

The Mediating Role of Learning Motivation in the Relationship Between Online Learning Environment and Cognitive Engagement Among Open and Distance Learning (ODL) Students in Selangor

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ABSTRACT

The rapid development of digital technology has transformed higher education and increased the importance of Open and Distance Learning (ODL). However, the effectiveness of online learning depends not only on the availability of digital platforms but also on the quality of the learning environment and students' willingness to invest mental effort in their studies. This study examines the relationships between Technology Support, Learning Accessibility, Interaction and Communication, Learning Motivation, and Cognitive Engagement among ODL students in Selangor. It also investigates whether Learning Motivation mediates the relationships between the three dimensions of the online learning environment and Cognitive Engagement. A quantitative cross-sectional design was adopted, and data were collected through a structured online questionnaire. A total of 297 completed responses were included in the analysis. Descriptive statistics, reliability analysis, Pearson correlation, multiple regression, and regression-based mediation analysis using PROCESS Macro Model 4 with 5,000 bootstrap resamples were conducted. All seven direct relationships were positive and statistically significant at $p < .001$. The regression model explained 79.3% of the variance in Cognitive Engagement. Learning Motivation partially mediated the effects of Technology Support, Learning Accessibility, and Interaction and Communication on Cognitive Engagement. The findings show that effective ODL requires reliable technology, accessible resources, meaningful interaction, and strong motivational support. These factors operate together to encourage students to participate more deeply in their learning activities.

Keywords: Online Learning Environment, Learning Motivation, Cognitive Engagement, Open and Distance Learning, Technology Support, Learning Accessibility

INTRODUCTION

The growth of online and distance education has changed the way higher education institutions deliver learning opportunities. Through ODL, students can access course materials, attend virtual classes, communicate with lecturers, and complete academic activities without being physically present on campus. This flexibility is particularly important for students who need to balance academic study with employment, family responsibilities, and other personal commitments. Nevertheless, flexibility alone does not guarantee a meaningful learning experience. Students still require a learning environment that enables them to access information, receive support, communicate effectively, and remain motivated throughout their studies. The growth of online and distance education has changed the way higher education institutions deliver learning opportunities. Through ODL, students can access course materials, attend virtual classes, communicate with lecturers, and complete academic activities without being physically present on campus. This flexibility is particularly important for students who need to balance academic study with employment, family responsibilities, and other personal commitments. Nevertheless, flexibility alone does not guarantee a meaningful learning experience. Students still require a learning environment that enables them to access information, receive support, communicate effectively, and remain motivated throughout their studies.

Cognitive Engagement is an important outcome in the present study because it reflects the mental effort students invest in understanding learning materials, concentrating on academic tasks, connecting new information with prior knowledge, and applying deeper learning strategies. Students may have access to online classes and materials but still experience difficulties in sustaining attention and effort. Therefore, identifying the conditions that support Cognitive Engagement is important for improving the quality of ODL.

The present study focuses on three dimensions of the online learning environment: Technology Support, Learning Accessibility, and Interaction and Communication. These dimensions were examined because they represent important features of students' everyday ODL experience. The study also positions Learning Motivation as a key psychological mechanism that may explain how a supportive online learning environment contributes to stronger Cognitive Engagement.

Research Objectives and Hypotheses

The study was guided by ten research objectives and corresponding hypotheses. RO1 to RO3 examined the relationships between Technology Support, Learning Accessibility, Interaction and Communication, and Cognitive Engagement. RO4 to RO6 examined the relationships between these three dimensions and Learning Motivation. RO7 examined the relationship between Learning Motivation and Cognitive Engagement. RO8 to RO10 examined whether Learning Motivation mediated the relationships between each online learning environment dimension and Cognitive Engagement.

Hypothesis	Statement
H1	Technology Support has a significant positive relationship with Cognitive Engagement among ODL students in Selangor.
H2	Learning Accessibility has a significant positive relationship with Cognitive Engagement among ODL students in Selangor.
H3	Interaction and Communication has a significant positive relationship with Cognitive Engagement among ODL students in Selangor.
H4	Technology Support has a significant positive relationship with Learning Motivation among ODL students in Selangor.
H5	Learning Accessibility has a significant positive relationship with Learning Motivation among ODL students in Selangor.
H6	Interaction and Communication has a significant positive relationship with Learning Motivation among ODL students in Selangor.
H7	Learning Motivation has a significant positive relationship with Cognitive Engagement among ODL students in Selangor.
H8	Learning Motivation significantly mediates the relationship between Technology Support and Cognitive Engagement.
H9	Learning Motivation significantly mediates the relationship between Learning Accessibility

	and Cognitive Engagement.
H10	Learning Motivation significantly mediates the relationship between Interaction and Communication and Cognitive Engagement.

These hypotheses form an integrated framework in which environmental conditions are expected to influence Cognitive Engagement directly and indirectly through Learning Motivation.

LITERATURE REVIEW

The study is conceptually supported by Self-Determination Theory (Deci & Ryan, 2000), which emphasizes the importance of psychological conditions that encourage self-directed and sustained behaviour. In an educational context, students are more likely to demonstrate strong motivation when their learning environment supports competence, autonomy, and relatedness. These needs are relevant to ODL because students often manage a substantial part of their learning independently while relying on technology and digital communication.

Cognitive Engagement is an individual's effort in understanding complex ideas or mastering a difficult skill through engagement in higher-order cognitive processes. It involves deep learning methods such as critical thinking, problem solving, metacognition, and self-regulated learning (Xie et al., 2020; Reeve, 2022). An online learning environment is defined as the virtual atmosphere within which teaching and learning are performed especially through the internet. It includes elements such as structure and other materials used for learning and interaction within that environment. In terms of higher education and open distance learning, it is essential in creating a suitable experience and achievement for students because it enables students to interact effectively within the learning environment through access, communication, and application. A good online learning environment creates the basis for Cognitive Engagement of students in learning processes (Deci & Ryan, 2000).

These include Technology Support, Learning Accessibility, and Interaction & Communication.

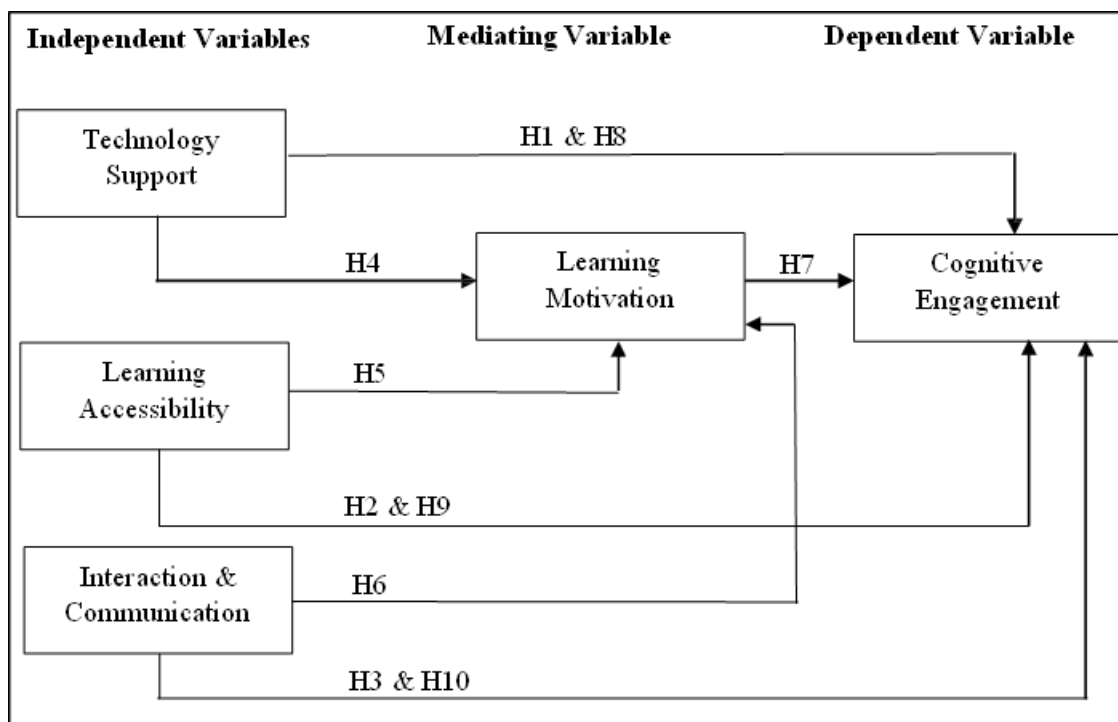
Technology Support may strengthen competence by helping students use online platforms effectively and by reducing disruptions caused by technical problems. It refers to students' access to reliable technology and adequate technological assistance. Such technologies include learning management systems, video conferencing technologies, proper internet connection, appropriate technological gadgets, and technological support services. These all provide the basic infrastructures for how online education can be provided ((Almaiah et al., 2020; Martin & Bolliger, 2021, Nik Roseli et al.,2023). Learning Accessibility may support autonomy because students can access materials and organize their study activities according to their own schedules. Using technology in the classroom increases student accomplishment, fosters engagement, and shortens the time needed for different parts of teaching and learning (Rahman et al., 2023). Learning Accessibility is defined by how readily students are able to access learning materials within the online learning platform. The materials accessed can be lecture notes, recordings of lectures, e-books, reading materials, and other resources. Accessibility does not only mean availability of learning materials but also clear organization of the materials in a way such that it is easily locatable and usable by the students (Dhawan, 2020; Al-Azawei et al., 2016). Interaction and Communication may support relatedness by allowing students to communicate with lecturers and peers, obtain feedback, and participate in academic discussions. In online learning, Interaction & Communication encompass the ways in which students interact with instructors and other class participants streamline to through digital communication channels. This interaction can be synchronous by holding live lecture classes, participating in live discussions, and conducting video conferencing classes or asynchronous through discussion forums, emails, and recorded messages. The strength of synchronous communication is that it provides instant feedback while that of asynchronous communication is that it provides flexibility (Hrastinski, 2008; Nair and Nesamany, 2021).

Based on this perspective, a supportive online learning environment is expected to contribute to stronger Learning Motivation. Motivated students are then more likely to invest effort, persist with difficult tasks,

and become cognitively engaged. Learning Motivation refers to the internal and external influences that make students participate in the process of learning. It serves as an intermediate variable that mediates the effect of the online learning environment on students' outcomes, including Cognitive Engagement and achievement (Deci & Ryan, 2000; Chiu, 2021, Hartnett et al. 2011). Learning Motivation can be subdivided into intrinsic and extrinsic motivation. According to scholars, intrinsic motivation is defined as the engagement in the process of learning due to inner forces, as an example interest, satisfaction, curiosity, or personal benefit gained throughout the process of learning. Intrinsic motivation is a key factor that contributes to making one understand something and think critically about it. Intrinsic motivation is connected to the basic needs for autonomy and competence that are discussed in Self-Determination Theory by Deci & Ryan (2000), Hartnett (2016).

The proposed framework at Figure 1 below recognizes both direct effects of the learning environment and indirect effects through Learning Motivation.

Figure 1 : Proposed Conceptual Framework



METHODOLOGY

This study employed a quantitative cross-sectional research design. The research focused on ODL students residing in Selangor who had experience participating in online learning. Data were collected through an online questionnaire, and convenience sampling was used to obtain respondents. A total of 297 completed questionnaires were included in the final analysis. All collected responses were usable because no incomplete or invalid questionnaires were reported. This study employed a quantitative cross-sectional research design. The research focused on ODL students residing in Selangor who had experience participating in online learning. Data were collected through an online questionnaire, and convenience sampling was used to obtain respondents. A total of 297 completed questionnaires were included in the final analysis. All collected responses were usable because no incomplete or invalid questionnaires were reported.

The questionnaire measured five constructs: Technology Support, Interaction and Communication, Learning Accessibility, Learning Motivation, and Cognitive Engagement. Each construct consisted of seven items, resulting in 35 measurement items. Respondents also provided demographic information. Composite scores for the five constructs were used in the subsequent analyses. The questionnaire measured five constructs: Technology Support, Interaction and Communication, Learning Accessibility, Learning Motivation, and

Cognitive Engagement. Each construct consisted of seven items, resulting in 35 measurement items. Respondents also provided demographic information. Composite scores for the five constructs were used in the subsequent analyses. IBM SPSS Statistics Version 27 was used to conduct descriptive analysis, reliability analysis, Pearson correlation analysis, and regression analysis. Mediation analysis was conducted using PROCESS Macro Model 4 with 5,000 bootstrap resamples. A 95% bootstrap confidence interval was used to determine the significance of each indirect effect. An indirect effect was considered significant when the confidence interval did not include zero.

Descriptive And Reliability Findings

Descriptive analysis was conducted to determine the overall level of each construct among the 297 respondents. The results showed that all five constructs recorded relatively high mean scores.

Construct	N	Minimum	Maximum	Mean	SD
Technology Support	297	1.71	4.71	3.923	0.775
Interaction & Communication	297	2.00	4.57	3.899	0.769
Learning Accessibility	297	1.71	4.71	3.915	0.801
Learning Motivation	297	1.86	4.71	3.852	0.770
Cognitive Engagement	297	1.86	5.00	3.873	0.799

Technology Support recorded the highest mean score, followed closely by Learning Accessibility and Interaction and Communication. Learning Motivation recorded the lowest mean score, although the value remained relatively high. The small differences among the means suggest that respondents generally perceived their online learning environment positively and reported favorable levels of motivation and Cognitive Engagement.

Reliability analysis showed that all five constructs had good internal consistency.

Construct	Cronbach's Alpha	Items	Interpretation
Technology Support	0.818	7	Good
Interaction & Communication	0.804	7	Good
Learning Accessibility	0.828	7	Good
Learning Motivation	0.826	7	Good
Cognitive Engagement	0.849	7	Good
Overall Instrument	0.960	35	Excellent

All construct-level Cronbach's Alpha values were above 0.80, while the overall instrument recorded an Alpha value of 0.960. These results indicate that the measurement items were sufficiently reliable for further statistical analysis.

Correlation Analysis

Pearson correlation analysis was used to examine the relationships specified in RO1 to RO7. The results showed that all relationships were strong, positive, and statistically significant at $p < .001$.

Relationship	r	p-value	Decision
Technology Support and Cognitive Engagement	0.858	< .001	H1 Accepted
Learning Accessibility and Cognitive Engagement	0.837	< .001	H2 Accepted
Interaction & Communication and Cognitive Engagement	0.814	< .001	H3 Accepted
Technology Support and Learning Motivation	0.836	< .001	H4 Accepted
Learning Accessibility and Learning Motivation	0.845	< .001	H5 Accepted
Interaction & Communication and Learning Motivation	0.841	< .001	H6 Accepted
Learning Motivation and Cognitive Engagement	0.827	< .001	H7 Accepted

Technology Support had the strongest relationship with Cognitive Engagement, whereas Learning Accessibility had the strongest relationship with Learning Motivation. Overall, the results indicate that students who experience better technological support, easier access to learning resources, and more effective communication are more likely to report higher levels of motivation and deeper cognitive involvement.

Multiple Regression Analysis

A multiple regression analysis was conducted to examine the combined contribution of Technology Support, Learning Accessibility, Interaction and Communication, and Learning Motivation to Cognitive Engagement.

R	R ²	Adjusted R ²	Std. Error
0.890	0.793	0.790	0.366

The model explained 79.3% of the variance in Cognitive Engagement. This indicates that the predictors included in the model collectively provided substantial explanatory power.

Predictor	B	Beta	t	Sig.	VIF
Technology Support	0.397	0.385	6.418	< .001	5.066
Learning Accessibility	0.226	0.227	3.732	< .001	5.185
Interaction & Communication	0.113	0.109	1.845	0.066	4.878
Learning Motivation	0.231	0.223	3.868	< .001	4.668

Technology Support was the strongest unique predictor of Cognitive Engagement. Learning Accessibility and Learning Motivation also made statistically significant contributions. Interaction and Communication

remained positively associated with Cognitive Engagement, but its unique contribution was not statistically significant after the other predictors were considered simultaneously. This result should not be interpreted as evidence that interaction is unimportant, because its bivariate relationship with Cognitive Engagement remained strong.

Mediation Analysis

Mediation analysis was performed to determine whether Learning Motivation explained part of the relationship between each online learning environment dimension and Cognitive Engagement. The significance of the indirect effects was evaluated using 5,000 bootstrap resamples and 95% confidence intervals.

Independent Variable	Path a	Path b	Total c	Direct c'	Indirect Effect	95% CI	Conclusion
Technology Support	0.831	0.380	0.884	0.568	0.316	[0.204, 0.429]	Partial mediation
Learning Accessibility	0.814	0.436	0.835	0.480	0.354	[0.249, 0.469]	Partial mediation
Interaction & Communication	0.842	0.506	0.845	0.419	0.426	[0.306, 0.563]	Partial mediation

Learning Motivation significantly mediated the relationship between Technology Support and Cognitive Engagement because the indirect effect was 0.316 and the 95% bootstrap confidence interval did not include zero. The direct effect remained significant after Learning Motivation was included, indicating partial mediation.

Learning Motivation also partially mediated the relationship between Learning Accessibility and Cognitive Engagement. The indirect effect was 0.354, and the 95% confidence interval ranged from 0.249 to 0.469. Similarly, the indirect effect for Interaction and Communication was 0.426, with a confidence interval from 0.306 to 0.563. This was the strongest of the three indirect effects.

DISCUSSION

The findings demonstrate that Technology Support is closely related to Cognitive Engagement. Students who experience reliable systems, useful digital tools, and effective technical assistance may be better able to focus on academic tasks because fewer technological disruptions interfere with the learning process. The regression findings further show that Technology Support made the strongest unique contribution to Cognitive Engagement.

Learning Accessibility was also strongly related to Cognitive Engagement and remained a significant predictor in the regression model. The availability of recorded lectures, online resources, and well-organized materials may allow students to revisit difficult topics and manage their study time more effectively. This flexibility is particularly relevant to ODL students who may need to balance learning with work and other responsibilities.

Interaction and Communication showed a strong positive correlation with Cognitive Engagement. Regular communication, feedback, peer discussion, and collaboration may help students clarify ideas and develop a stronger connection with the learning process. Although its unique regression effect was not significant when the other predictors were entered together, the overall findings show that interaction remains meaningfully associated with engagement and motivation.

All three dimensions of the online learning environment were strongly and positively related to Learning Motivation. The strongest relationship was observed between Learning Accessibility and Learning

Motivation, followed closely by Interaction and Communication and Technology Support. These findings suggest that students are more likely to remain motivated when they can access learning materials conveniently, communicate effectively with others, and use reliable technological systems. Learning Motivation also had a strong positive relationship with Cognitive Engagement. Students who are motivated to learn may be more willing to concentrate, persist when learning becomes difficult, and invest additional effort in understanding course content. The relationship therefore highlights motivation as an important condition for deeper involvement in ODL. The mediation findings provide further support for this interpretation. Learning Motivation partially explained how Technology Support, Learning Accessibility, and Interaction and Communication were related to Cognitive Engagement. The partial mediation results show that environmental conditions can influence engagement directly while also strengthening engagement indirectly by increasing students' motivation.

Theoretical And Practical Implications

Theoretically, the study supports the proposed framework linking the online learning environment, Learning Motivation, and Cognitive Engagement. The results are consistent with the general perspective that supportive learning conditions can encourage students to become more motivated and subsequently more engaged. The findings also show that motivation is an important explanatory mechanism, although it does not completely account for the relationship between the learning environment and Cognitive Engagement. Practically, higher education institutions should ensure that online platforms are reliable and that technical assistance is available when students experience difficulties. Learning resources should be clearly organized and accessible so that students can study flexibly. Lecturers should also maintain meaningful communication with students, provide constructive feedback, and create opportunities for discussion and collaboration. Institutions should not treat technological support, accessibility, communication, and motivation as separate concerns. The results suggest that these factors operate together. Improvements in the online learning environment may therefore have both direct benefits for Cognitive Engagement and indirect benefits by strengthening students' willingness to participate and persist in their studies.

Summary Of Hypotheses

Hypothesis	Finding	Decision
H1	$r = 0.858, p < .001$	Accepted
H2	$r = 0.837, p < .001$	Accepted
H3	$r = 0.814, p < .001$	Accepted
H4	$r = 0.836, p < .001$	Accepted
H5	$r = 0.845, p < .001$	Accepted
H6	$r = 0.841, p < .001$	Accepted
H7	$r = 0.827, p < .001$	Accepted
H8	Indirect effect = 0.316, 95% CI [0.204, 0.429]	Accepted; Partial mediation
H9	Indirect effect = 0.354, 95% CI [0.249, 0.469]	Accepted; Partial mediation
H10	Indirect effect = 0.426, 95% CI [0.306, 0.563]	Accepted; Partial mediation

All ten hypotheses were supported. The findings consistently demonstrate that the three dimensions of the online learning environment are positively associated with both Learning Motivation and Cognitive Engagement. In addition, Learning Motivation significantly mediates each proposed relationship between the online learning environment and Cognitive Engagement.

LIMITATIONS AND FUTURE RESEARCH

The findings should be interpreted in light of several limitations. First, the cross-sectional design captures respondents' perceptions at one point in time and does not examine how motivation or engagement changes over time. Second, the study was limited to ODL students residing in Selangor, which may restrict the generalizability of the findings to other populations and settings. Third, convenience sampling may limit the representativeness of the sample. The study also focused on Technology Support, Learning Accessibility, Interaction and Communication, Learning Motivation, and Cognitive Engagement. Other variables that may contribute to online learning outcomes were outside the scope of the present research. Future studies may therefore examine additional factors and test a broader explanatory model. Future research could include respondents from different states or institutions, compare groups of students, and use longitudinal designs to examine changes over time. Qualitative or mixed-method approaches could also provide a deeper understanding of how students experience online learning conditions and how those experiences influence their motivation and engagement.

CONCLUSION

This study examined the determinants of Cognitive Engagement among 297 ODL students in Selangor by focusing on Technology Support, Learning Accessibility, Interaction and Communication, and Learning Motivation. The results showed that all three dimensions of the online learning environment were strongly and positively related to Cognitive Engagement and Learning Motivation. Learning Motivation was also strongly related to Cognitive Engagement. The regression findings showed that Technology Support was the strongest unique predictor of Cognitive Engagement, while Learning Accessibility and Learning Motivation also made significant contributions. The mediation findings confirmed that Learning Motivation partially mediated all three relationships between the online learning environment dimensions and Cognitive Engagement. Overall, the findings show that effective ODL depends on more than providing online access. Students need dependable technology, accessible learning materials, meaningful communication, and conditions that sustain motivation. When these elements are strengthened together, students may be better positioned to invest the attention, effort, and deeper mental processing that characterize Cognitive Engagement.

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