

Modelling Online Learning Retention Among University Students with Learning Disabilities

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ABSTRACT:

The rapid expansion of online learning has created new educational opportunities while simultaneously exposing persistent barriers for university students with learning disabilities. Although previous studies have identified individual determinants of online learning retention, limited research has examined how social, technological, instructional, institutional, and motivational factors collectively influence students' persistence in online learning environments. This study investigated the factors influencing online learning retention among university students with learning disabilities and examined the mediating role of motivation in the relationships between social and family support, perceived usefulness, perceived ease of use, lecturer engagement, institutional support and learning resources, and online learning retention.

A quantitative, cross-sectional survey design was employed. Data were collected from 256 university students with learning disabilities using a structured questionnaire, with respondents selected through random sampling. Structural Equation Modelling (SEM) was used to assess the measurement model and test the hypothesised structural relationships among the study constructs.

The findings confirmed that the measurement model demonstrated satisfactory reliability and validity. The structural model indicated that online learning retention is influenced by an interconnected set of social, technological, instructional, institutional, and motivational factors. Furthermore, motivation emerged as a significant mediating mechanism through which supportive learning environments enhance students' persistence in online learning. The validated SEM model provides a comprehensive explanation of online learning retention by integrating multiple determinants within a single conceptual framework.

The study contributes to the literature by extending existing theoretical perspectives on online learning retention through the development and validation of an integrated SEM model for

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university students with learning disabilities. The findings further highlight the need for higher education institutions to adopt coordinated strategies that strengthen inclusive teaching practices, accessible educational technologies, institutional support services, and student motivation to improve retention in online learning environments.

Keywords: online learning retention, learning disabilities, structural equation modelling, motivation, inclusive higher education

1. Introduction

Online learning has become an integral component of higher education, accelerated by the rapid digital transformation following the COVID-19 pandemic (Hollister et al., 2022; Islam & Habib, 2022; Martin & Bolliger, 2022). Although online learning offers flexibility, expanded access, and opportunities for personalised learning, it has also intensified concerns regarding student retention, particularly among students who require additional academic and institutional support (Martin & Bolliger, 2022; Reyes et al., 2022). While higher education institutions have invested substantially in digital learning platforms and online pedagogies, retaining students in online programmes remains a persistent challenge (Ferri et al., 2020; Muljana & Luo, 2019). These challenges are especially pronounced for students with learning disabilities (LDs), whose academic participation may be constrained by inaccessible learning environments, limited assistive technologies, inconsistent institutional support, and instructional approaches that are not designed to accommodate diverse learning needs (Holden et al., 2021; Moriña & Biagiotti, 2022).

Research on online learning retention has identified several factors that influence students' persistence, including learner motivation, technological readiness, social support, instructor engagement, and institutional resources (Al Rawashdeh et al., 2021; Muljana & Luo, 2019; Moriña & Biagiotti, 2022). However, most empirical studies have examined these predictors within general student populations, assuming relatively homogeneous learning experiences (Martin & Bolliger, 2022; Moriña & Biagiotti, 2022). Consequently, there is limited understanding of whether these factors operate

similarly for university students with LDs, who often experience additional cognitive, social, and environmental barriers that influence their academic persistence (Cumming & Rose, 2022; Moriña & Biagiotti, 2022). Existing studies concerning students with LDs have largely focused on accessibility, policy implementation, or descriptive accounts of students' experiences, with relatively few developing empirically validated predictive models of online learning retention for this population (Meleo-Erwin et al., 2021; Moriña & Biagiotti, 2022; Reyes et al., 2022).

This gap is significant because higher education institutions increasingly rely on evidence-based strategies to improve student success and reduce attrition in digitally mediated learning environments (Islam & Habib, 2022; Jumareng et al., 2022). Without a comprehensive understanding of the factors that promote retention among students with LDs, universities risk implementing generic interventions that fail to address disability-specific challenges (Cumming & Rose, 2022; Moriña & Biagiotti, 2022). Moreover, previous research has rarely examined the combined influence of social and family support, technology acceptance, institutional support, lecturer engagement, and motivational processes within a single explanatory framework. Understanding how these factors interact is essential for developing targeted interventions that promote equitable participation, academic persistence, and long-term success among students with learning disabilities (Martin & Bolliger, 2022; Moriña & Biagiotti, 2022).

Against this background, the present study develops and validates a Structural Equation Modelling (SEM) model of online learning

retention for university students with learning disabilities. The proposed model integrates social and family support, perceived ease of use and perceived usefulness of educational technologies, lecturer engagement, institutional support, and access to learning resources, while examining motivation as a mediating construct influencing retention. By providing an empirically validated model, this study contributes to the growing body of knowledge on inclusive online education and offers practical guidance for higher education institutions seeking to design accessible learning environments, strengthen student support systems, and improve retention outcomes for students with learning disabilities.

Research Question

This study was guided by the following research question:

What factors influence online learning retention among university students with learning disabilities, and how does motivation mediate the relationships between social, technological, instructional, and institutional factors and students' retention in online learning environments?

To address this question, the study develops and validates a Structural Equation Modelling (SEM) model that integrates social and family support, perceived ease of use and perceived usefulness of educational technologies, lecturer engagement, institutional support, access to learning resources, and motivation as determinants of online learning retention among university students with learning disabilities.

2. Methodology

Research Design

This study employed a quantitative, cross-sectional survey design to develop and validate a Structural Equation Modelling (SEM) model of online learning retention among university students with learning disabilities (LDs). A quantitative approach was appropriate because the study sought to examine relationships among multiple latent constructs and test a theoretically informed structural model using empirical data. The cross-sectional survey enabled data to be collected from respondents at a single point in time, providing a snapshot of their online

learning experiences and perceptions (Saunders et al., 2019; Setia, 2016).

Participants and Sampling

The target population comprised 700 university students with learning disabilities enrolled at a South African university. Using a probability-based random sampling technique, 300 students were invited to participate in the study, of whom 256 returned completed questionnaires, yielding the final sample for analysis. Random sampling was selected to minimise selection bias and improve the representativeness of the sample (Daniel & Cross, 2018; Jackson, 2018).

The final sample exceeded the minimum sample size recommended for Structural Equation Modelling (SEM). According to Hair et al. (2010) and Kline (2023), SEM studies involving multiple latent constructs require a minimum of 200 respondents to produce stable parameter estimates. Consequently, the sample of 256 respondents was considered adequate for estimating both the measurement and structural models.

Research Instrument

Data were collected using a structured online questionnaire consisting of closed-ended items measured on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. The questionnaire was adapted from validated instruments developed by Lee and Choi (2013), Bawa (2016), Heyman (2010), and Osika et al. (2009) to ensure content relevance and construct validity.

The instrument measured seven latent constructs included in the proposed SEM model:

- Social and family support;
- Perceived usefulness of educational technology;
- Perceived ease of use of educational technology;
- Lecturer engagement and support;
- Institutional support and learning resources;
- Motivation; and
- Online learning retention.

Prior to the main study, the questionnaire underwent pilot testing to evaluate the clarity, relevance, and reliability of the measurement

items. Minor revisions were made based on the pilot results before the instrument was administered to the main sample.

Data Collection Procedure

Ethical approval was obtained from the relevant university research ethics committee before data collection commenced. Eligible students were invited to participate through institutional communication channels. The questionnaire was administered electronically, enabling respondents to complete it at their convenience.

Participation was voluntary, and respondents received information outlining the purpose of the study, the confidentiality of their responses, and their right to withdraw at any stage without penalty. Only completed questionnaires were retained for analysis, resulting in 256 valid responses.

Data Analysis

Data analysis was conducted using IBM SPSS Statistics for preliminary analyses and Mplus for the measurement and structural modelling procedures. The analysis was undertaken in five sequential stages.

First, descriptive statistics were computed to summarise respondents' demographic characteristics and the distribution of the study variables.

Second, Exploratory Factor Analysis (EFA) was performed to examine the underlying factor structure of the questionnaire and to assess sampling adequacy using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's Test of Sphericity.

Third, Confirmatory Factor Analysis (CFA) was conducted to evaluate the measurement model by examining construct reliability, convergent validity, and discriminant validity.

Fourth, Structural Equation Modelling (SEM) was employed to test the hypothesised relationships among the latent constructs. Model fit was evaluated using multiple goodness-of-fit indices, including the chi-square to degrees of freedom ratio (χ^2/df), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardised Root Mean Square Residual (SRMR) (Hair et al., 2010; Kline, 2023).

Finally, mediation analysis was undertaken within the SEM framework to determine whether motivation significantly mediated the relationships between the social, technological, instructional, institutional, and online learning retention constructs.

3. Results

3.1 Respondent Characteristics

A total of 300 questionnaires were distributed to university students with learning disabilities enrolled at a South African university. Of these, 256 completed questionnaires** were returned and deemed suitable for analysis, yielding a response rate of 85.3%. This sample exceeded the minimum recommended sample size for Structural Equation Modelling (SEM), supporting the robustness of the subsequent analyses (Hair et al., 2022; Kline, 2023).

Table 1 presents the demographic characteristics of the respondents. The majority of respondents were aged 18–25 years (37.9%), followed by those aged 26–35 years (27.0%) and 992–1009 years (25.4%), while respondents aged 46 years and older constituted 9.8% of the sample. Male respondents represented 44.1% of the sample, females 42.6%, and 13.3% identified as other.

With respect to academic programmes, most respondents were enrolled in undergraduate qualifications, particularly the **Bachelor of Science (21.1%), followed by the Bachelor of Arts (15.2%) and Bachelor of Commerce (12.9%). The respondents reported a range of learning disabilities, with visual impairment (24.2%), learning impairment (21.5%), and physical impairment (19.1%) being the most frequently reported. Regarding learning environments, 37.9% studied in shared spaces, 32.0% in private spaces, and the remainder in public or campus-based learning environments. Most respondents (60.9%) were enrolled in three-year academic programmes.

Collectively, these demographic characteristics indicate that the sample represented a diverse group of university students with learning disabilities across age groups, academic programmes, disability categories, and learning environments, providing an appropriate basis for examining the factors influencing online learning retention.

Table 1 Demographic characteristics of respondents

	Variable	Frequency (f)	Percentage (%)
Gender	Male	113	44.1
	Female	109	42.6
	Other	34	13.3
Age	992-1009	97	37.9
	992-1009	69	27
	992-1009	28	10.9
	992-1009	43	16.8
	56+	19	7.4
Programme of study	BA	48	18.8
	BCom	52	20.3
	BSc	54	21.1
	Honours	34	13.3
	Masters	38	14.4
	PhD	30	11.7
Duration of study	1	7	2.7
	2	22	8.6
	3	156	60.9
	4	63	24.6
	5	6	2.3
	6	2	0.8
Number of siblings	1	4	1.6
	2	8	3.1
	3	31	12.1
	4	82	32.0
	5	88	34.4
	6	20	7.8
	7	17	6.6
	8	6	2.3
Monthly income	<10000	47	18.4
	992-10090	49	19.1
	992-10090	64	25
	992-10090	38	14.8
	992-10090	38	14.8
	50001	20	7.8
Nature of disability	Hearing impairment	35	13.7
	Visual impairment	62	24.2
	Learning/psychiatric	55	21.5
	Physical	54	21.1
	impairments	50	19.5
Study space	Speech impairments		
	Private	71	27.7
	Library	82	32.0
	Private and library	97	37.9
	Sharing/common	6	2.3

3.2 Measurement Model Assessment

Before examining the structural relationships among the study variables, the measurement model was evaluated to determine the reliability and validity of the latent constructs included in the proposed Structural Equation Modelling (SEM) model. Specifically, the assessment examined the psychometric properties of the constructs representing social and family support, perceived usefulness, perceived ease of use, lecturer engagement, institutional support and learning resources, motivation, and online learning retention. The evaluation comprised descriptive statistics, reliability analysis,

Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA).

4.2.1 Descriptive Statistics

Descriptive statistics were computed to summarise the distribution of responses across the study constructs. Table 2 presents the means and standard deviations for each construct. Overall, the mean scores indicated moderate to high levels of agreement across the measured constructs, suggesting generally positive perceptions of the online learning environment among the respondents. The standard deviations indicated acceptable variability in responses, supporting the suitability of the data for multivariate analysis.

Table 2 Descriptive statistics for the study constructs

Statistics								
	Age group	Monthly income	Gender	Program me	Disability	Study space	Duration	Siblings
Mean	2.29	3.12						
Median			2.00	3.00	2.00	3.00	3.18	3.56
Mode			1	3	2	3	3.00	4.00
Std. Deviation	1.323	1.538	.693	1.644	1.334	.855	.759	1.306

3.2.2 Reliability Analysis

The internal consistency of the measurement instrument was evaluated using Cronbach's alpha (α), Composite Reliability (CR), and Average Variance Extracted (AVE). Cronbach's alpha values exceeding 0.70 indicate acceptable reliability, while Composite Reliability values above 0.70 and AVE values greater than 0.50 provide evidence of satisfactory construct

reliability and convergent validity (Hair et al., 2022).

As presented in Table 3, all constructs demonstrated satisfactory internal consistency, with Cronbach's alpha and Composite Reliability values exceeding the recommended threshold of 0.70. Similarly, the AVE values met or exceeded the recommended criterion of 0.50, indicating that the measurement items adequately represented their respective latent constructs.

Table 3 Reliability and convergent validity of the measurement model

Variable/ Constructs	Items	Items				
		Standardized factor loadings	Cronbach Alpha	Composite Reliability	Average variance extracted	Maximum Shared Variance
Online Retention	OR1	.587				
	OR2	.636				
	OR3	.572				
Motivational	MF6	.547				
	MF4	.612		.887	.666	.897

	MF5	.547			
Lecturer student understanding	LSU7	.596			
	LSU8	.568	.672	.632	.882
	LSU6	.528			
Faculty affluence	FAF7	.621			
	FAF8	.528	.743	.768	.747
	FAF12	.568			
Technological constraints	TC4	.509			
	TC5	.634	.810	.716	.914
	TC6	.525			
Social & family	SF7	.553			
	SF9	.526	.738	.792	.900
	SF10	.583			
Institutional training capacity	ICT5	.614			
	ICT6	.757	.670	.627	.870
	ICT7	.608			

3.2.3 Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was conducted to examine the underlying factor structure of the measurement instrument prior to confirmatory analysis. Sampling adequacy was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's Test of Sphericity. Principal Axis Factoring with Promax rotation was employed because the study constructs were theoretically expected to be correlated.

The KMO value exceeded the recommended threshold of 0.60, indicating adequate sampling adequacy for factor analysis. Furthermore, Bartlett's Test of Sphericity was statistically significant ($p < .001$), confirming that the correlation matrix was appropriate for factor extraction. These results provided evidence that the data were suitable for factor analysis.

Table 4 Sampling adequacy and tests of factorability

KMO and Bartlett's Test^a		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.806
Bartlett's Test of Sphericity	Approx. Chi-Square	1481.495
	df	351
	Sig.	.000

Seven factors with eigenvalues greater than one were retained, corresponding to the theoretical constructs underpinning the proposed SEM model. Together, these factors explained a substantial proportion of the total variance, supporting the multidimensional structure of the instrument.

The rotated pattern matrix demonstrated that the retained measurement items loaded strongly on their intended constructs, with factor loadings exceeding the recommended minimum threshold. Cross-loadings were minimal, indicating satisfactory discriminant properties among the constructs.

Table 5 Rotated pattern matrix of the retained measurement items

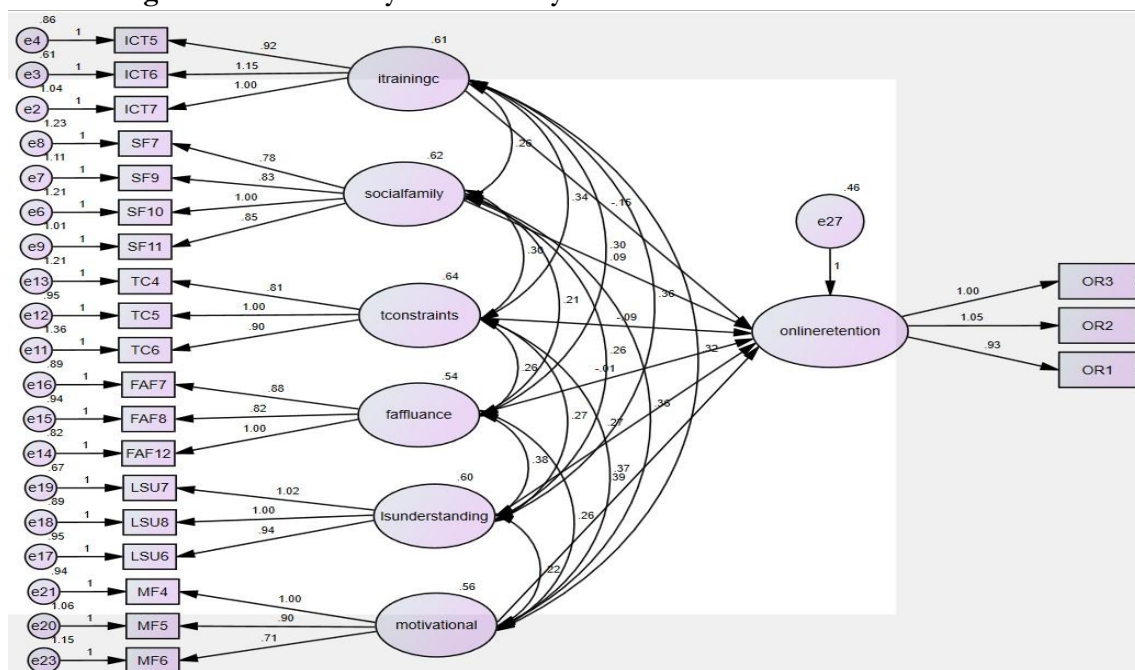
Pattern Matrix ^a							
	Component						
	1	2	3	4	5	6	7
ICT7	.738						
ICT10	.702						
ICT11	.611						
ICT6	.611						
ICT5	.545						
ICT9	.481						
LSU8		.800					
LSU7		.792					
LSU6		.523					
OR2			.758				
OR3			.727				
OR1			.724				
SF11				.745			
SF10				.705			
SF9				.574			
SF7				.472			
TC6					.698		
TC4					.595		
TC5					.594		
FAF8						.831	
FAF7						.620	
FAF12						.562	
MF6							.702
MF4							.573
MF5							.540
MF3							.481
Extraction Method: Principal Component Analysis.							
Rotation Method: Promax with Kaiser Normalisation. ^a							
a. Rotation converged in eight iterations.							

3.2.4 Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) was subsequently performed to validate the measurement model identified through the exploratory analysis. Standardised factor loadings, Composite Reliability (CR), and Average Variance Extracted (AVE) were examined to assess convergent validity, while discriminant validity was evaluated by comparing the square roots of the AVE values with the inter-construct correlations.

As shown in Figure 1, all retained indicators loaded significantly on their respective latent constructs, providing evidence of convergent validity. Composite Reliability values exceeded the recommended threshold of 0.70, while the AVE values demonstrated that each construct explained more than half of the variance in its indicators. Furthermore, the discriminant validity assessment confirmed that each construct was empirically distinct from the others.

Figure 1 Confirmatory Factor Analysis results for the measurement model



Overall, the results demonstrate that the measurement model exhibited satisfactory reliability, convergent validity, and discriminant validity. Having established the adequacy of the measurement model, the study proceeded to evaluate the structural relationships among the latent constructs using Structural Equation Modelling to address the research question concerning the determinants of online learning retention among university students with learning disabilities.

3.3 Structural Model Assessment

Following confirmation of the reliability and validity of the measurement model, Structural Equation Modelling (SEM) was employed to examine the relationships among the latent constructs and to determine the factors influencing online learning retention among university students with learning disabilities. The

structural model was evaluated in two stages. First, the overall model fit was assessed to determine the extent to which the proposed model adequately represented the observed data. Second, the structural path coefficients were examined to evaluate the direct relationships among the latent constructs.

3.3.1 Structural Model Fit

The adequacy of the structural model was assessed using multiple goodness-of-fit indices, including the chi-square to degrees of freedom ratio (χ^2/df), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardised Root Mean Square Residual (SRMR). These indices provide complementary evidence regarding the extent to which the hypothesised structural model reproduces the observed covariance matrix.

As presented in Table 6, the structural model demonstrated an acceptable overall fit to the data. The χ^2/df ratio fell within the recommended threshold, while the CFI and TLI values exceeded the recommended minimum of 0.90. Furthermore, the RMSEA and SRMR values were below the recommended cut-off values,

indicating that the proposed model adequately represented the relationships among the latent constructs. Collectively, these findings supported the suitability of the structural model for examining the determinants of online learning retention among university students with learning disabilities.

Table 6 Goodness-of-fit indices for the structural model

Category	Measure	Abbrev.	Result	Comment
Absolute fit	Discrepancy Chi-Square	Chisq	.000	Acceptable, since the sample is > 200 (n = 250)
	Root Mean Square of Error Approximation	RMSEA	.039	Acceptable
	Goodness of Fit Index	GFI	.919	Acceptable
	P – of Close Fit	PCLOSE	.957	Acceptable
Category	Measure	Abbrev.	Result	Comment
Absolute fit	Discrepancy Chi-Square	Chisq	.000	Acceptable, since the sample is > 200 (n = 250)
	Root Mean Square of Error Approximation	RMSEA	.039	Acceptable
	Goodness of Fit Index	GFI	.919	Acceptable
	P – of Close Fit	PCLOSE	.957	Acceptable

Note: Chisq = 0.000; RMSEA = 0.039; GFI = .919; PCLOSE = .957

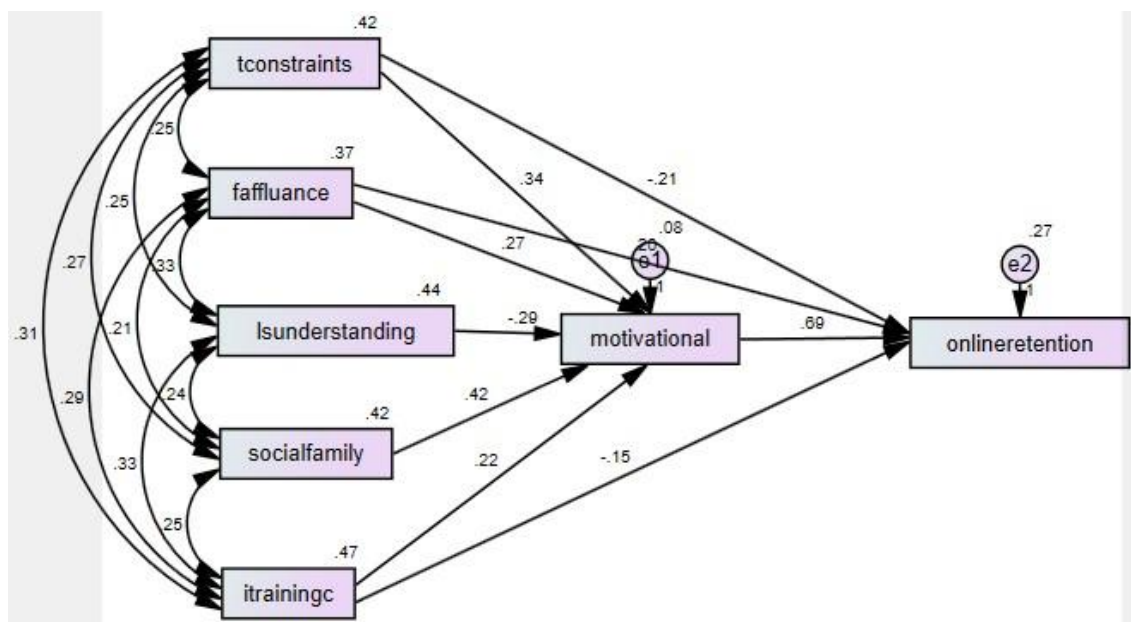


Figure 2 Final Structural Equation Model of Online Learning Retention

3.3.2 Structural Relationships

Having established an acceptable table fit, the standardised path coefficients were examined to

determine the direct effects of the latent constructs on online learning retention. Table 6 and figure 2 summarises the estimated path coefficients, standard errors, critical ratios, p-

values, and decisions regarding the proposed hypotheses.

The SEM results demonstrated that online learning retention was influenced by a combination of social, technological, instructional, institutional, and motivational factors. Significant positive relationships were

observed between the relevant latent constructs and online learning retention, while non-significant paths indicated that some hypothesised relationships were not directly supported by the data. These findings provide empirical evidence regarding the relative contribution of each construct within the proposed structural model.

Table 7 Structural path coefficients and hypothesis testing

Factors	Variables	Coefficients
Institutional training capacity	ICT5; ICT6; ICT7	0.92; 1.15; 1.00
Social and family factors	SF7; SF9; SF10; SF11	0.78; 0.83; 1.00; 0.85
Technological constraints and digital natives	TC4; TC5; TC6	0.81; 1.00; 0.90
Faculty affluence in technology use	FAF7; FAF8; FAF12	0.88; 0.82; 1.00
Lecture student understanding	LSU7; LSU8; LSU6	1.02; 1.00; 0.94
Motivational factor	MF4; MF5; MF6	1.00; 0.90; 0.71
Online Retention	OR3; OR2; OR1	1.00; 1.05; 0.93

The structural table provides evidence that online learning retention among university students with learning disabilities is a multidimensional phenomenon shaped by interconnected social, technological, instructional, and institutional factors. However, the magnitude and statistical significance of these relationships varied across the constructs, indicating that some factors exert stronger direct influences on retention than others. The indirect effects operating through motivation are examined in the following section to determine the mediating role of motivation within the proposed model.

3.4 Mediating Role of Motivation

To address the second component of the research question, the mediating role of motivation in the relationships between social, technological, instructional, institutional factors and online learning retention was examined using Structural Equation Modelling (SEM). Indirect effects were estimated using the bootstrapping procedure, which provides robust estimates of mediation effects and their statistical significance.

The mediation analysis evaluated whether motivation served as the mechanism through which the exogenous constructs influenced online learning retention. Specifically, the analysis examined the indirect effects of social and family support, perceived ease of use, perceived usefulness, lecturer engagement, and institutional support and learning resources on online learning retention through motivation.

The results presented in Table 9 indicate that motivation significantly mediated the relationships between selected antecedent constructs and online learning retention. Significant indirect effects suggest that improvements in social, technological, instructional, and institutional conditions enhance students' motivation, which subsequently promotes their retention in online learning environments. Conversely, non-significant indirect effects indicate that certain constructs exerted their influence primarily through direct pathways rather than through motivation.

Table 8 Mediation analysis of motivation in the structural model

Hypothesis	Direct	Indirect	Total	Comment
TC<MF<OR	.200	.185	.385	H_4 rejected
FAF<MF<OR	.000*	-.198**	-.198***	H_8 accepted
LSU<MF<OR	.000*	-.293**	.293***	H_5 accepted
SF<MF<OR	-.154	.153*	-.001***	H_2 accepted
ICT<MF<OR	-.211	.234	.023	H_6 rejected

Overall, the mediation analysis demonstrates that motivation functions as an important explanatory mechanism within the proposed structural model. The findings indicate that online learning retention among university students with learning disabilities is influenced not only by direct effects of social, technological, instructional, and institutional factors, but also by the extent to which these factors enhance students' motivation to engage and persist in online learning.

Taken together, the findings from the measurement model, structural model, and mediation analysis provide empirical support for the proposed Structural Equation Modelling (SEM) framework. The validated model offers a comprehensive explanation of the factors associated with online learning retention among university students with learning disabilities and provides the empirical foundation for the discussion of the study's theoretical and practical implications.

4. Discussion

5. Discussion

This study sought to answer the following research question: What factors influence online learning retention among university students with learning disabilities, and how does motivation mediate the relationships between social, technological, instructional, and institutional factors and students' retention in online learning environments? The findings indicate that online learning retention is shaped by a complex interplay of social, technological, instructional, institutional, and motivational factors. The validated Structural Equation Modelling (SEM)

model demonstrates that these factors collectively influence respondents' persistence in online learning environments while highlighting motivation as a central mechanism through which several of these relationships operate.

Unlike many previous studies that have examined isolated predictors of online learning retention, this study integrated multiple dimensions within a single explanatory framework. The findings therefore contribute to a more comprehensive understanding of how university students with learning disabilities navigate online learning environments and identify the conditions that promote sustained engagement and academic persistence.

5.1 Factors Influencing Online Learning Retention

The findings demonstrate that online learning retention among university students with learning disabilities is not determined by a single factor but by the interaction of social, technological, instructional, and institutional influences. This supports previous research suggesting that student persistence in online learning is multidimensional and depends on both individual and environmental conditions (Lee & Choi, 2013; Bawa, 2016; Martin & Bolliger, 2022).

The structural model indicates that social and family support remains an important determinant of online learning retention. Respondents who perceived stronger support from their families and social networks were more likely to remain engaged in their online studies. This finding aligns with previous studies showing that supportive social environments strengthen

students' resilience, reduce feelings of isolation, and enhance persistence in online learning (Lee & Choi, 2013; Reyes et al., 2022). For students with learning disabilities, social support may be particularly important because it provides emotional encouragement and practical assistance in managing the academic demands of digitally mediated learning.

The study also confirms the importance of instructional factors, particularly lecturer engagement, in supporting online learning retention. Consistent lecturer communication, timely feedback, and inclusive teaching practices appear to strengthen respondents' commitment to their studies. These findings are consistent with the Community of Inquiry framework, which emphasises the central role of teaching presence in facilitating meaningful learning experiences and sustaining student engagement in online environments (Garrison et al., 2000; Martin & Bolliger, 2022). For university students with learning disabilities, responsive lecturer support may help reduce barriers associated with inaccessible instructional practices and foster a greater sense of academic belonging.

Institutional support and access to learning resources also emerged as important contributors to online learning retention. Respondents who perceived that their institutions provided accessible learning resources, appropriate technological infrastructure, and disability support services demonstrated greater persistence in online learning. This finding reinforces the view that retention extends beyond individual student characteristics and is strongly influenced by institutional capacity to create inclusive and supportive learning environments (Moriña & Biagiotti, 2022; Cumming & Rose, 2022). These findings suggest that universities should regard accessibility and disability support as integral components of student success rather than supplementary services.

The technological dimensions of the model further demonstrate that students' perceptions of educational technologies influence online learning retention. In line with the Technology Acceptance Model (TAM), perceived usefulness

and perceived ease of use contribute to respondents' willingness to engage with online learning systems by shaping their confidence in using educational technologies effectively (Davis, 1989). Although the magnitude of these relationships varied across the structural model, the findings suggest that accessible, user-friendly technologies remain essential for promoting meaningful participation among students with learning disabilities.

Collectively, these findings demonstrate that online learning retention is influenced by multiple interconnected factors rather than isolated institutional or individual characteristics. The validated SEM model therefore provides a more comprehensive explanation of online learning retention by integrating social support, instructional quality, institutional capacity, technological acceptance, and learner motivation within a single explanatory framework.

5.2 Motivation as the Mediating Mechanism

A key contribution of this study is the identification of motivation as a central mechanism through which social, technological, instructional, and institutional factors influence online learning retention among university students with learning disabilities. While previous studies have consistently recognised motivation as an important predictor of academic persistence (Lee & Choi, 2013; Bawa, 2016), the present study extends this body of knowledge by demonstrating that motivation functions as a mediating construct linking students' learning environments with their decisions to remain engaged in online learning.

The mediation analysis suggests that supportive learning environments do not promote retention solely through their direct effects. Rather, they contribute to retention by strengthening students' motivation to participate, engage, and persist in online learning. This finding highlights that institutional support, positive lecturer engagement, accessible educational technologies, and strong social and family support become more effective when they foster students' confidence, sense of competence, and willingness

to continue learning despite the challenges associated with online education.

These findings are consistent with Self-Determination Theory (Ryan & Deci, 2020), which proposes that individuals are more likely to sustain learning behaviours when their psychological needs for autonomy, competence, and relatedness are supported. Within the context of this study, institutional support and accessible learning resources enhance students' sense of competence by reducing barriers to participation, lecturer engagement strengthens relatedness through meaningful academic interactions, and accessible technologies facilitate greater autonomy by enabling students to navigate online learning environments more independently. Collectively, these conditions strengthen students' intrinsic motivation, which subsequently promotes sustained engagement and retention.

The findings also provide additional insight into the Technology Acceptance Model (Davis, 1989). Although perceived usefulness and perceived ease of use have traditionally been viewed as direct determinants of technology adoption, the present study suggests that their influence on online learning retention is also partly explained through motivation. When respondents perceived educational technologies as useful and easy to use, they were more likely to feel motivated to participate in online learning, thereby increasing their likelihood of remaining enrolled. This finding extends the application of the Technology Acceptance Model by demonstrating that technology acceptance contributes not only to system use but also to longer-term educational outcomes through motivational processes.

Furthermore, the mediating role of motivation reinforces Tinto's Student Integration Model, which emphasises that students' persistence is shaped by their academic and social integration within the institution (Tinto, 1993). The present findings suggest that successful integration is not solely reflected in students' participation in institutional structures but also in the motivational processes that develop when

students perceive themselves as supported, valued, and capable of succeeding. For university students with learning disabilities, these motivational processes may be particularly important because they help mitigate barriers associated with inaccessible learning environments, limited assistive resources, and feelings of social isolation.

Taken together, these findings position motivation as the mechanism through which multiple dimensions of the online learning environment converge to influence retention. Rather than functioning as an isolated psychological attribute, motivation emerges as the outcome of supportive institutional policies, inclusive teaching practices, accessible technologies, and positive social relationships. This integrated perspective represents an important contribution of the present study by demonstrating that improving online learning retention among university students with learning disabilities requires interventions that strengthen both the learning environment and students' motivation to engage with it.

5.3 Theoretical Contributions

This study makes several important theoretical contributions to the literature on online learning retention and inclusive higher education. While previous studies have examined individual determinants of student retention, such as motivation, technology acceptance, institutional support, or social support in isolation (Bawa, 2016; Lee & Choi, 2013; Martin & Bolliger, 2022), the present study demonstrates that online learning retention among university students with learning disabilities is best understood as a multidimensional phenomenon shaped by the interaction of social, technological, instructional, institutional, and motivational factors. By integrating these dimensions within a single Structural Equation Modelling (SEM) framework, the study provides a more comprehensive explanation of online learning retention than approaches that focus on individual predictors.

The validated SEM model also extends the application of the Technology Acceptance Model

(TAM) (Davis, 1989) beyond technology adoption to the broader context of student retention. Although TAM has traditionally been used to explain users' acceptance and continued use of technology, the present findings demonstrate that perceived usefulness and perceived ease of use contribute to students' persistence in online learning through their interactions with instructional, institutional, and motivational factors. This finding suggests that technology acceptance should be viewed as one component of a broader ecosystem influencing students' educational experiences rather than as an isolated determinant of technology use.

Similarly, the findings reinforce and extend Self-Determination Theory (Ryan & Deci, 2020) by demonstrating that motivation functions as the mechanism through which supportive learning environments promote student persistence. Rather than conceptualising motivation solely as an individual psychological characteristic, the present study shows that motivation is shaped by external conditions, including accessible learning resources, supportive lecturer practices, institutional support, and positive social relationships. This perspective highlights the dynamic interaction between environmental conditions and students' internal motivational processes in sustaining engagement with online learning.

The study further contributes to Tinto's Student Integration Model (Tinto, 1993) by extending its application to digitally mediated learning environments for students with learning disabilities. While Tinto's model emphasises academic and social integration as key determinants of student persistence, the present findings suggest that successful integration in online learning also depends on accessible technologies, inclusive institutional practices, and motivational processes. Consequently, the study broadens the conceptualisation of student integration by recognising accessibility and inclusive support systems as essential dimensions of persistence in contemporary online higher education.

Beyond extending individual theories, this study contributes by proposing and empirically validating an integrated conceptual model of online learning retention specifically for university students with learning disabilities. This population remains underrepresented in the online learning literature despite facing distinct educational challenges. The validated model therefore addresses an important gap by demonstrating how social support, technology acceptance, lecturer engagement, institutional support, learning resources, and motivation collectively influence online learning retention within an inclusive higher education context.

Collectively, these theoretical contributions advance current understanding of online learning retention by positioning persistence as the outcome of interconnected social, technological, instructional, institutional, and motivational processes rather than the consequence of isolated student or institutional characteristics. The integrated SEM model provides a theoretical foundation for future studies investigating inclusive online learning and offers a framework that can be refined and tested across different higher education contexts and student populations.

5.4 Practical Implications

The findings of this study have important implications for higher education institutions seeking to improve online learning retention among university students with learning disabilities. The validated Structural Equation Modelling (SEM) model demonstrates that retention is influenced by interconnected social, technological, instructional, institutional, and motivational factors. Consequently, strategies aimed at improving student persistence should adopt a holistic and coordinated approach rather than addressing these factors in isolation.

At the institutional level, universities should strengthen disability-inclusive policies and support systems by ensuring that online learning environments are designed according to the principles of accessibility and Universal Design for Learning (UDL). This includes providing accessible learning management systems, assistive

technologies, alternative learning materials, and dedicated disability support services that enable students with learning disabilities to participate equitably in online learning. Institutional investment in accessible digital infrastructure should be regarded as an essential component of student success rather than an optional support service. The findings also underscore the critical role of lecturers in promoting online learning retention. Universities should therefore invest in continuous professional development programmes that equip academic staff with the knowledge and skills required to implement inclusive online pedagogies. Training should focus on accessible course design, effective online communication, timely and constructive feedback, inclusive assessment practices, and the pedagogical use of educational technologies. Such initiatives would strengthen teaching presence and foster learning environments that encourage sustained student engagement. The technological dimensions of the model further suggest that online learning platforms should be designed to maximise both perceived usefulness and perceived ease of use. Universities should prioritise user-centred digital environments that minimise unnecessary complexity and are compatible with assistive technologies commonly used by students with learning disabilities. Regular usability evaluations involving students with disabilities should inform the design and continuous improvement of institutional digital learning environments to ensure that technological barriers do not undermine student participation and persistence.

The identification of motivation as a central mediating mechanism also has important implications for student support initiatives. Rather than focusing exclusively on academic performance, institutions should develop interventions that strengthen students' motivation to engage and persist in online learning. These interventions may include structured academic advising, peer mentoring programmes, learning communities, wellbeing services, and early-alert systems that identify students at risk of disengagement and provide timely academic and psychosocial support. By

fostering students' confidence, sense of belonging, and academic self-efficacy, these initiatives can enhance motivation and improve retention outcomes. More broadly, the integrated SEM model developed in this study provides institutional leaders, disability support practitioners, instructional designers, and policymakers with an evidence-based framework for planning, implementing, and evaluating inclusive online learning initiatives. Rather than implementing fragmented interventions, the model highlights the importance of aligning institutional policies, teaching practices, technological infrastructure, and student support services to create learning environments that enable university students with learning disabilities to participate successfully and persist in their studies. Taken together, these practical implications suggest that improving online learning retention among university students with learning disabilities requires a systemic institutional response. Sustainable improvements are unlikely to result from isolated technological or instructional interventions alone; instead, they depend on coordinated efforts that strengthen motivation while simultaneously enhancing the social, instructional, technological, and institutional conditions that support student success.

5. Conclusion

This study examined the factors influencing online learning retention among university students with learning disabilities and investigated the mediating role of motivation in the relationships between social, technological, instructional, and institutional factors and students' retention in online learning environments. Using a Structural Equation Modelling (SEM) approach, the study developed and validated an integrated model that provides a comprehensive explanation of the factors associated with online learning retention within an inclusive higher education context.

The findings demonstrate that online learning retention is a multidimensional phenomenon shaped by the interaction of social and family support, lecturer engagement, institutional support and learning resources, perceived

usefulness, perceived ease of use, and motivation. Rather than operating independently, these factors collectively influence students' ability to remain engaged and persist in online learning. The study further establishes motivation as a key mediating mechanism through which supportive learning environments translate into sustained engagement and retention. These findings emphasise that improving online learning retention among university students with learning disabilities requires coordinated efforts that address both the learning environment and the motivational processes that underpin students' persistence.

The study makes an important contribution to the literature by developing and empirically validating an integrated SEM model of online learning retention specifically for university students with learning disabilities. While previous research has often examined isolated determinants of retention, the present study demonstrates that persistence in online learning is best understood through the interaction of social, technological, instructional, institutional, and motivational dimensions. The validated model extends the application of the Technology Acceptance Model, Self-Determination Theory, and Tinto's Student Integration Model by demonstrating how these complementary perspectives collectively explain online learning retention in inclusive higher education settings.

The findings also have important implications for policy and practice. Universities seeking to improve online learning retention should adopt institution-wide strategies that strengthen inclusive teaching practices, accessible educational technologies, disability support services, and student-centred learning environments. Investment in lecturer professional development, accessible digital infrastructure, Universal Design for Learning principles, and comprehensive student support services can contribute to enhancing students' motivation and promoting their long-term persistence in online learning. These findings underscore that improving retention among university students with learning disabilities is a shared institutional responsibility requiring

collaboration among academic staff, instructional designers, disability support practitioners, and institutional leaders.

Although the study provides valuable insights, several limitations should be acknowledged. First, the study was conducted at a single South African university, which may limit the generalisability of the findings to other higher education contexts. Second, the cross-sectional research design captured respondents' perceptions at one point in time and therefore does not account for changes in motivation or retention over the course of students' academic journeys. Third, the study relied on self-reported questionnaire data, which may be influenced by response bias despite the measures taken to ensure anonymity and confidentiality.

Future research should validate the proposed SEM model across multiple higher education institutions, disciplinary contexts, and cultural settings to examine its broader applicability. Longitudinal studies are also needed to investigate how motivation and online learning retention evolve over time and to establish causal relationships among the identified constructs. In addition, future studies could incorporate objective indicators of student engagement and academic performance alongside self-reported measures to provide a more comprehensive understanding of online learning retention among university students with learning disabilities.

In conclusion, this study demonstrates that online learning retention among university students with learning disabilities is shaped by interconnected social, technological, instructional, institutional, and motivational factors rather than by isolated influences. By validating an integrated Structural Equation Modelling (SEM) framework, the study provides both a theoretical foundation and an evidence-based framework for advancing inclusive online learning. The findings offer valuable guidance for researchers, educators, and higher education institutions seeking to design accessible, supportive, and motivating online learning environments that enable students with learning disabilities to thrive and succeed.

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Author Declaration

The authors declare that this manuscript is original, has not been published previously, and is not under consideration for publication elsewhere.

The authors further declare that there are no conflicts of interest that could have influenced the work reported in this study.