the research adds to the theory through explaining how cognitive and interactive dimensions can be converted into critical thinking by the interaction between students in virtual learning contexts.

7.2 Practical Implications

The results of this research are applicable to the practice of instructors and institutions that want to enhance the critical thinking of students in online distance learning. To begin with, like in the case of online teaching, interaction and reflective evaluation should be focused on because they are very important in the development of critical thinking. To promote the use of active learning, educators need to develop interactive learning tasks: discussions, group work, and feedback. Second, online courses should have reflective learning practices. Self-assessment, reflection journals, and feedback are some of the activities that can assist students to evaluate their learning process and enhance their thinking process. Third, analytical skills and problem-solving ability have no direct impacts but their impact in student involvement indicate the significance of establishing interesting learning conditions. The educators must create assignments where active engagement is promoted, including case studies and problem-based learning. On the whole, institutions ought to aim at creating interactive, reflective, and engaging online learning systems that will improve critical thinking in students. Online distance learning can be made more efficient in facilitating higher-order cognitive development through forming higher-quality learning activities and encouraging student interaction. Research results indicate a need for customizing the method of providing support in an online distance learning environment based on the type of learner who will be using that environment. For example, reflective learners thrive when provided with opportunities for self-reflection and generating critical thought, whereas interactive learners thrive when provided with collaborative discussions and opportunities to engage with peers to improve their learning outcomes. In addition, students who have limited experience with online learning may require more assistance, structured support and/or development of technology skills if they are to participate successfully. The constructivist viewpoint is that learning is most successfully accomplished when the instructional strategies being used are in alignment with the learners' needs so that the learner is actively engaged in the learning process as well as building new knowledge .

8. Limitations and Future Research Directions

Even though the research presents useful information on the impacts of the cognitive and interactive variables on critical thinking of the students in online distance learning, there are a number of limitations that can be taken into consideration. To begin with, the research design used in the study was cross-sectional, which cannot be used to make strong causal conclusions regarding variables. Second, the study focused on Myanmar's students; hence, the results cannot be generalized to other countries or classrooms. Third, using self-reported data could bring in bias in the responses, even though it has been done to maintain data reliability and validity. Moreover, even though the student engagement was studied as a moderating variable, other possible moderators or mediating variables were not considered in this research, including learning motivation, digital literacy, or the quality of teaching.

Future studies might take the longitudinal or experimental design to help establish better causal relationships between the variables. It would be more appropriate to increase the sample and involve students of other countries or education systems to increase the validity of the results. Moreover, it is possible that in the future other factors will be investigated, including technology preparedness, learning strategies, and instructional design, to offer a more

insightful view of the development of critical thinking in online distance learning. Lastly, an understudy of the interplay between student attributes and learning conditions may provide more precise information on how various learners learn to become critical thinkers in an online setting.

This study employed judgmental (non-probability) sampling, which may limit the generalizability of the findings beyond the sampled respondents. Since participants were selected based on specific criteria related to online learning experience, the results may not fully represent the broader student population in Myanmar. As noted by Sekaran and Bougie (2016), non-probability sampling restricts external validity, as not all individuals in the population have an equal chance of selection. Therefore, future studies are recommended to adopt probability sampling techniques to enhance representativeness and generalizability.

9. Conclusion

This paper has reviewed the impact of cognitive and interactive variables on students' critical thinking in online distance learning in Myanmar, with special emphasis on the mediating variable of student engagement. The results show that interaction, reflective evaluation, and engagement with students have a significant impact on students' critical thinking, with no direct impact observed on analytical skills and problem-solving capacity. Among them, the aspect of reflective evaluation proves to be the most important; thus, the relevance of reflective learning in the acquisition of higher-order thinking is shown. Moreover, the mediation analysis shows that student engagement is a major factor explaining the correlation between cognitive factors and critical thinking. In particular, student engagement completely mediates the impact of the analytical skills and problem-solving ability, partially mediates the impact of the reflective evaluation, and does not mediate the interaction. The findings indicated that engagement is one of the most important processes, with cognitive processes supporting critical thinking in online learning settings. Finally, the study contributes to knowledge about the role of cognitive and interactive factors in students' critical thinking in online distance learning. Results point to the necessity of creating interactive, reflective, and engaging learning conditions in order to develop critical thinking. These lessons have useful implications on the educators and institutions that strive to enhance the efficiency of online education in Myanmar and such other settings. A validated integrated structural model has developed both theoretically and empirically in this research that can explain how cognitive and interactive elements influence critical thinking through the mediating role of the engagement of students studying online from home. Using data from a study that was conducted within a constructivist perspective, this research demonstrated that engagement was more than just an enhancer of the student's learning, but rather, served as the primary mechanism for transforming the inputs that students obtain to the higher-order cognitive outcomes of learning. This research provides empirical evidence of learning-related factors that were obtained from the developing education country of Myanmar and shows that these factors have not previously been studied in other countries. Additionally, the results of the study indicate practical implications for educators and institutions to design engagement-focused learning environments to effectively service diverse learners' needs and enhance their cognitive development.

References

- Akpen, C., Asaolu, S., & Atobatele, S. (2024). Impact of online learning on students' performance and engagement: A systematic review. *Discover Education*, 3, Article 205. <https://doi.org/10.1007/s44217-024-00253-0>
- Arbuckle, J. (2016). IBM SPSS AMOS 24 user's guide. IBM Corp.
- Bates, T. (2014). Open and distance learning in Myanmar. <https://www.tonybates.ca>
- Bernard, R. M., Abrami, P. C., Borokhovski, E., Wade, C. A., Tamim, R. M., Surkes, M. A., & Bethel, E. C. (2009). A meta-analysis of three types of interaction treatments in distance education. *Review of Educational Research*, 79(3), 1243-1289. <https://doi.org/10.3102/0034654309333844>
- Bhuttah, T., Xusheng, Q., & Abid, M. (2024). Enhancing student critical thinking and learning outcomes through innovative pedagogical approaches in higher education: The mediating role of inclusive leadership. *Scientific Reports*, 14, Article 24362.
- Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2020). Mapping research in student engagement and educational technology in higher education: A systematic evidence map. *International Journal of Educational Technology in Higher Education*, 17, Article 2. <https://doi.org/10.1186/s41239-019-0176-8>
- Bower, M. (2019). Technology-mediated learning theory. *British Journal of Educational Technology*, 50, 1035-1048.
- Cecilia, K., & Katherine, K. (2021). Reflection literacy: A multilevel perspective on the challenges of using reflections in higher education through a comprehensive literature review. *Educational Research Review*, 32.
- Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, 49(1), 5-22.
- Dixon, M. D. (2015). Measuring student engagement in the online course: The Online Student Engagement Scale (OSE). *Online Learning*, 19(4). <https://doi.org/10.24059/olj.v19i4.561>
- Etikan, I., Musa, S., & Alkassim, R. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1-4.
- Facione, P. (2015). Critical thinking: What it is and why it counts. *Insight Assessment*.
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59-109. <https://doi.org/10.3102/00346543074001059>
- Garrison, D. R., Anderson, T., & Archer, W. (2010). The first decade of the Community of Inquiry framework: A retrospective. *The Internet and Higher Education*, 13(1-2), 5-9.
- Gaskin, J., & Lim, J. (2016). Model fit measures, AMOS plugin.
- Goldie, J. G. S. (2016). Connectivism: A knowledge learning theory for the digital age? *Medical Teacher*, 38, 1-6. <https://doi.org/10.3109/0142159X.2016.1173661>
- Hair, J., Black, W., Babin, B., & Anderson, R. (2013). *Multivariate data analysis (7th ed.)*. Pearson Education.
- Hamid, M., Sami, W., & Sidek, M. (2017). Discriminant validity assessment: Use of Fornell-Larcker criterion versus HTMT criterion. *Journal of Physics: Conference Series*, 890, Article 012163. <https://doi.org/10.1088/1742-6596/890/1/012163>

- Henseler, J., Ringle, C., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43, 115-135. <https://doi.org/10.1007/s11747-014-0403-8>
- Hu, J., & Xiao, W. (2025). What are the influencing factors of online learning engagement? A systematic literature review. *Frontiers in Psychology*, 16, Article 1542652. <https://doi.org/10.3389/fpsyg.2025.1542652>
- Hu, L., & Bentler, P. (1999). Cutoff criteria for fit indexes in covariance structure analysis. *Structural Equation Modeling*, 6(1), 1-55.
- Jonassen, D. (2011). *Learning to solve problems: A handbook for designing problem-solving learning environments*. Routledge.
- Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education*, 38(5), 758-773. <https://doi.org/10.1080/03075079.2011.598505>
- Kember, D., Leung, D., Jones, A., Loke, A., McKay, J., Sinclair, K., & Wong, M. (2000). Development of a questionnaire to measure the level of reflective thinking. *Assessment & Evaluation in Higher Education*, 25, 381-395. <https://doi.org/10.1080/713611442>
- Kline, R. (2016). *Principles and practice of structural equation modeling (4th ed.)*. Guilford Press.
- Kok, X.-F., Pua, C., Pua, S., & Devilly, O. (2025). The mediating role of student engagement in the relationship between teacher and digital support and learner satisfaction in blended learning environments at higher education. *British Educational Research Journal*, 51, 1313-1341. <https://doi.org/10.1002/berj.4123>
- Kok, F., & Duman, B. (2023). The effect of problem-based learning on problem-solving skills in English language teaching. *Journal of Pedagogical Research*. <https://doi.org/10.33902/JPR.202318642>
- Li, J., & Xue, E. (2023). Dynamic interaction between student learning behaviour and learning environment: Meta-analysis of student engagement and its influencing factors. *Behavioral Sciences*, 13(1), Article 59. <https://doi.org/10.3390/bs1301059>
- Lynn, H., Mathew, R., & Nadin, B. (2025). Social opportunities, learning practices, and performance in metaverse and virtual world: A comparative scoping review in higher education. *Computers & Education*, 239, Article 105391. <https://doi.org/10.1016/j.compedu.2025.105391>
- Martin, F., & Bolliger, D. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online Learning*, 22(1), 205-222.
- Miao, J., & Ma, L. (2022). Students' online interaction, self-regulation, and learning engagement in higher education: The importance of social presence to online learning. *Frontiers in Psychology*, 13, Article 815220. <https://doi.org/10.3389/fpsyg.2022.815220>
- Moore, M. G. (1989). Three types of interaction. *American Journal of Distance Education*, 3(2), 1-7. <https://doi.org/10.1080/08923648909526659>
- Ooi, K. (2013). TQM practices, knowledge sharing and innovation performance. *Journal of Manufacturing Technology Management*, 24(6), 1013-1035. <https://doi.org/10.1108/JMTM-09-2012-0096>
- Piaget, J. (1972). *The psychology of the child*. Basic Books.

- Rasheed, R., Kamsin, A., & Abdullah, N. (2020). Challenges in the online component of blended learning. *Computers & Education*, 144, Article 103701. <https://doi.org/10.1016/j.compedu.2019.103701>
- Raykov, T. (1997). Estimation of composite reliability for congeneric measures. *Applied Psychological Measurement*, 21(2), 173-184. <https://doi.org/10.1177/01466216970212006>
- Redmond, P., Abawi, L., Brown, A., & Henderson, R. (2018). An online engagement framework. *Online Learning Journal*, 22(1), 183-204.
- Richardson, J., Caskurlu, S., & Lv, J. (2017). Social presence in relation to students' satisfaction and learning in the online environment: A meta-analysis. *Computers in Human Behavior*, 72, 402-417. <https://doi.org/10.1016/j.chb.2017.02.001>
- Rusmin, L., Misrahayu, Y., Pongpalilu, F., Radiansyah, R., & Dwiyanto, D. (2024). Critical thinking and problem-solving skills in the 21st century. *Journal of Social Science*, 1, 144-162. <https://doi.org/10.59613/svhy3576>
- Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill-building approach (7th ed.)*. Wiley.
- Selwyn, N. (2016). *Education and technology: Key issues and debates*. Bloomsbury.
- Tiruneh, D., Verburch, A., & Elen, J. (2014). Effectiveness of critical thinking instruction in higher education: A systematic review of intervention studies. *Higher Education Studies*, 4(1), 1-1. <https://doi.org/10.5539/hes.v4n1p1>
- UNESCO. (2020). Myanmar education response to COVID-19. UNESCO.
- Vygotsky, L. (1978). *Mind in society*. Harvard University Press.
- Wang, M., Mohd, M., & Rosli, R. (2025). A systematic literature review on analytical thinking development in mathematics education: Trends across time and countries. *Frontiers in Psychology*, 16, Article 1523836. <https://doi.org/10.3389/fpsyg.2025.1523836>
- World Bank. (2021). Myanmar: Education sector overview. World Bank.
- Zhu, C. (2012). Student satisfaction, performance, and knowledge construction. *Educational Technology & Society*, 15(3), 127-136.