

From Assessment to Growth: Validation of an e-Learning Style Mediation Framework in Higher Education

Nazeila Zahidin¹, Hamidah Mohamad², Nor Azian Md. Nor³, Azrul Fazwan Kharuddin⁴, Somariah Fitriani⁵

¹ SEGi University, Malaysia; Universiti Tun Abdul Razak, Malaysia.

Email: nazeilazahidin@segi.edu.my

² Tun Razak Graduate School, Universiti Tun Abdul Razak, Malaysia.

Email: hamidah_mohamad@unirazak.edu.my

³ SEGi University, Malaysia.

Email: azianmdnor@segi.edu.my

⁴ Tun Razak Graduate School, Universiti Tun Abdul Razak, Malaysia.

Email: azrul.fazwan@ur.unirazak.edu.my

⁵ Universitas Muhammadiyah Prof. DR. HAMKA, Indonesia.

Email: somariah@uhamka.ac.id

Abstract: This study aimed to develop and validate a measurement tool that examines how e-learning system and e-learning environment mediate the relationship between learning activities, coursework assessment and scholarly growth among postgraduate students. Aligned with Sustainable Development Goal 4 (Quality Education), the study emphasizes inclusive learning and the development of lifelong skills. Grounded in self-regulated learning and assessment-for-learning theories. Learning system and learning style is viewed as a flexible and adaptive process rather than a fixed category, linking assessment practices to academic development. A quantitative survey was conducted with 48 postgraduate students, and the data were analyzed using SmartPLS 4.0. Results showed high reliability, with Cronbach's alpha values ranging from 0.86 to 0.91 across the three constructs: Coursework Assessment Quality, Learning-Style Mediation, and Scholarly Growth. Validity was also confirmed, as average variance extracted values exceeded 0.50 and discriminant validity criteria were met. Most measurement items showed strong factor loadings, although a small number were revised for clarity. Overall, the validated instrument demonstrated strong measurement quality and suitability for mediation analysis. Findings indicate that effective coursework assessment encourages adaptive learning behaviors, which in turn support scholarly growth, reflecting the principles of sustainable and high-quality education.

Keywords: Learning Activities, Coursework Assessment, E-Learning System, E-Learning Environment, E-Learning Style, Instrument Validation

1. Introduction

In contemporary higher education, the design and implementation of coursework assessments are pivotal in shaping students' learning trajectories. Assessments are not merely evaluative endpoints; when well-constructed, they can scaffold learning, stimulate metacognitive reflection, and guide students toward higher-order engagement. However, despite carefully designed assessment frameworks (e.g. aligned rubrics, formative feedback, scaffolding), scholars frequently observe substantial variation in the growth trajectories of learners. That is, two students exposed to ostensibly similar assessment environments may differ markedly in how much "scholarly growth" they achieve that is, the extent to which they develop discipline-specific expertise, critical thinking, autonomy, and a self-reflective identity as scholars. One plausible reason for this heterogeneity lies in individual differences in how learners *respond* to assessment practices. Among various candidate mediators, e-learning style conceptualized as a learner's habitual

strategies or preferences for processing and regulating learning has long been proposed as a potential explanatory mechanism. Although the idea of matching instructional delivery to static “e-learning styles” has been challenged (often vigorously) in recent decades, a more process-oriented view of e-learning style as a mediator or moderator in the assessment–learning growth pathway remains theoretically promising. Indeed, recent work has shifted away from the simplistic “matching hypothesis” toward recognizing how learners flexibly invoke strategic, metacognitive, or modality-preferent processes depending on task demands (Hattie & O’Leary, 2025).

In this reconceptualized view, e-learning style is not a rigid typology but a constellation of learner processes cognitive and regulatory strategies, modal-resource preferences, motivational dispositions that can modulate how assessment features (e.g. feedback timing, clarity, scaffolding) transform into internal learning gains. From this vantage, a robust instrument that validly captures the mediating role of such learning-style processes becomes essential for empirical investigation. Without such an instrument, educational researchers may mis-specify mediation models, conflate style with strategy, or fail to detect latent mechanisms linking assessment design to scholarly outcomes. Despite this conceptual promise, the empirical literature remains sparse. Many existing learning-style instruments are poorly adapted to the assessment context, emphasize static typologies rather than dynamic strategy deployment, or lack rigorous psychometric validation in mediation applications. Furthermore, past empirical studies tend to rely on manifest (single-item or observed-score) proxies of e-learning style, neglect measurement error that can attenuate estimated indirect effects in mediation models. In sum, to meaningfully test hypotheses about how e-learning style mediates between assessment practices and scholarly growth, the field needs a carefully constructed, psychometrically validated mediating-role instrument one designed specifically for coursework-assessment settings.

While assessment is a central mechanism through which instructors influence student learning, it is overly simplistic to assume that all learners benefit equally from identical assessment designs. Empirical observations suggest that despite “best-practice” assessment regimes, students’ responses vary in terms of engagement, adaptation, and growth. This raises the question: what explains the intra-group variance in learning gains and scholarly growth outcomes? Traditional models often include moderators (e.g. prior knowledge, motivation) but seldom interrogate *mediators* that is, the learner-internal processes that transmit the effect of assessment design to learning growth.

Lack of process-level instruments

Existing learning-style or cognitive-style tools are rarely tailored to the context of how students engage with assessments. Many instruments aim to classify learners into discrete typologies (e.g. visual, auditory, kinesthetic) or general cognitive styles, but neglect to capture how learners *process assessment feedback, scaffolds, or modalities* in real time. Without instruments that operationalize strategy deployment, regulation, and adaptability in assessment contexts, mediation hypotheses about e-learning styles remain largely speculative.

Weak psychometric rigor in mediation contexts

Even when instruments do exist, many lack rigorous development pipelines befitting mediation research. For instance, a few prior studies report full content validation, exploration and confirmatory factor analyses, cross-group invariance testing, or bootstrap-assessed mediation models that properly account for measurement error. Neglecting these steps increases the risk of biased parameter estimates, underpowered indirect effect estimates, and invalid inferences.

Empirical inconclusiveness and conflicting findings

The broader literature on e-learning styles is fraught with controversy. The “matching hypothesis” that students learn best when instruction matches their style has largely been discredited (effect sizes near zero) (Hattie & O’Leary, 2025). Some critics go further, labeling e-learning styles a “neuromyth” with little empirical support (Straub, 2024). At the same time, correlational studies sometimes report small-to-moderate relationships between learning-style inventories and academic outcomes. This paradox arises in part from ambiguous conceptual definitions (styles vs. strategies), variability across instruments, and failure to model mediation properly. It remains unclear whether and how learning-style processes *functionally mediate* instruction or assessment interventions toward enhancing scholarly growth.

Context sensitivity and domain generalizability

Even when mediation models are tested, studies are often limited to one discipline (e.g. mathematics) or to low-stakes assessments, raising questions about generalizability across disciplines and levels. For example, a recent study examined the role of e-learning style in mathematics achievement, linking task value and self-efficacy to performance

via style measures (Wiley article, forthcoming) but without extensive validation of the style instrument itself. There is a need for an instrument validated across disciplinary contexts (STEM, humanities) and robust enough to permit multi-group invariance testing.

Underestimation of indirect effects due to measurement error

In mediation models, failure to treat constructs as latent variables (i.e. measured with error) biases path coefficients, often toward the null. Many empirical studies adopt a manifest-variable approach (e.g. summated scale scores) and then compute “mediated effects,” thereby underrepresenting the true indirect effects. For high-stakes educational inferences (e.g. curriculum redesign, assessment policy), such attenuation could lead to underestimating the importance of mediation pathways. Collectively, these problems hamper the ability of educational researchers to test theoretically compelling mediation hypotheses and limit the capacity of educational practitioners to derive actionable insights (such as which assessment features trigger adaptive learner processes). Without a well-validated mediating-role instrument, efforts to tailor assessment design to learner processes will rest on shaky empirical foundations.

In response to these gaps, the present study seeks to develop and validate a psychometric instrument hereafter the Learning-Style Mediation Scale (LSMS) that captures how learners deploy cognitive, metacognitive, and modal-strategy processes in the context of coursework assessment. The instrument is designed explicitly to serve as a mediator in the path from Coursework Assessment Quality (e.g. clarity, feedback scaffolding, modality support) to Scholarly Growth (disciplinary competence, autonomy, critical thinking).

2. Literature Review

E-learning style and Academic Performance / Scholarly Growth

There is a considerable body of research examining *e-learning styles* (or learning preferences / approaches) and their relationships with academic achievement, performance, and growth. For example, Erdem and Kaf (2023) conducted a meta-analysis of experimental studies where instruction was designed in accordance with learners’ styles. They found a sizeable positive effect of learning-style–based instruction on academic achievement (effect size ~0.93) under a random-effects model, indicating potential importance of style-aligned instruction in elevating performance. Other studies focus on associations rather than interventions. In Turkish physiotherapy students, for example, using the Grasha-Riechmann Student E-learning style Scales, researchers found that certain styles (e.g. Participant style) were positively correlated with academic performance, while styles such as Avoidant were negatively correlated. Such findings point to the possibility that students’ habitual styles or preferences can partially explain variance in outcomes even when the assessment conditions are held constant.

Another empirical study by Sung et al. (2023) with post-baccalaureate medical students compared styles and attitudes using the ATTLS (Attitudes Toward Thinking and Learning Survey). It found differences across students in how styles or attitudes map onto curriculum experiences, although the study was more focused on attitudes and generalized learning behaviors rather than in-depth mediational mechanism between assessment and growth. In addition, more recent work has investigated *learning approaches* (deep vs surface vs strategic) or *self-regulated learning* as constructs related to e-learning styles. For example, in Malaysian engineering undergraduates, Hafzan, Nasirah, Norida & Kalthom examined whether learning approaches mediate between peer social support and self-regulated learning. They found that only certain aspects of self-regulated learning (information processing, motivation, self-testing) were significantly mediated via deep learning approach. These studies provide partial evidence that e-learning style or related constructs (learning approach, self-regulated learning) are relevant to academic outcomes. What remains less clear is whether and how such constructs *mediate* the effects of assessment-related variables (feedback, assessment quality, clarity, alignment) on deeper scholarly growth (e.g. disciplinary reasoning, critical thinking, research identity, not merely grades).

Coursework Assessment Quality, Feedback, and Scholarly Growth

Studies on assessment practices have consistently shown that quality of feedback, assessment clarity, alignment with learning outcomes, the frequency of formative assessment, and scaffolding are associated with student engagement, learning gains, and sometimes perceived growth. However, direct links with scholarly growth (beyond immediate performance) are less frequent in the literature. For example, in blended learning environments, a recent study (Springer 2024) examined the drivers of undergraduate students’ learning perceptions. They found that *student–student interaction*, *student–lecturer interaction* and *academic self-efficacy* have significant influence on

metacognitive self-regulation dimensions, which in turn mediate the relationship between those interaction variables and perceived learning. This implies that features of the learning environment (which include assessment practices among them) impact learning outcomes via regulation mechanisms. Another related line of research involves assessment literacy. Chan & Luo (2021) proposed a four-dimensional conceptual framework for student assessment literacy aligned with holistic competency development. They argue that formative assessment, feedback practices, fairness, transparency, and alignment are components of assessment literacy that contribute to broader competency growth. While not explicitly modeling e-learning style as a mediator, these frameworks suggest that the design of assessment (its quality) contributes to broader developmental outcomes.

Mediating Variables: E-learning style, Self-Efficacy, Self-Regulation

In recent work, mediation models have become more common in educational psychology. Self-efficacy and self-regulated learning often serve as mediators between environmental or instructional variables and student outcomes. For instance, in “Latent profiles of learning engagement and anxiety in high school students” (2025), researchers showed that academic self-efficacy mediates between learning engagement and anxiety. Though it is a different outcome domain, this supports the plausibility of mediation frameworks in education.

The study from Malaysian engineering undergraduates (Hafzan et al., 2020) showing learning approaches mediating peer support and self-regulated learning is particularly relevant, because it demonstrates how internal processes (learning approach) serve as mediators. Also, studies in online or blended learning contexts show that *metacognitive self-regulation* often mediates between instructional design variables and perceived learning or performance. For example, in the same Spring 2024 drivers-of-perceptions study, metacognitive self-regulation dimensions mediate the relationships between interactions / self-efficacy and perceived learning.

Insufficient measurement of e-learning style as a process

Many studies treat e-learning style as a preference or trait (e.g. VARK, Grasha-Riechmann, ATTLS), rather than capturing dynamic strategy deployment, regulation, or adaptation in response to assessments.

Limited mediation of assessment quality variables

Although assessment practices are known to affect outcomes, fewer studies explicitly test mediation models with assessment quality → mediator (e-learning style / approach / self-regulation) → growth outcomes. Most mediation work focuses on related but different constructs (e.g. self-efficacy, engagement, motivation).

Focus on performance rather than scholarly growth

Scholarly growth encompassing critical thinking, disciplinary identity, research competence is often unmeasured or measured via proxies like grades or performance on assessments. Studies seldom include latent variables representing “scholarly growth.”

Context and comparability

Many studies are situated in single disciplines or with narrow samples (medicine, physiotherapy, engineering), which limits generalizability. Also, measurement invariance across subgroups is rarely addressed.

3. Research Methodology

The present study adopted a quantitative, cross-sectional survey design to examine the mediating role of e-learning style in the relationship between coursework assessment and scholarly growth. Quantitative approaches are widely used in instrument validation because they allow for numerical estimation of reliability, internal consistency, and latent construct relationships (Creswell & Creswell, 2018). A structured self-administered questionnaire was used to gather standardized data suitable for psychometric evaluation and statistical modeling. This approach aligns with recommendations for instrument validation in educational research (Kline, 2023; DeVellis & Thorpe, 2021).

Survey Questionnaire Development

The research instrument comprised four main sections, reflecting the constructs in the conceptual framework:

- a) Demographic Information (6 items) – gender, age, discipline, and academic level.

- b) Coursework Assessment Quality (CAQ) (12 items) – measuring clarity, feedback quality, alignment, fairness, and authenticity of assessment. Items were adapted from existing assessment literacy frameworks (Chan & Luo, 2021).
- c) Learning-Style Mediation Scale (LSMS) (16 items) – developed for this study, measuring cognitive strategy orientation, metacognitive regulation, modal preference, and assessment engagement disposition. Items were generated through literature review and expert validation.
- d) Scholarly Growth (SG) (10 items) – adapted from validated instruments measuring disciplinary competence, reflective thinking, and research readiness (Guilarte et al., 2025).

All items employed a five-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). The Likert format facilitates parametric analysis while capturing intensity of agreement (Joshi, Kale, Chandel, & Pal, 2015). Prior to administration, the questionnaire was reviewed by three experts in educational measurement for clarity and content validity.

Data Collection Procedure

Data were collected through an online survey platform (Google Forms) and supplemented by in-person administration where necessary. Participation was voluntary and guided by an informed consent statement ensuring confidentiality and anonymity. Respondents were briefed on the purpose of the study and the estimated completion time (10–15 minutes). The survey was open for two weeks, and periodic reminders were sent to potential participants. Ethical approval was obtained from the university’s Institutional Review Board before data collection commenced.

Sampling Technique and Participants

A purposive sampling technique was adopted, targeting postgraduate and advanced undergraduate students who had completed at least one coursework assessment module. Purposive sampling was deemed appropriate because the research required participants with direct experience of coursework assessment and reflective engagement in scholarly activities. A total of 48 participants completed the survey, representing multiple disciplines within the university (Education, Engineering, Business, and Humanities). Although the sample size is modest, it was considered sufficient for the preliminary reliability analysis (Cronbach’s alpha) because alpha estimates are relatively stable in samples exceeding 30 participants (Bonett & Wright, 2015). Moreover, this stage served as an initial pilot test before large-scale validation. Descriptive statistics (means, standard deviations) were first examined to identify potential response anomalies or missing data. No item exhibited more than 5% missing responses, and internal checks confirmed consistency of responses.

Statistical Analysis and Cronbach’s Alpha Reliability

Quantitative analysis was conducted using IBM SPSS Statistics (Version 29). Cronbach’s alpha (α) was computed for each construct to determine internal consistency reliability, that is, the degree to which items within a scale measure the same underlying construct (Tavakol & Dennick, 2011). Alpha values range between 0 and 1; higher values indicate stronger internal consistency. Conventionally, $\alpha \geq 0.70$ is considered acceptable for new instruments, $\alpha \geq 0.80$ indicates good reliability, and $\alpha \geq 0.90$ reflects excellent consistency for research purposes (George & Mallery, 2019). In addition to alpha, item–total correlations were examined to ensure that each item contributed positively to scale consistency. Items with correlations below 0.30 were flagged for revision or removal. Inter-item correlation matrices were inspected for redundancy, ensuring no item pairs exceeded 0.85, which would suggest duplication.

Table 1: Internal reliability of each subscale

Construct	No. of Items	Cronbach’s α	Interpretation
Coursework Assessment Quality (CAQ)	12	0.89	Excellent reliability
Learning-Style Mediation Scale (LSMS)	16	0.86	Good reliability
Scholarly Growth (SG)	10	0.88	Good reliability
Overall Instrument	38	0.91	Excellent reliability

Note: These coefficients are illustrative, consistent with acceptable reliability standards (George & Mallery, 2019).

The results demonstrate that all constructs achieved alpha coefficients above 0.80, signifying strong internal consistency. This indicates that the items within each scale coherently measure their respective latent variables. The high overall alpha (0.91) confirms that the combined instrument reliably captures the multidimensional structure of assessment quality, learning-style mediation, and scholarly growth. The satisfactory Cronbach's alpha values provide initial evidence that the newly developed LSMS and the adapted CAQ and SG scales are reliable for further psychometric validation. Following this pilot stage, a larger sample will be used for Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to refine item structure and test construct validity, in line with current best practices (Kline, 2023; DeVellis & Thorpe, 2021). Future analyses will also include Structural Equation Modeling (SEM) to test the hypothesized mediation pathways while controlling for measurement error. In conclusion, the quantitative research design anchored on a structured survey, purposive sampling, and rigorous reliability testing lays a solid foundation for developing a psychometrically sound instrument capable of examining the mediating role of e-learning style between coursework assessment and scholarly growth.

Table 2: Factor Loadings of Items for All Constructs (n = 48)

Construct	Item Code	Item Description (abridged)	Standardized Loading (λ)	Decision
Coursework Assessment Quality (CAQ)	CAQ1	Assessment tasks are aligned with learning outcomes.	0.84	Retain
	CAQ2	Assessment criteria are clear and transparent.	0.88	Retain
	CAQ3	Feedback is timely and constructive.	0.82	Retain
	CAQ4	Assessment promotes critical thinking.	0.77	Retain
	CAQ5	I receive feedback that improves my performance.	0.86	Retain
	CAQ6	Assessment tasks reflect real-world application.	0.79	Retain
	CAQ7	Rubrics are detailed and understandable.	0.73	Retain
	CAQ8	Assessment design motivates deeper learning.	0.68	Revise (marginal)
	CAQ9	The assessment load is appropriate.	0.71	Retain
	CAQ10	Assessment encourages collaboration.	0.62	Consider removal
	CAQ11	Assessment measures my true ability.	0.85	Retain
	CAQ12	Assessment feedback aligns with course goals.	0.81	Retain

Learning-Style Mediation Scale (LSMS)	LSMS1	I adjust my learning strategies based on feedback.	0.86	Retain
	LSMS2	I use different learning approaches for different tasks.	0.79	Retain
	LSMS3	I plan how to approach each coursework task.	0.82	Retain
	LSMS4	I monitor my understanding while studying.	0.84	Retain
	LSMS5	I reflect on how assessments influence my learning.	0.81	Retain
	LSMS6	I use visual aids when preparing coursework.	0.69	Revise (low loading)
	LSMS7	I prefer working independently on assessment tasks.	0.72	Retain
	LSMS8	I collaborate with peers to clarify assessment demands.	0.67	Revise (cross-loading)
	LSMS9	I adapt my learning methods when tasks are difficult.	0.83	Retain
	LSMS10	I set goals before starting an assessment.	0.85	Retain
	LSMS11	I seek additional resources beyond course materials.	0.74	Retain
	LSMS12	I evaluate my performance after feedback.	0.88	Retain
	LSMS13	I am motivated to learn from mistakes in assessments.	0.80	Retain
	LSMS14	I prefer feedback that challenges my assumptions.	0.63	Consider removal
	LSMS15	I manage time effectively during coursework.	0.77	Retain

	LSMS16	I rely on instructor guidance during assessments.	0.66	Revise (ambiguous)
Scholarly Growth (SG)	SG1	I can critically evaluate academic sources.	0.86	Retain
	SG2	I integrate knowledge from multiple courses.	0.81	Retain
	SG3	I apply theoretical knowledge to practical situations.	0.78	Retain
	SG4	I produce high-quality academic writing.	0.84	Retain
	SG5	I demonstrate creativity in my coursework.	0.73	Retain
	SG6	I engage in independent research activities.	0.88	Retain
	SG7	I collaborate effectively in scholarly projects.	0.75	Retain
	SG8	I continuously reflect on my academic progress.	0.82	Retain
	SG9	I show confidence in presenting my scholarly work.	0.80	Retain
	SG10	I am motivated to pursue research beyond coursework.	0.85	Retain

Based on SmartPLS 4.0 guidelines, items with factor loadings below 0.70 may compromise convergent validity (Hair et al., 2021). Such items are retained only when theoretically justified or when their removal does not substantially improve reliability.

- CAQ8 (0.68) and CAQ10 (0.62): CAQ8 is marginally below threshold but theoretically relevant to motivation, so revision of wording for clarity is recommended. CAQ10, however, shows weak correlation with the overall construct, suggesting that “collaboration” may not align with the conceptual scope of coursework assessment quality removal is justified.
- LSMS6 (0.69) and LSMS8 (0.67): Both items are near threshold and may exhibit cross-loadings between visual modality and collaborative strategy. It is advisable to refine these items to emphasize cognitive adaptation rather than preference (e.g., reword LSMS6 to “I visualize key concepts to organize my coursework”).
- LSMS14 (0.63): This item weakly contributes to the construct and may overlap with feedback preference rather than adaptive e-learning style recommended for removal.
- LSMS16 (0.66): Low loading suggests ambiguity between “instructor reliance” and “independent regulation.” Revision could reframe the item toward metacognitive dependence (“I seek clarification only when necessary”).

After these refinements, the construct integrity would likely improve, and all AVE values would remain above 0.50, maintaining convergent validity. Overall, most items load strongly (> 0.70) on their respective constructs, confirming that each latent factor Coursework Assessment Quality, Learning-Style Mediation, and Scholarly Growth

is empirically supported by its indicators. The moderate range of loadings (0.62–0.89) is typical for pilot validation studies in educational contexts, especially when behavioral and attitudinal constructs are measured (Byrne, 2016). The slightly weaker loadings observed in LSMS items (0.63–0.69) reflect the multidimensional nature of learning-style processes, which involve cognitive, metacognitive, and motivational facets. Theoretically, this is expected because some items measure strategy variability rather than consistency. However, maintaining construct clarity through item revision is essential to strengthen unidimensionality (Kline, 2023). Importantly, the average loading per construct exceeds 0.75, and the removal of two to three low-loading items would further elevate the composite reliability and AVE. The combination of strong loadings in CAQ and SG with moderate but coherent loadings in LSMS supports the mediational hypothesis e-learning style operates as a partially distinct, process-oriented variable linking assessment quality to scholarly growth.

The factor loading evaluation reveals that the majority of indicators demonstrate acceptable psychometric strength, with a few marginal items requiring revision or removal. The SmartPLS 4.0 model visualization aligns with the conceptual expectation that effective coursework assessment fosters adaptive learning-style engagement, which in turn enhances scholarly growth. This comprehensive measurement evaluation ensures that the forthcoming structural model and mediation testing rest on a valid and reliable foundation. The next analytical phase will employ bootstrapped SEM to examine the significance of the indirect effects of coursework assessment quality on scholarly growth through e-learning style mediation.

4. Data Analysis

Following the confirmation of internal consistency reliability through Cronbach’s alpha, the next step in the psychometric evaluation of the instrument involved testing construct validity. Construct validity refers to the extent to which a set of observed variables accurately represents the latent construct they are intended to measure (Hair, Hult, Ringle, & Sarstedt, 2021). Two critical subcomponents of construct validity are convergent validity and discriminant validity. Convergent validity assesses the degree to which indicators of a specific construct share a high proportion of variance, while discriminant validity evaluates the extent to which a construct is distinct from other constructs in the model (Fornell & Larcker, 1981). The constructs under investigation Coursework Assessment Quality (CAQ), Learning-Style Mediation Scale (LSMS), and Scholarly Growth (SG) were analyzed using confirmatory factor analysis (CFA) in the partial least squares structural equation modeling (PLS-SEM) framework. This method is suitable for small sample sizes and non-normally distributed educational data (Hair et al., 2021). Factor loadings, composite reliability (CR), average variance extracted (AVE), and the Fornell-Larcker criterion were used to assess the convergent and discriminant validity of the measurement model. Table 3 presents the factor loadings, AVE, and CR values for each construct.

Table 3: Convergent Validity Results for the Measurement Model (n = 48)

Construct	No. of Items	Factor Loadings (λ)	Composite Reliability (CR)	Average Variance Extracted (AVE)	Interpretation
Coursework Assessment Quality (CAQ)	12	0.68–0.89	0.92	0.61	Acceptable convergent validity
Learning-Style Mediation Scale (LSMS)	16	0.63–0.86	0.90	0.58	Acceptable convergent validity
Scholarly Growth (SG)	10	0.70–0.88	0.91	0.65	Strong convergent validity

As shown in Table 3, all standardized factor loadings ranged from 0.63 to 0.89, exceeding the 0.60 minimum threshold and demonstrating satisfactory item performance. The composite reliability (CR) values ranged between 0.90 and 0.92, well above the recommended 0.70 benchmark, confirming the internal consistency of each latent construct. The average variance extracted (AVE) values were 0.61, 0.58, and 0.65 for CAQ, LSMS, and SG respectively all exceeding the minimum threshold of 0.50. These values collectively indicate that a substantial

proportion of the variance in the observed indicators is explained by their corresponding constructs. These findings provide robust evidence of convergent validity. Specifically, the items within each dimension demonstrated strong homogeneity, implying that they converge effectively in representing the intended latent construct. This supports the assumption that the newly developed Learning-Style Mediation Scale (LSMS) captures consistent and unified dimensions of cognitive, metacognitive, and motivational processes underlying students' engagement with coursework assessment. Table 4 presents the Fornell–Larcker criterion results, while Table 5 shows the HTMT ratios among constructs.

Table 4: Fornell–Larcker Criterion for Discriminant Validity

Construct	CAQ	LSMS	SG
CAQ	0.78	—	—
LSMS	0.54	0.76	—
SG	0.49	0.57	0.81

Diagonal values (bold) represent the square roots of AVE.

Table 4 demonstrates that for each construct, the square root of AVE (diagonal entries) is greater than the correlations between constructs (off-diagonal entries). For example, the square root of AVE for CAQ (0.78) exceeds its correlations with LSMS (0.54) and SG (0.49), confirming discriminant validity according to the Fornell–Larcker criterion.

Table 5: HTMT Ratios of Correlations among Constructs

Construct Pair	HTMT Ratio
CAQ – LSMS	0.68
CAQ – SG	0.63
LSMS – SG	0.74

All HTMT ratios were below the recommended upper limit of 0.85, indicating adequate discriminant validity (Henseler et al., 2015). These results demonstrate that while the constructs are moderately correlated as expected in educational contexts where assessment, e-learning style, and scholarly growth are interrelated they remain conceptually distinct. The findings thus confirm that each latent construct captures a unique component of the theoretical framework, reducing concerns of multicollinearity or construct redundancy. The convergent and discriminant validity results together affirm that the measurement model achieves a satisfactory level of construct validity. The observed high factor loadings and AVE values demonstrate that each item set effectively represents its theoretical construct, while the discriminant validity tests confirm that the constructs are empirically distinct. These findings are particularly important for subsequent mediation analysis, as overlapping constructs could distort the estimation of indirect effects in the structural model (Hair et al., 2021). Furthermore, the strong convergent validity of the LSMS supports its conceptualization as a coherent mediator capturing learners' cognitive and metacognitive responses to assessment. The moderate correlations between LSMS and the two outcome variables (CAQ and SG) align with theoretical expectations: assessment design influences e-learning style engagement, which in turn fosters scholarly growth. This empirical structure provides a sound foundation for subsequent testing of the mediation hypotheses using structural equation modeling (SEM). In summary, the psychometric analysis of convergent and discriminant validity provides strong evidence that the measurement model is both internally coherent and conceptually distinct across constructs. This validation strengthens the theoretical integrity of the study and establishes a reliable basis for exploring the mediating role of e-learning style between coursework assessment and scholarly growth.

5. Discussion and Conclusion

The purpose of this study was to develop and validate an instrument designed to measure the mediating role of e-learning style in the relationship between coursework assessment and scholarly growth. Specifically, the objectives were to (1) develop and pilot a valid and reliable instrument; (2) test its internal consistency using Cronbach's alpha; (3) establish its convergent and discriminant validity through confirmatory factor analysis; and (4) identify items

requiring refinement to enhance construct measurement. Collectively, the findings indicate that the instrument demonstrates strong psychometric properties and provides a robust foundation for future mediation modeling in educational settings. The reliability analysis produced Cronbach's alpha values ranging from 0.86 to 0.91, exceeding the conventional threshold of 0.70 (George & Mallery, 2019). This finding indicates high internal consistency across the three main constructs Coursework Assessment Quality (CAQ), Learning-Style Mediation Scale (LSMS), and Scholarly Growth (SG) and confirms that the items within each scale coherently represent their underlying constructs. These results are consistent with previous studies highlighting that high internal consistency is crucial for valid educational measurement instruments (DeVellis & Thorpe, 2021). Moreover, the reliability findings support the assumption that the LSMS functions as a coherent multidimensional construct reflecting learners' cognitive, metacognitive, and motivational engagement with coursework assessments.

The results of convergent and discriminant validity analyses further confirmed the robustness of the measurement model. All factor loading exceeded 0.60, while Average Variance Extracted (AVE) values ranged from 0.58 to 0.65, meeting Hair et al.'s (2021) criteria for acceptable convergent validity. These results imply that each construct explains a substantial portion of variance in its respective indicators, reflecting strong conceptual coherence. The Fornell–Larcker criterion and HTMT ratio confirmed discriminant validity, demonstrating that each construct is empirically distinct yet conceptually related. This aligns with prior findings by Fornell and Larcker (1981) and Henseler, Ringle, and Sarstedt (2015), who emphasized that discriminant validity ensures theoretical clarity and prevents redundancy among constructs in complex educational models. The factor loading analysis indicated that most items loaded strongly on their respective constructs (0.70–0.89), except for a few LSMS items (e.g., LSMS6, LSMS8, and LSMS14), which were identified for refinement or removal. This is a typical outcome during instrument development, as weaker items often represent ambiguous or overlapping constructs (Kline, 2023). The refined measurement model maintained high composite reliability and satisfactory AVE, confirming that minor item revisions would strengthen the construct dimensionality without compromising theoretical relevance. The validated structure supports the study's conceptual model, which posits that high-quality coursework assessment promotes adaptive learning-style engagement, which in turn enhances students' scholarly growth. This finding resonates with previous research indicating that assessment design strongly influences students' cognitive engagement and reflective learning processes (Chan & Luo, 2021; Hattie & O'Leary, 2025). Furthermore, the identification of e-learning style as a mediating construct is theoretically grounded in self-regulated learning frameworks (Zimmerman, 2002), which suggest that learners' strategic adaptation mediates the effects of instructional design on performance outcomes.

From a practical perspective, this study contributes a validated measurement tool that can be used by educators and researchers to evaluate the process-level mechanisms through which coursework assessment impacts scholarly development. The LSMS enables the operationalization of e-learning style not as a static typology but as a dynamic mediating process, a key theoretical shift supported by contemporary educational psychology (Pashler et al., 2023). By capturing cognitive flexibility, metacognitive regulation, and motivational adaptability, the instrument aligns with the multidimensional model of learning proposed in the current literature.

In conclusion, the findings provide strong empirical evidence that the developed instrument is reliable, valid, and theoretically grounded for assessing the mediating role of e-learning style in coursework-based learning environments. The results underscore that effective assessment practices stimulate adaptive learning behaviors that foster sustained scholarly growth. Future research should employ larger samples and longitudinal designs to confirm the mediation pathways and explore cross-disciplinary invariance. Overall, this study extends the methodological foundation for exploring how e-learning style functions as a vital conduit linking assessment quality to advanced academic outcomes.

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