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ONLINE ENGAGEMENT REVISITED USING CONNECTIVISM THEORY

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Abstract:

Studies on online learning have gone beyond its benefits and drawbacks. This is because many higher institutions are using online learning as part of the learning mode. Many institutions are now using mixed mode (traditional face-to-face and online classes) to impart knowledge to their students. So, when it comes to online classes, the concern is -how are the students engaging in the lessons? This study combines the engagement theory and the theory of connectivism to explore their connections. The study used existing theories to test the model for connectedness in online learning. 100 respondents were conveniently chosen to participate in this study. The instrument used for data collection is the constructs of engagements by Redmond et al. (2018). Data was analyzed using SmartPLS to confirm relationships among variables and to form a model of connectedness. The result of this study reveals the proposed connectivism model for online learning. Findings revealed that there are significant relationships between connectivism and diversity, openness, connectedness, and autonomy. The findings showed there are larger effects of all variables tested. Further tests reveal the goodness of the predicted model. Results of this study bear an interesting theoretical, conceptual, and practical framework for connectedness in online classes.

Keyword:

Autonomy, Connectedness, Diversity, Online Engagement, Openness, PLS-SEM



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Introduction

Connections in the classroom foster learning success. Learners need to have strong connections with their learning tasks to achieve overall success. Siemens (2004) introduced the theory of connectivism to emphasize the need for different levels of connections in classroom learning. Siemens' (2004) theory of connectivism emphasizes learning through bridging. This involves the learners connecting with the instructors, with their peers, and also with the materials. That is why it is encouraged to include active learning in the classroom.

Post-COVID online learning experiences have shown that online learning is fast becoming the mode of learning. More educators are depending on online learning instruction. At the same time, more learners are choosing online courses over face-to-classes because of convenience. With these changes, some are bringing up the issues of connections and engagement in online classes.

Nevertheless, from the learners' point of view, online learning has given them many forms of connections that the traditional face-to-face mode may not be able to offer. Whether the class is synchronous or asynchronous, learners who attended online classes depended on the recorded class. Especially for difficult topics (step-by-step topics), the recorded class helps learners review the class at their own pace. They have the luxury to rewind sections of the instructions that they were not sure of (which may or may not be convenient in a face-to-face class). How many times can we ask the instructor to repeat certain sections of the class?

Are online learners connecting enough in terms of connectedness? Connectivism in the classroom involves a shift from passive learning to a model where learning takes place via networks and collaboration. According to Siemens (2005), connectivism is a learning theory that states that knowledge is dispersed across the internet and that learning is done through different ways across the network. There are several principles involved in this theory.

The first principle is connectedness, and this principle emphasizes connectedness through physical, emotional, and social connections. The second principle is openness, and this refers to the free flow of information that learners are exposed to. The third principle is diversity, and this refers to the recognition of a variety of information and knowledge. The information and knowledge are presented from a diverse set of perspectives. The fourth principle is autonomy. The availability of a variety of information gives learners the capacity to be self-directed in their learning. They can choose their own knowledge paths and make their own decisions on their knowledge construction.

With reference to connectedness, according to Leino et al. (2024), teachers' connectedness was a significant and positive predictor of online learning self-efficacy. Instructors' connectedness with students has been recognized as a key factor in learning.

Nevertheless, when it comes to the online learning environment, there is a worry that students may feel disconnected and isolated (Brown, 2023). The students may feel they lack attention in online learning settings. Online classrooms can end up making the participants disconnected. This is because online environments fail to offer students hands-on, face-to-face, or even physical space.

This study is therefore carried out to investigate whether online learning engagement complies with the concept of connectivism in learning by Siemens (2005). This study is guided by five research objectives, questions, and a research hypothesis.

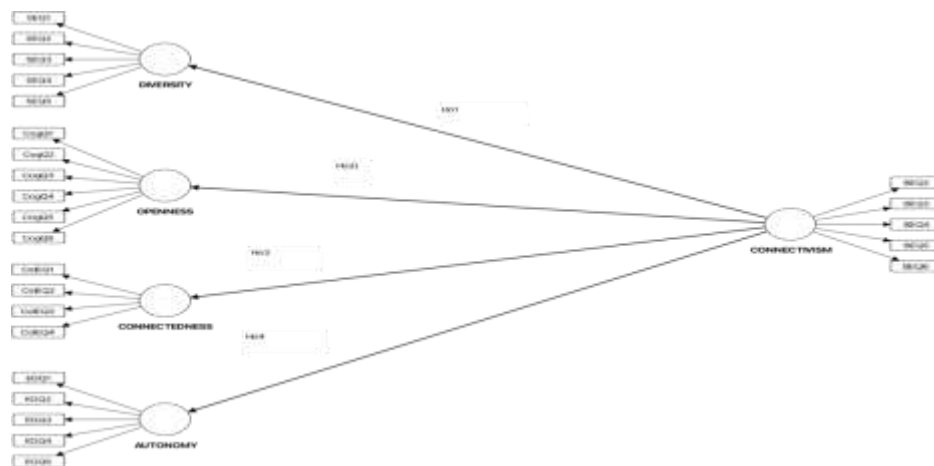


Figure 1- Framework Indicating Research Hypotheses (H01-03)

Research Objectives, Research Questions and Hypotheses,

RO1-To determine the relationship between connectivism and diversity

RQ1- Is there a significant relationship between connectivism and diversity?

H01-There is no significant relationship between connectivism and diversity

RO2: To determine the relationship between connectivism and openness

RQ2- Is there a significant relationship between connectivism and openness?

H02- There is no significant relationship between connectivism and openness

RO3-To determine the relationship between connectivism and connectedness

RQ3- Is there a significant relationship between connectivism and connectedness?

H03- There is no significant relationship between connectivism and connectedness

RO4-To determine the relationship between connectivism and autonomy

RQ4- Is there a significant relationship between connectivism and autonomy?

H04- There is no significant relationship between connectivism and autonomy

RO5- To determine whether there is a significant effect of connectivism on diversity, openness, connectedness, and autonomy.

RQ5-Is there a significant effect of connectivism on diversity, openness, connectedness, and autonomy?

H05- There is no significant effect of connectivism on diversity, openness, connectedness, and autonomy

Literature Review

This section presents an overview of the (a) theoretical framework of the study, (b) past studies, and (c) conceptual framework of the study.

Theoretical Framework of the Study

Theories are needed in research as they provide the foundation for understanding a phenomenon. Theories provide guidance towards the research process, as well all add new insights. Theories are helpful towards the formation of the conceptual framework of the study as they help researchers explain the relationships between variables, make predictions, and structure the research journey. Theories give meaning and direction to research. They allow for the synthesis of existing knowledge and probably the identification of unexplored areas for further studies. This section presents the theories of connectivism, online engagement, and engagement theory.

Connectivism Theory and Online Engagement

Before the influx of online learning, the education world had already been used to non-face-to-face modes of study such as distance education, e-learning, or even blended classroom modes. People learned to turn to non-face-to-face learning modes for their convenience. Siemens (2005) introduced connectivism for the digital age. The theory of connectivism emphasizes the need for connectedness, openness, and diversity in online learning. This theory accepts technology as the environment for learning. Siemens (2005) states that there should be a striving for connectedness in learning.

Each factor in connectivism can mirror engagement in an online environment in several ways. Firstly, connectedness refers to the feeling of being socially, emotionally, and even spiritually linked to others. In online learning, connectedness can be achieved through social engagement. The next factor in connectivism is openness, which refers to the learners' ability to engage in diverse information and ideas within networks. In the context of online learning, openness is achieved through cognitive engagement, where learners learn to integrate ideas, justify decisions, and even develop deep discipline and understanding by accessing information outside the lesson's scope. The next factor in connectivism is diversity. Diversity in connectivism is promoted through networked learning, synthesis of ideas, and participation in learning. In the context of online learning, this is achieved through behavioural and collaborative engagement. The last factor in connectivism is autonomy, and this refers to the learners' self-direction and capacity to be in charge of their own learning. In the context of online learning, this refers to. The learners' ability to manage their expectations, recognize their own motivations, and be committed to learning through emotional engagement.

Engagement Theory

One of the many concerns for online learning is engagement. From the standpoint of the learners, the main worry is that they could not engage themselves in the learning. Kahn (1990) states in his engagement theory that successful engagement requires three dimensions: physical, cognitive, and emotional engagement. His theory was initially intended for work situations. In the context of online learning (or even face-to-face learning), learners need to feel physically, cognitively, and also emotionally engaged.

One main worry when it comes to online learning is the absence of physical engagement. Even in online learning, learners can feel physically engaged if they have access to the learning materials as they learn. According to Limbu & McKinley (2025), many online learning instructors make sure the learners are given (or have access to) learning materials before the online lesson. Well-designed course materials can facilitate learning. Coupled with well-planned learning activities, the learning materials can become a useful learning tool, even in the online mode.

Next, cognitive engagement is important for online learning. Cognitive engagement refers to the intellectual engagement that takes place during the learning process. This is a key factor in learning where learners utilize their mental effort, strategies, and motivation to make sense of their own learning. Limbu & McKinley (2025) state that the most prevalent factors associated with learning engagement are student-related factors such as student efficacy and attitude towards learning. Similar findings were reported by Hu and Xiao (2025), who mentioned that for online learning engagement to be successful, learners need to have motivation, digital experience, and literacy, even positive emotions towards the learning activities. They also need to use regulatory strategies such as self-directed learning to be able to have cognitive engagement in the online learning experience.

Lastly, emotional engagement is needed in online learning, so learners stay focused. Limbu & McKinley (2025) suggest that students need motivation in order to be successful in their learning. When they are motivated, they would make the best of the learning tasks to maximize understanding. In addition to that, Hu and Xiao (2025) add that learners' perspectives towards their learning improve when they are motivated in the learning process. Learners' emotional engagement is gained from their motivation to improve their learning success.

Past Studies on Online Engagement

Through online engagement, learners gain more than the contents of the intended lesson. Collaborative activities encouraged connectedness. The interaction also stimulates openness among learners. Learning to accept the opinions of others lets students embrace the diversity of knowledge. Shared knowledge enables learners to gain autonomy over their own learning. The study by Leino et.al (2024) investigated how lecturers' connectedness influences students' learning experience of online learning. This study investigated different forms of connectedness that influence lecturers' self-efficacy in the online teaching environment. 252 lecturers from UK and Swiss universities participated in this study. Data was collected via an online survey. Data was analyzed using multiple regressions. Findings showed that connectedness was a significant and positive predictor of online teaching self-efficacy.

A quantitative study was done by Conklin et.al. (2024) to investigate the relationships among student-instructor connectedness, learners' anxiety, and motivation in online higher education institutions. The instrument in the study is the Student-Instructor Relationship Scale, containing 36 items. 472 students responded to the questionnaire. Findings revealed that there are significant relationships between all the dependent variables: connectedness, anxiety, and motivation. The results showed that students with a higher connectedness to the instructor showed higher motivation and lower anxiety levels. Results also indicated that students with higher anxiety levels were more likely to have lower motivation levels. Lastly, students perceived a lower level of connectedness with male instructors.

Kennedy (2018) conducted a study to investigate connectedness in personal learning networks. The study explored how connectedness is apparent in personal learning networks. 6 doctoral students participated in this qualitative study. Data was collected from lived experience descriptions, think-aloud observations, and in-depth interviews. Findings revealed that connectedness is known to influence learners' motivation, learning, and identity.

The study by Mohammed et.al. (2024) looked at students' connectedness. 73 students participated in the study. The students are undergraduates who are studying Physics in University of Ilorin. The instrument used in this study is a questionnaire. Findings revealed that the students are highly connected to online learning. The respondents reported that they were particularly connected with their instructors. Nevertheless, the students reported that they preferred live interactions. They also would like more peer collaborations. Peer collaboration provides the participants with cognitive engagement. Discussions pushed participants to depend on their mental capacity to create meaning from the interactions. In the discussions, the participants learn to embrace the ideas and opinions of others, and this leads to openness in the learning.

Next, Dulfer et al. (2025) conducted a study to investigate the online learning experiences of twenty postgraduate students. This study also explores learners' online learning experiences pertaining to feelings of isolation or inclusion, and also aspects that helped them feel engaged. Findings also revealed interactions for variables such as learner-to-instructor interaction, learner-to-learner interaction and learner-to-content. The findings also showed that learners studying the course architecture and pedagogy had enabling connections with their instructors and also their peers. The planned group activities encouraged learners to share their opinions and also accept the opinions of others. The collaboration thus encourages a diversity of ideas and opinions to merge as new shared knowledge.

The study by Bergdahl (2022) looks at Swedish teachers' understanding of their students' online learning through an engagement model. The Mixed Method Grounded Theory study specifically explored online engagement and disengagement among their students. The study carried out an intervention. Data was collected from an interview-diary-interview method. 10 teachers were interviewed 20 times. They were chosen as they taught hybrid, remote or distance classes in K-12 education. Findings revealed that the teachers showed their understanding of macro and micro level of engagement. Findings showed that there were both engagement and disengagement factors that teachers need to pay attention to so that students can maximize learning. When students feel engaged with their learning, they gain autonomy over how they make their own meaning.

Next, Getenet et.al. (2024) carried out a study to investigate online engagement, digital technology attitude, digital literacy, and self-efficacy theories. This study used existing theories to test a model connecting these factors. The participants of the study are 100 first-year students in a regional university in Australia. The instrument used is a survey. The instrument contains constructs to measure the impact of students' attitudes and digital literacy on their self- efficacy. Data was analyzed using AMOS 28. Data was analyzed using the measurement and structural model path analysis. Findings revealed that positive students' attitudes and digital literacy significantly contributed to the self-efficacy of students. This attitude then positively affected their engagement dimensions.

The study by Zhong (2018) examined how learners connected in a collaborative activity in an asynchronous online discussion. This qualitative study also investigated how these online discussions fostered autonomy. Data was collected from postings from twenty students in a peer-moderated online forum. Data was analyzed using thematic analysis. Findings revealed that the sharing of knowledge in the forum deepened learners' understanding. The collaborative inquiry facilitated understanding. This understanding gave the learners autonomy over their own learning. The learners decide for themselves how much they need to absorb in the discussion and also how much they use what they already know.

Therefore, in online learning, the presence of different types of engagement allows learners to feel connected. Through this connection, learners experience diversity of opinions. The online interactions encourage openness when it comes to handling the diversity of ideas and opinions. Next, the discussions online provide learners with connectedness. Lastly, being allowed to communicate enables learners to gain autonomy over their won learning.

Conceptual Framework

Figure 2 below presents the conceptual framework of the study. The main anchor for this study is connectivism theory by Siemens (2005), and the theory is responsible for the formation of the main variables. In the context of this study, connectedness is the effect of four independent variables: diversity, openness, connectedness, and autonomy.

How is engagement achieved through connectivism? According to Redmond et al. (2018), there are three types of engagement in online learning. In the context of this study, openness is through the construct of cognitive engagement. Next, diversity is achieved through social engagement. Autonomy is achieved through the construct of emotional engagement. Openness is achieved through cognitive engagement. Connectedness is achieved through collaborative engagement. Lastly, behavioural engagement was used to indicate the construct for connectivism.

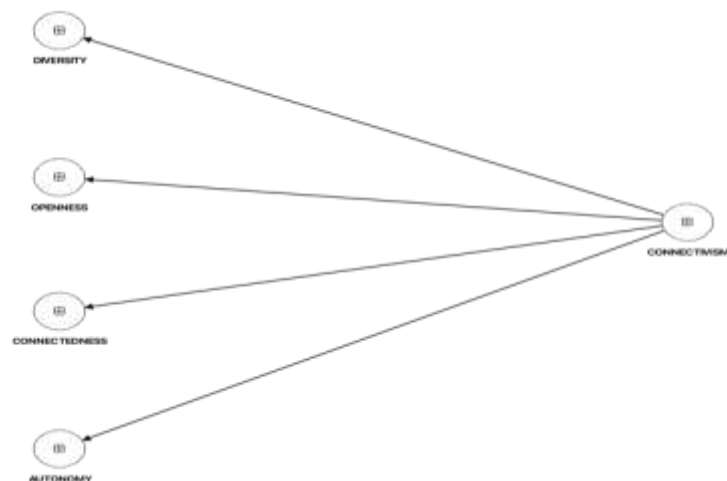


Figure 2-Conceptual Framework of the Study Exploring Connectivism in Online Engagement

Methodology

Research Design

This study employs a quantitative design. The research goal is to explore an extension of an existing theory. The model chosen for this study is that of a hierarchical component model, Type II, and uses the combination of reflective-reflective models. According to Fornell and Bookstein (1982), a reflective model is employed when the construct is a trait and explains the indicators.

With reference to Figure 3 below, the higher construct (HOC) is Connectedness with 5 items. This HOC comprises three lower-order constructs (LOC): Connectivism (5 items), Diversity (5 items), Openness (6 items), Connectedness (4 items), and Autonomy (5 items).

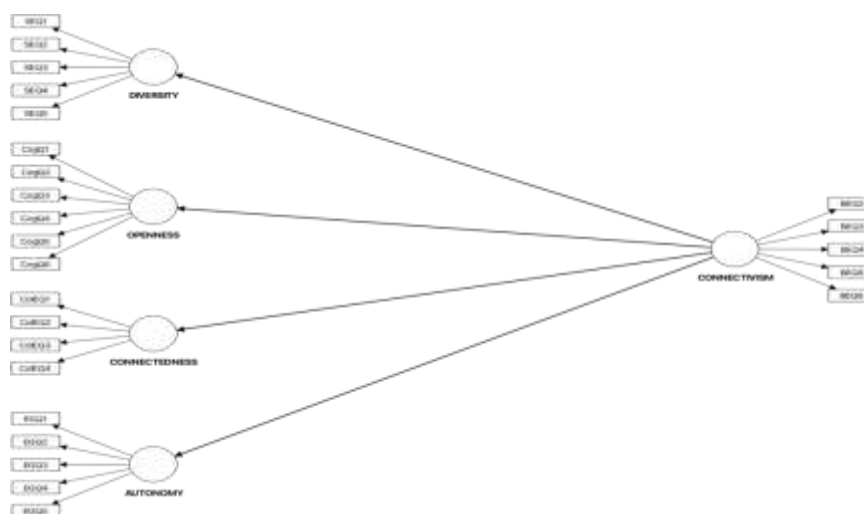


Figure 2- Type 3- Reflective-Reflective Model

Population and Sample

The demographic analysis is presented in percentages. According to Zienefuss et al. (2021), researchers report demographic data in percentages to establish sample representativeness and allow for generalizability to a larger population. Presenting in percentages also provides an overview of participants' characteristics and offers a clear and understandable picture of the sample makeup.

The population of the study is students who underwent online classes throughout the semester in a public university in Malaysia. The sample is 110 respondents who attended online classes for the whole semester. The sample size is in accordance with the minimum as stated by Boomsma (1982), which stated a minimum of 100 respondents for PLS-SEM.

With reference to Table 1, 28% of the participants are male, while 72% are female students. Next, 51% are from the Science & Technology cluster, while 49% attended the Social Sciences & Humanities.

Table 1- Percentage for Demographic Profile

Question	Demographic Profile	Categories	Percentage (%)
1	Gender	Male	28%
		Female	72%
2	Cluster	Science & Technology	51%
		Social Sciences & Humanities	49%

Instrument

The instrument (refer to Table 2) used is anchored from Siemens' (2005) connectivism as the variables, and using Redmond, et al. (2018) constructs of engagements. The instrument used a 5 Likert scale with scale 1 is strongly disagree, 2 is disagree, 3 is undecided, 4 is agree, and 5 is strongly agree. Connectedness is supported by the construct Social with 5 items. Next, Openness is supported by the construct of Cognitive with 6 items. Diversity is measured by the constructs. and Behavioural (6 items) and Collaborative (5 items). Finally, Autonomy is measured by the construct of emotion with 5 items.

Table 2- Distribution of Items in Questionnaire

SECTION	VARIABLE CONNECTIVISM (Siemens, 2005)	CONSTRUCT TYPE OF ENGAGEMENT (Redmond, et.al., 2018)	ITEM
	CONNECTIVISM	BEHAVIOURAL	5
B	DIVERSITY	SOCIAL	5
C	OPENNESS	COGNITIVE	6
D	CONNECTEDNESS	COLLABORATIVE	4
E	AUTONOMY	EMOTIONAL	5
		TOTAL ITMES	25

Data Collection and Data Analysis

Data is collected via a Google Form. The data is then analyzed using SmartPLS through two main stages. As suggested by Hair et al. (2017), data analysis is done at two levels: the measurement and structural model. The first stage is the measurement model, which measures the outer model. The second stage is the structural model, which measures the inner model. The analyzed data is used to answer the research questions and also to confirm the model chosen.

Findings

The findings are presented in two stages. The first stage involves the measurement model, and the second stage presents the structural model, as well as answers research questions 1 to 5.

Measurement Model

In SmartPLS, the measurement model (Figure 3) assesses the reliability and validity of the constructs. This is done by examining the relationships between them and their observable behavior. The measurement model measures the outer model.

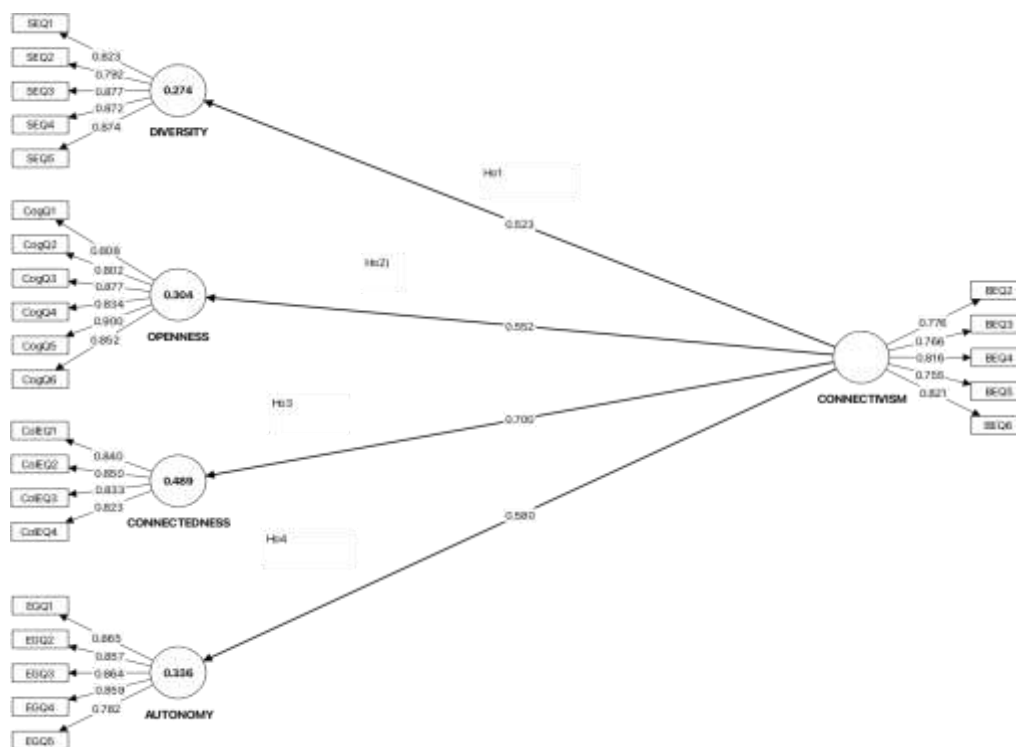


Figure 3- Measurement Model

Reliability

According to Ringle et al. (2024), reliability is assessed by checking indicator reliability and internal consistency reliability. Internal consistency is done using Composite reliability (ρ_c) and Cronbach's Alpha. The cut-off value for Cronbach's Alpha is 0.70 to 0.90. The cut-off values for composite reliability (ρ_c) are 0.70-0.90. For indicator reliability, the factor loadings cut-off values are >0.70 and squared loadings ≥ 0.50 . Finally, the cut-off values for Average Variance Extracted (AVE) are ≥ 0.50 .

Table 3 -Results for Reliability- Connectivism

CONSTRUCT/ ITEM	FACTOR LOADING	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (rho_c)	AVERAGE VARIANCE EXTRACTED (AVE)
		0.847	0.891	0.62
BEQ2	0.776			
BEQ3	0.766			
BEQ4	0.816			
BEQ5	0.755			
BEQ6	0.821			

Table 3 presents the reliability results for connectivism. Factor loading of all items was found to be between 0.755 and 0.8221. The loadings comply with the indicator reliability of more than 0.7. Next, the Cronbach's Alpha for connectedness is 0.902, the composite reliability is 0.891, and the AVE is 0.62.

Table 4 -Results for Reliability- Diversity

CONSTRUCT/ ITEM	FACTOR LOADING	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (rho_c)	AVERAGE VARIANCE EXTRACTED (AVE)
		0.902	0.928	0.72
SEQ1	0.823			
SEQ2	0.792			
SEQ3	0.877			
SEQ4	0.872			
SEQ5	0.874			

Table 4 presents the reliability results for the diversity. Factor loading of all items were found to be between 0.792 and 0.87. The loadings comply with the indicator reliability of more than 0.7. Next, the Cronbach's Alpha for connectedness is 0.92, composite reliability is 0.928 and AVE is 0.72.

Table 5 -Results for Reliability- Openness

CONSTRUCT/ ITEM	FACTOR LOADING	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (rho_c)	AVERAGE VARIANCE EXTRACTED (AVE)
		0.92	0.938	0.716
CogQ1	0.808			
CogQ2	0.802			
CogQ3	0.877			
CogQ4	0.834			
CogQ5	0.9			
CogQ6	0.852			

Table 5 presents the reliability results for openness. Factor loading of all items were found to be between 0.802 and 0.9. The loadings comply with the indicator reliability of more than 0.7. Next, The Cronbach's Alpha for connectedness is 0.92, composite reliability is 0.938 and AVE is 0.716.

Table 6 -Results for Reliability- Connectedness

CONSTRUCT/ ITEM	FACTOR LOADING	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (rho_c)	AVERAGE VARIANCE EXTRACTED (AVE)
		0.858	0.903	0.7
CoIEQ1	0.84			
CoIEQ2	0.85			
CoIEQ3	0.833			
CoIEQ4	0.823			

Table 6 presents the reliability results for the connectedness. Factor loading of all items was found to be between 0.823 and 0.85. The loadings comply with the indicator reliability of more than 0.7. Next, the Cronbach's Alpha for connectedness is 0.901, the composite reliability is 0.858, and AVE is 0.7.

Table 7 -Results for Reliability- Autonomy

CONSTRUCT/ ITEM	FACTOR LOADING	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (rho_c)	AVERAGE VARIANCE EXTRACTED (AVE)
		0.901	0.926	0.716
EGQ1	0.865			
EGQ2	0.857			
EGQ3	0.864			
EGQ4	0.859			
EGQ5	0.782			

Table 7 presents the reliability results for the autonomy. Factor loading of all items was found to be between 0.782 to 0.865. The loadings comply with the indicator reliability of more than 0.7. Next, the Cronbach's Alpha for connectedness is 0.901, the composite reliability is 0.901, and the AVE is 0.716.

Validity

According to Ramayah et.al. (2018), for validity, the Discriminant validity (HTMT) needs to be <0.85 or <0.90.

Table 8- Discriminant Validity (HTMT)

	AUTONO MY	CONNECTED NESS	CONNECTI VISM	DIVER SITY
CONNECTEDNESS	0.59			
CONNECTIVISM	0.65	0.806		
DIVERSITY	0.889	0.541	0.579	
OPENNESS	0.86	0.586	0.606	0.87

Table 8 presents the discriminant validity of the model. The HTMT for connectedness and autonomy is 0.889 and is therefore valid.

The HTMT for connectedness and autonomy is 0.59. The HTMT for Connectivism and autonomy is 0.65, for connectivism and connectedness of 0.806. Next, the HTMT for Diversity for Autonomy is 0.889, for Diversity and Connectedness 0.541, and for Diversity and Connectivism is 0.579. The HTMT for Openness and Autonomy is 0.86, for Openness and Connectedness is 0.586, for Openness and Connectivism is 0.696, and for Openness and Diversity is 0.87.

Structural Model

In SmartPLS, the structural model visualizes the hypothesized causal relationships between constructs. The structural model is thus formed after the researcher has established the reliability and validity in the measurement model. For the analysis of the structural model, the researcher runs bootstrapping and examines the collinearity, path coefficients of determination, effect size, PLS predict and IPMA. In addition to that, the analysis in the structural model allows the researcher to answer research questions and reject or accept 1-5 and hypotheses 1-5.

Collinearity

According to Ringle et.al (2024), the cut-off value for collinearity inner model VIF is ≤ 5.0 .

Table 9- Collinearity

	Original sample (O)
CONNECTIVISM -> AUTONOMY	1
CONNECTIVISM -> CONNECTEDNESS	1
CONNECTIVISM -> DIVERSITY	1
CONNECTIVISM -> OPENNESS	1

Table 9 above presents the collinearity results for this study. According to Ringle et al. (2024), the inner model VIF must be less than or equal to 5.0. All interactions met the threshold for Collinearity.

Coefficients Of Determination (R^2)

According to Ramayah et.al. (2018), for coefficients of determination (R^2) 0.2 to 0.7, depending on the field of study. Social Sciences & Economics follows the range above.

Table 10- R^2

	Original sample (O)
AUTONOMY	0.330
CONNECTEDNESS	0.485
DIVERSITY	0.267
OPENNESS	0.298

Table 10 shows the results for coefficients of determination (R^2). Results indicate that the R^2 for Autonomy 33%, for Connectedness is 49%, for Diversity is 27%, and for Openness is 30%.

P-Value**Table 11- Interpretation For P-Value**

Thresholds	Interpretation	Decision
$p \leq 0.05$	Often considered statistically significant	Reject H_0
$p \leq 0.01$	Indicates very strong evidence against H_0	Reject H_0
$p > 0.05$	Weak or no evidence against H_0	Fai to reject H_0

According to Goodman (1999), a threshold of p-value is the cut-off for determining statistical significance, most commonly set at 0.05. Below is the table that interprets the threshold. Table 11 shows the interpretation for p-value. According to Goodman (1999), if the p-value is $p \leq 0.05$, the data is often considered statistically significant, and the null hypothesis is rejected. If it is $p \leq 0.01$, then it indicates very strong evidence to reject the null hypothesis (H_0). However, a $p > 0.05$ is considered weak and there is no evidence to reject the null hypothesis.

Table 12-Path Coefficient for Current Study

	T statistics (O/STDEV)	P values
CONNECTIVISM -> AUTONOMY	10.045	0
CONNECTIVISM -> CONNECTEDNESS	12.787	0
CONNECTIVISM -> DIVERSITY	8.068	0
CONNECTIVISM -> OPENNESS	8.543	0

Table 12 presents data to answer research questions and hypotheses. Path coefficients are presented in beta and t-value. The significant value (t-statistic) must be more than 1.65, and p-values must be less than 0.05 to show significant relationships. The p-value for connectivism -> autonomy is $p=0$ ($t=10.045$); for connectivism ->connectedness is $p=0$ ($t=12.787$); for connectivism ->diversity is $p=0$ ($t=8.068$), and connectivism ->openness is $p=0$ ($t=8.543$). Hence, all paths indicate significant relationships.

Effect Size (f^2)

According to Ramayah et.al. (2018), the cutoff values for effect sizes (f^2) are 0.02 (small), 0.15 (medium), and 0.35 (large). This section presents data to answer research questions and reject null hypotheses.

RQ5- Is there a significant effect of connectivism on diversity, openness, connectedness, and autonomy?

H₀₅- There is no significant effect of connectivism on diversity, openness, connectedness, and autonomy

According to Ringle et.al (2024), for effect size, values from 0.02 to 0.15 are considered small. Values between 0.15 to 0.35 are considered medium while values 0.35 and above are considered large.

Table 13- Effect Size

	Original sample (O)	Interpretation
CONNECTIVISM -> AUTONOMY	0.507	large
CONNECTIVISM -> CONNECTEDNESS	0.959	large
CONNECTIVISM -> DIVERSITY	0.377	large
CONNECTIVISM -> OPENNESS	0.437	large

With reference to Table 13 above, H₀₅ is rejected. Results indicate that there is a large effect size for all interactions.

PLS Predict (Q^2)

In PLS-SEM, it is stated that $Q^2 \geq 0$ (Ringle et.al., 2024). Table 18 below reveals the PLS Predict (Q^2) for the dependent variable. The analysis reveals the Q^2 for all items in the dependent variable -connectedness.

Table 14- PLS Predict (Q^2)

	Q^2 predict	RMSE	MAE
AUTONOMY	0.314	0.845	0.615
CONNECTEDNESS	0.473	0.74	0.562
DIVERSITY	0.252	0.881	0.702
OPENNESS	0.285	0.862	0.644

Table 14 above shows the results for Q^2 Predict in the study. According to Cohen (1988), Q^2 Predict is used to interpret the magnitude of the predictive relevance. For $Q^2 > 0$ indicates the model has predictive relevance. Secondly, **0.02** indicates **small** predictive relevance. Next, **0.15** indicates **medium** predictive relevance. Finally, **0.35** indicates **large** predictive relevance. Results for table 13 that all variables indicate predictive relevance.

Specifically, Autonomy shows medium predictive relevance, Connectedness has high predictive relevance, Diversity shows medium predictive relevance, while Openness shows medium predictive relevance. The results, therefore, confirm the goodness of the model predicted in this study.

IPMA

IPMA or Importance-Performance Matrix Analysis. According to Ringle & Sarstedt (2016), IPMA is used to evaluate the performance and importance of the chosen constructs or indicators within a model. In the context of this study, individual IPMA analysis was done on each construct and reported in Table 15. According to jointly (Hauf, 2024) for PLS-SEM IPMA (Importance-Performance Map Analysis), there isn't a single "good score," but rather **constructs with high importance (total effects) but low performance scores (rescaled 0-100)** are key areas for improvement, indicating high potential for managerial action, while high importance/high performance is good, and low importance/low performance means less priority. Performance scores range 0-100, with higher values showing better attainment, but you interpret them *relative* to their importance.

Table 15- Performance

	LV performance
AUTONOMY	71.905
CONNECTEDNESS	69.332
CONNECTIVISM	69.379
DIVERSITY	65.327
OPENNESS	66.453

Figure 15 above shows the IPMA (importance-performance map). The findings reveal that Autonomy has medium importance /high performance (Importance=0.314, Performance=71.905). This is followed by Connectedness with high importance/high performance (Importance=0.473, Performance=69.332). Openness has medium importance/ (high performance (Importance=0.285, Performance=66.453), and finally Diversity has medium importance/high performance (Importance=0.252, Performance=65.327).

Outcome of the Research

Table 16- Outcome of Study

NO	Research Question	Research Hypothesis	Outcome
1	Is there a significant relationship between connectivism and diversity?	There is no significant relationship between connectivism and diversity	Null Hypothesis Rejected. There is a significant relationship between connectivism and diversity.
2	Is there a significant relationship	There is no significant	Null Hypothesis Rejected. There is a

	between connectivism and openness?	relationship and between connectivism and openness			significant relationship between connectivism and openness.
3	Is there a significant relationship between connectivism and connectedness?	There is no significant relationship between connectivism and connectedness			Null Hypothesis Rejected. There is a significant relationship between connectivism and connectedness.
4	Is there a significant relationship between connectivism and autonomy?	There is no significant relationship between connectivism and autonomy			Null Hypothesis Rejected. There is a significant relationship between connectivism and autonomy.
5	Is there a significant effect for connectivism on diversity, openness, connectedness, and autonomy?	There is no significant effect for connectivism on diversity, openness, connectedness, and autonomy			Null Hypothesis Rejected. There are significant effects for connectivism on diversity, openness, connectedness, and autonomy. All interactions reveal large interactions.

With reference to table 16, above summarizes the outcome of the research by mapping the research question, research hypotheses, and the outcomes of the findings. Results indicate that the null hypotheses for questions 1-4 are rejected. In addition to that, the null hypothesis is also rejected, showing large effects for all interactions.

Conclusion

Summary of Findings

Connectivism in Online Learning

Data analysis has shown that online engagement has shown adherence to Simen's (2004) aspects of connectivism. Firstly, findings revealed evidence on connectedness, openness, diversity, and autonomy in online learning engagement.

Participants in this study reported that although it was online learning, the students felt they could participate in academic and non-academic activities, and this gave them a sense of connectedness. They also reported that online engagement planned by the instructors allowed them to participate in academic activities even if the lesson was done online. This finding is in accordance with studies done by Leino et.al. (2024) and Mohammed et.al. (2024) who reported similar findings on connectedness being the predictor of online teaching self-efficacy. Staying connected gives learners, a sense of belonging to the learning task.

Next, a summary of the findings revealed that being connected gave the learners the opportunity to compare ideas from different sources, and that gave them a sense of openness. They also reported that being connected allowed them to make comparisons when they found sources. The studies by Mohammed et.al (2024) and Dulfer et.al. (2025) also found that the openness in online collaboration provided the students an opportunity to embrace the ideas of others. Dulfer, et.al. (2025) also reported that the collaboration encouraged a diversity of ideas and opinions.

In addition to that, an overall summary of the findings for diversity showed that learners found that online collaboration gave students the opportunity to gain information outside their course. In addition to that, the learners also reported that online collaboration allowed them to engage with the industries. Similarly, the study by Getener et.al. (2024) reported that the diversity of online engagement modes facilitated the learners' quest for information. They did not depend on one mode of interaction to gain information, and freedom gave the students a positive attitude towards learning.

Lastly, a recapitulation of the findings for autonomy reveals that learners needed to be in charge of their learning outcomes to stay motivated. Limbu & McKinley (2025) also suggest that students need motivation to be successful in their learning. In addition to that, Hu and Xiao (2025) add that learners' perspectives towards their learning improve when they are motivated in the learning process. This is because students need emotional engagement to feel motivated to learn.

Significant Relationship

In summary, this study has shown that there are significant relationships between openness and autonomy with connectedness (refer to figure 4 below). Similar findings were reported by Leino et.al. (2024), Kennedy (2018) and Mohammed et.al. (2024). Their findings established the influence of connectedness on both openness and autonomy in online engagement. This study also revealed that there is no significant relationship between diversity and connectedness. Bergdahl (2022) reported that online learning can sometimes cause disengagement among learners when different learners may depend on a variety of sources to gain information. The diversity in methods of learning for one course can sometimes confuse learners on the stability of knowledge gained. This can be especially true if learners have not quite grasped the skill of synthesizing information in learning.

Effect of Connectivism

Figure 4 below presents the compliance with the connectivism model that is formed from this study.

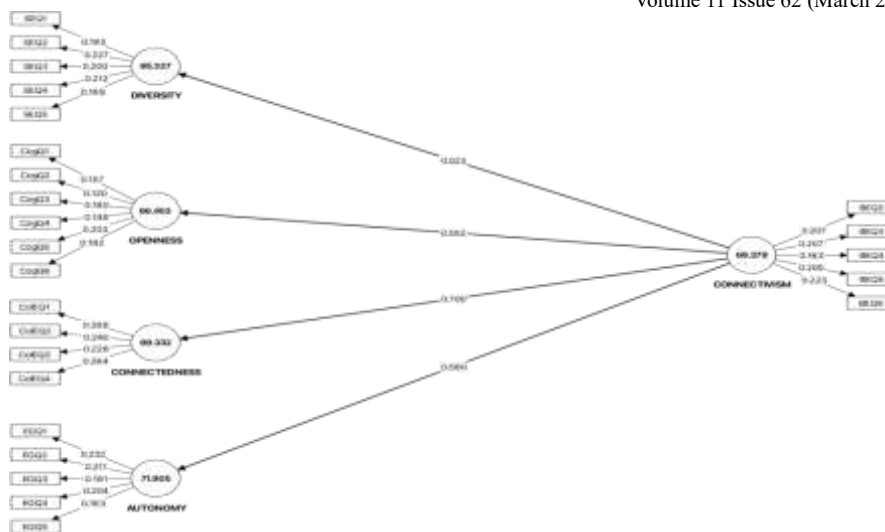


Figure 4- Online Engagement Complying with Connectivism

In addition to that, the IPMA map in Figure 4 above confirms the importance of the variables chosen in this study. Analysis showed that the highest importance is Autonomy. This is followed by Connectedness, then Openness, and finally Diversity. In other words, for online classes, the main concern is the learners' feeling of autonomy. The need to feel they are in charge of their own learning. Next, being online demands that the learners feel connected. This connectedness can be obtained through online interactions with their surrounding environment, the instructor, and also their peers. Similarly, Conklin et.al. (2024) also reported that learners with higher connectedness to the instructor had high motivation for learning.

Implications

Theoretical Significance

The anchor that holds this study is the theory of connectivism by Siemens (2005). Basically, this theory holds four main principles: connectedness, openness, diversity, and autonomy. In the context of computers (and gadgets) and online technology, learners depend on being connected to be part of the learning task. Connectedness does not end with having access to the internet and being exposed to a diversity of ways to obtain knowledge. The internet can provide learners with information on a variety of issues. Learners can also refer to many sources as they navigate one chosen issue. Next, the internet's borderless world enables learners to interact with learners and instructors outside their institutions. This encourages free exchange of ideas and exploration for the learners, and they gain diversity of thought. The variety of ideas, sources of ideas, and interactions enable learners to take control of their learning journey. As a result, learners can become self-directed when it comes to their own learning. This somehow gives them their autonomy in their own learning.

Conceptual Significance

The concept of this study (refer to Figure 1) was based on using. The findings in this study shows that the factors that make up online engagement (behavioural, social, cognitive, collaborative, emotional) comply with the factors present in connectivism (diversity, openness, connectedness, and autonomy).

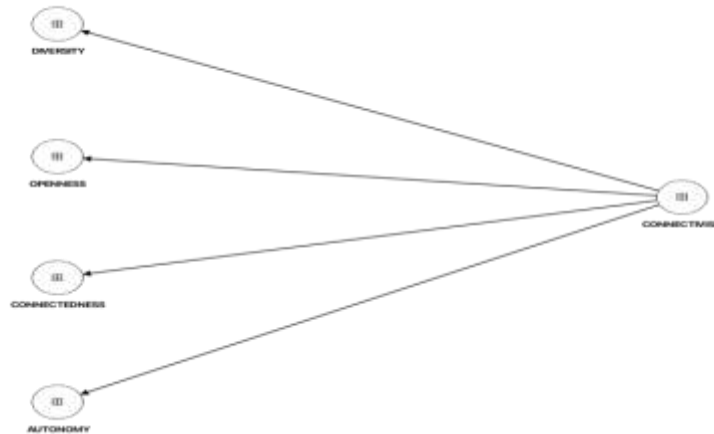


Figure 1-Conceptual Framework of the Study Exploring Connectivism in Online Engagement

Practical Implications

The key to online learning is engagement. Learners need to stay engaged to be a part of the learning journey. According to Vygotsky (1978), the concept of engagement is active participation among learners. He adds that active participation in social interactions is a good foundation for cognitive development. Online learning should be focused on having social interactions throughout the sessions. If learners are needed to respond in online classes, perhaps plan for online group work so learners do not feel isolated when they are talking and listening through their computer's camera. The key to cognitive development is not the ability to absorb and understand the lesson taught (although that is also important), but rather social interaction.

Suggestions for Future Research

Future researchers could look into patterns of group interaction during online engagement. Exploring the patterns may reveal different aspects of cognitive development that emerged during the interaction. For instance, the researcher could explore how different types of cognitive engagement, such as (a) interactive, (b) constructive, (c) active, or even (d) passive engagement, influence the group dynamics.

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Author Contribution Statement: All authors contributed significantly to the development of this manuscript

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