Received: 28 JUN 2025 | Accepted: 30 NOV 2025 | Published Online: 30 NOV 2025
Recoletos Multidisciplinary Research Journal Vol. 13 no. 2Si (November 2025)
DOI: https://doi.org/10.32871/rmrj1302si.i2504

Original Article

Tri-X Modality Continuance: A Digital Learning Innovation in the Context of the New Normal

Ma. Janice J. Gumasing[1*], Althea Loreen B. Aguilar[2], Dana Marie T. delos Santos[2], Shaina Polyne S. Fajatin[2], Dominador Jr. V. Magtoto[2], Loreli Denice Oaing[2], Ardvin Kester S. Ong[3]

[1] Department of Industrial and Systems Engineering, Gokongwei College of Engineering, De La Salle University, Manila, Philippines

[2] Young Innovators Research Center, Mapua University, Manila, Philippines

[3] School of Industrial and Systems Engineering, Mapua University, Manila, Philippines

*Correspondence:
ma.janice.gumasing@dlsu.edu.ph

Abstract

Background: *While Hybrid-Flexible (HyFlex) learning models are increasingly adopted in higher education, sustaining students' continued engagement, particularly in STEM programs, remains a critical challenge. This study investigates the factors influencing STEM students' intention to continue using Tri-X, Mapúa University's Hyflex learning system, which enables in-person, online, and asynchronous participation.*

Methods: *A quantitative research design was adopted, involving 600 STEM students enrolled in Tri-X. Partial Least Squares Structural Equation Modeling was employed to assess the relationships among key determinants and analyze their impact on students' sustained use of the modality.*

Results: *Findings showed that information quality ($\beta = 0.415$, $p < 0.001$) and institutional support ($\beta = 0.261$, $p = 0.023$) significantly influenced perceived performance. Access to technology strongly predicts expectations ($\beta = 0.528$, $p < 0.001$) and also affects perceived performance ($\beta = 0.174$, $p = 0.029$). Perceived performance substantially predicts confirmation ($\beta = 0.794$, $p < 0.001$), which enhances satisfaction ($\beta = 0.455$, $p < 0.001$). Satisfaction is a strong driver of continuance intention ($\beta = 0.745$, $p < 0.001$). Overall, the model explains 55.5% of the variance in students' intention to continue using Tri-X.*

Conclusion: *The study extends Expectation-Confirmation Theory to HyFlex learning, emphasizing confirmation and satisfaction as key mediators. Practical implications underscore the necessity of high-quality content, robust institutional support, and equitable access to technology to sustain engagement in technology-enhanced learning environments.*

Keywords

HyFlex education, technology-enhanced learning, Expectation-confirmation theory, PLS-SEM, quality education, online learning

INTRODUCTION

The COVID-19 pandemic accelerated the transformation of higher education worldwide, compelling universities to adopt flexible learning systems that blend traditional and digital modes of delivery (Azouri, 2023). Among these, HyFlex (Hybrid-Flexible) learning has emerged as a widely discussed approach that allows students to participate in face–to-face, synchronous, or asynchronous classes, depending on their needs and circumstances (Bockorny et al., 2024; Hidayati et al., 2025). This model aims to promote inclusivity, adaptability, and continuity of instruction amid disruptions and the shift toward digitally enhanced education.

In the Philippines, universities are increasingly adopting flexible and technology-enhanced learning modalities in response to national policies on learning continuity and digital transformation in higher education. These initiatives seek to address long-standing challenges such as geographical disparities, variability in internet connectivity, and unequal access to digital devices (Ong et al., 2023; Sankey et al., 2023; Ali, 2025). While several local and regional studies have examined blended and online learning, empirical evidence on students' continued use of HyFlex systems in Philippine universities remains scarce, particularly with respect to factors that sustain engagement beyond initial implementation (Moldez, 2024).

Within this national landscape, Mapúa University has implemented the Tri-X modality, short for Triple experience, as its institutional adaptation of the HyFlex model (www.mapua.edu.ph). Introduced during the pandemic and sustained thereafter, Tri-X has enabled students to choose, on a per-session basis, whether to attend classes on-site or online. This design aims to support real-life, student-centered learning and to manage diverse academic, personal, and logistical constraints. Despite its promise, questions remain on how students' expectations, actual experiences, and satisfaction with Tri-X determine their intention to continue using this modality.

Continuance intention or learners' willingness to persist in using a learning system is a critical indicator of the sustainability of educational technologies (Almaiah et al., 2022; Cheng & Yuen, 2018; Ye et al., 2023). Prior research suggests that continuance is influenced by technological, psychological, and institutional determinants, including information quality, system usability, and support mechanisms (Cheng, 2020; Li & Zhu, 2022; Zheng et al., 2013). When there is accurate, relevant, and accessible instructional content, students develop stronger expectations and are more likely to sustain engagement (Barkley, 2020). Likewise, reliable access to digital infrastructure and responsive technical assistance enhance satisfaction and motivation, especially in resource-constrained settings such as many Philippine institutions (Khan et al., 2017). Institutional support further mediates students' learning experiences by providing technical help, faculty guidance, and a stable platform for academic interaction, thereby reducing frustration and aligning expectations with actual experiences (Chitrakar & Nisanth, 2023).

The Expectation-Confirmation Theory (ECT), introduced by Bhattacherjee (2001), offers a robust framework for explaining such post-adoption behavior. ECT posits that the continuance intention of users is driven by their pre-use expectations, post-use perceived performance, the confirmation or disconfirmation of those expectations, and the satisfaction that follows. When performance meets or exceeds expectations, users experience confirmation, which reinforces satisfaction and, in turn, the intention to continue system use. In educational contexts, ECT has been widely applied to understand learners' behavior toward e-learning, MOOCs, and blended learning systems (Cheng, 2023; Pan et al., 2024). Prior studies consistently show that confirmation mediates the relationship between perceived performance and satisfaction, while satisfaction directly predicts continuance intention (Li et al., 2022; Wang et al., 2021).

Despite these insights, limited research has applied ECT to HyFlex environments in developing countries, where technological constraints and institutional disparities may shape students' experiences differently from those in more advanced contexts. This study addresses this gap by articulating ECT to the Tri-X HyFlex environment at Mapúa University. Specifically, it incorporates contextual determinants—information quality, access to technology, and institutional support—as antecedents of expectations and perceived performance. This extended framework acknowledges that environmental and institutional conditions fundamentally shape students' experiences, satisfaction, and decisions to continue using flexible learning systems.

By validating this model among Philippine higher education students, the study contributes empirical evidence on continuance intention in a developing-country HyFlex context. The findings are expected to advance the literature by (1) integrating technological and institutional constructs into ECT, (2) explaining how these factors influence students' continued engagement in technology-enhanced flexible learning, and (3) providing practical insights to universities seeking to design, refine, and sustain HyFlex modalities such as Mapúa University's Tri-X system. Figure 1 shows the proposed conceptual framework for the analysis.

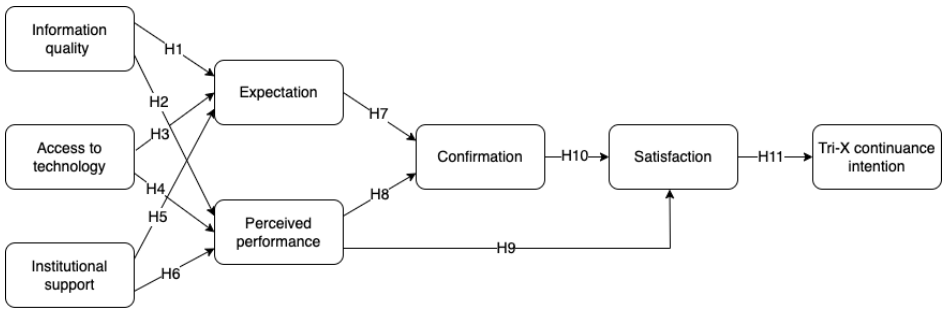

Figure 1. *Extended Expectation-Confirmation Model of Tri-X Modality Continuance*

Information quality refers to the accuracy, relevance, and reliability of the content and materials used in a Tri-X modality. Ensuring high-quality information is crucial for the effectiveness of the learning experience. Prior studies have proved that realistic and well-informed expectations are facilitated by high-quality information, which includes clear learning objectives, accurate and pertinent course descriptions, and transparent program specifics (Pickering, 2021). The degree to which an online or blended learning experience meets or exceeds expectations is the basis for evaluating its perceived performance, according to Al-Busaidi (2013). A favorable perceived performance is influenced by high-quality material that appropriately depicts the resources, structure, and content of the online course (Cheng & Yuen, 2018). With this, it was hypothesized that:

H1: Information quality positively affects expectation.
H2: Information quality positively affects perceived performance.

Access to technology refers to the availability and utilization of digital tools and resources that facilitate Tri-X modality (Rahi & Ghani, 2019) Tri-X creates an adaptable and dynamic learning environment by combining traditional classroom training with online components. In the context of online learning, expectation formation and perceived performance are two important elements of the Expectation-Confirmation Theory (ECT) paradigm that can be strongly impacted by the access and quality of technology available (Rahi & Ghani, 2019). Earlier studies indicate that access to technology is one crucial aspect in deciding whether or not people plan to continue with online or blended learnin. Additionally, the quality of access to technology significantly impacts how satisfied students are with their learning experience (Rodriguez et al., 2008). Satisfaction is influenced by adequate and dependable access that either meets or surpasses expectations (Ojo, 2010). With this, it was hypothesized that:

H3: Access to technology positively affects expectations.
H4: Access to technology positively affects perceived performance.

Institutional support refers to the assistance, tools, and frameworks that educational institutions offer to enable the successful application of Tri-X learning modality. According to studies, educators and students need this help to successfully negotiate the combination of traditional face-to-face instruction and online learning components, (Bartley & Golek, 2004; Singh et al., 2022). Hentea et al. (2003) posit that accurate expectations are developed by instructors and students when there is clear communication regarding the resources, technology infrastructure, and degree of institutional support. Similarly, Al Omari et al. (2020) revealed that perceived performance is positively impacted by institutional support for an efficient technology infrastructure, including a dependable learning management system (LMS) and technical assistance. With this, it was hypothesized that:

H5: Institutional support positively affects expectation.
H6: Institutional support positively affects perceived performance.

Confirmation refers to how students assess their experiences in the Tri-X learning environment compared to their preconceived notions. Learners receive guarantee when they believe their experiences match or fulfill their preconceived notions. Prior studies conducted in mixed and online learning environments have demonstrated that positive proof occurs when learners' expectations match their experiences, which raises satisfaction and engagement levels (Lee et al., 2010; Sahin & Shelley, 2008). Research on e-learning and

technology acceptance also highlights that favorable perceived performance—that is, usability and simplicity of use—confirms users' expectations. At the same time, according to Islam's (2013) research on e-learning systems, users' expectations were confirmed mainly when they reported positive performance. Additionally, studies conducted in the past in the context of blended have demonstrated that higher satisfaction levels occur when learners' expectations are met or surpassed (Almusharraf & Khahro, 2020). Initial expectations and overall satisfaction of learners were shown to be positively correlated with expectations and satisfaction in blended learning environments (Wu et al., 2010). With this, it was hypothesized that:

H7: Expectation positively affects confirmation.
H8: Perceived performance positively affects confirmation.
H9: Perceived performance positively affects satisfaction.
H10: Confirmation positively affects satisfaction.

In the context of Tri-X learning, satisfaction is defined as learners' general sense of fulfillment and happiness with the course material. It includes several elements, such as the quality of the content, the degree of participation, the usability of online resources, and the efficacy of in-person communication. Regarding continuation intention, satisfaction with the integrated learning process is a strong predictor (Lee et al., 2010). According to the ECT model, people who are satisfied with their experiences are likelier to continue with the learning program (Cheng et al., 2014). With this, it was hypothesized that:

H11: Satisfaction positively affects Tri-X continuance intention.

METHODS

Study Design

This study's research approach consisted of multiple steps. It started with formulating the research questions and study objectives to determine the direction and scope of the research. The researchers then chose a quantitative research methodology to analyze and to model the intricate interactions among various variables using Partial-Least Structural Equation Modeling (PLS-SEM). The target participants were Mapúa Senior High School students.They employed purposive sampling to determine a sample size of 600 participants for statistical significance and robust findings using SEM analysis. The researchers conducted an online survey on Tri-X modality continuance among Mapúa Senior High School students using Google Forms, which contained demographic questions and questions for all latent variables based on their framework.

Population

The study required a minimum of 300 participants to acquire accurate results, however, a total of 600 participants were gathered from the study. Participants were systematically selected from the target population of Mapúa University Senior High School students. The researchers employed purposive sampling for statistical significance using SEM analysis. A purposive sampling technique was used to recruit respondents who met the following inclusion criteria:

1. Currently enrolled in the STEM strand under the Tri-X modality;
2. Aged 18 years and above to ensure legal consent;
3. Had completed at least one full term under the Tri-X system.

Students who were under 18 years old or had no prior experience with Tri-X courses were excluded. Although purposive sampling limited generalization, researchers justified it as the most appropriate approach given the specific institutional focus and the need to collect responses from experienced users of the Tri-X modality.

Setting

In this research setting, data was collected within the Mapúa University (Intramuros) campus during school hours. The purpose of the data collection was to understand various aspects of the school environment, such as student behavior, academic performance, and teacher effectiveness. The data were typically gathered using a questionnaire to conduct surveys to students. The researchers needed to obtain the necessary permissions from the students before conducting any data collection activities. Additionally, appropriate measures were taken to ensure the privacy and confidentiality of the collected data.

Data Collection

The survey instrument consisted of 38 items divided into two main sections. The first section covered the demographic profile (6 items), which included questions on age, gender, academic strand, year level, and students' experience with the Tri-X modality. The second section measured latent constructs (32 items) using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The items were adapted from validated instruments in previous studies on Expectation-Confirmation Theory (ECT) and blended learning, with minor contextual modifications to suit the Tri-X learning environment. Specifically, Information Quality (4 items) was adapted from Smith and Basham (2014), Access to Technology (4 items) from Mirriahi et al. (2015), and Institutional Support (4 items) from Smith and Basham (2014) and Wisdom and Agnor (2007). Constructs related to Expectation (4 items) and Perceived Performance (4 items) were drawn from Bhattacherjee (2001), while Confirmation (4 items) and Satisfaction (4 items) were adapted from Dai et al. (2020). Finally, Continuance Intention (4 items) was based on the work of Hodges (2008) and Becirovic et al. (2022). An expert panel reviewed all adapted items to ensure content validity, and a pilot test involving 30 students was conducted to confirm the clarity, reliability, and contextual suitability of the instrument. A comprehensive summary of the constructs, corresponding sources, and measurement indicators is presented in Appendix A.

Data Analysis

Data were analyzed using SmartPLS 4.0 following a two-step approach. The first step involved measurement model evaluation, which assessed the reliability and validity of each construct. Internal consistency reliability was examined through Cronbach's alpha and Composite Reliability (CR), both of which were expected to meet the threshold of 0.70 or higher. Convergent validity was assessed using the Average Variance Extracted (AVE), with acceptable values above 0.50, while discriminant validity was verified through the Heterotrait-Monotrait Ratio (HTMT), which should remain below 0.85. The second step, structural model evaluation, tested the hypothesized paths and the predictive strength of the model. Multicollinearity was checked using the Variance Inflation Factor (VIF), ensuring values were below 5.0. The overall model fit was assessed using the Standardized Root Mean Square Residual (SRMR), which should be less than 0.08. Hypothesis significance was tested through bootstrapping with 5,000 resamples at a 95% confidence level, while the coefficient of determination (R^2) was interpreted as small (0.25), moderate (0.50), or substantial (0.75) following the criteria proposed by Hair et al. (2021). This systematic approach ensured that both measurement precision and predictive validity were evaluated according to established PLS-SEM standards in educational and behavioral research.

RESULTS

Measurement Model Evaluation

The measurement model shown in Figure 2 was evaluated to ensure reliability and validity of all constructs. As presented in Table 1, all factor loadings exceeded 0.70, and Cronbach's alpha (α), Composite Reliability (CR), and Average Variance Extracted (AVE) values met recommended thresholds (α, CR ≥ 0.70; AVE ≥ 0.50), confirming internal consistency and convergent validity.

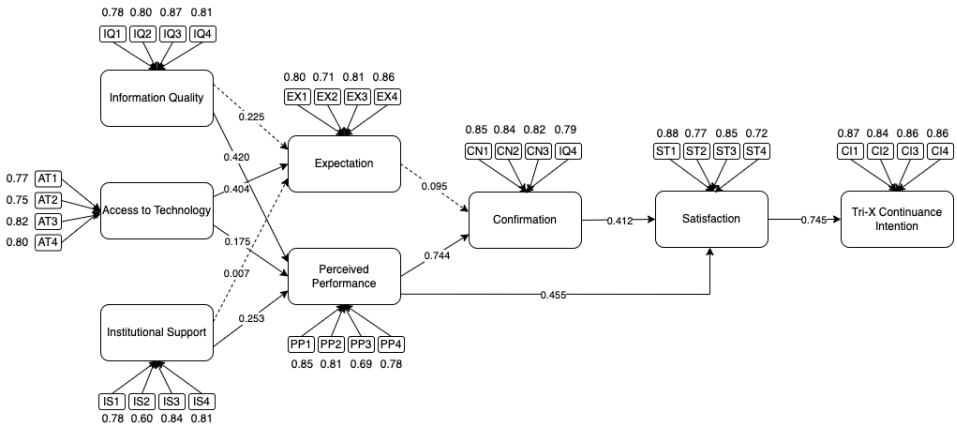

Figure 2. *Initial PLS-SEM Model of Tri-X Modality Continuance*

Table 2 and Table 3 present discriminant validity results using the Fornell–Larcker criterion and the Heterotrait–Monotrait Ratio (HTMT). All diagonal AVE square roots were greater than inter-construct correlations, and all HTMT values were below 0.85, confirming discriminant validity.

Model fit indices also indicated an acceptable fit (SRMR = 0.062 < 0.08; NFI = 0.921 > 0.90; $\chi^2/df = 4.03 < 5.0$), as summarized in Table 4. These results collectively establish the adequacy of the measurement model for further structural analysis.

Table 1. *Reliability and convergent validity result*

Metric	Corner 1	Corner 2	Corner 3	Corner 4
Accuracy	78%	70%	89%	84%
Error Rate	22%	30%	11%	16%
Recall	81%	71%	89%	87%
Precision	95%	89%	98%	95%
F1-Score	87%	79%	93%	91%
Specificity	40%	70%	90%	30%

Table 2. *Discriminant Validity: Fornell-Lacker Criterion*

	AT	CN	CI	EX	IQ	IS	PP	ST
AT	0.785							
CN	0.587	0.823						
CI	0.600	0.710	0.855					
EX	0.663	0.623	0.654	0.796				
IQ	0.437	0.531	0.565	0.653	0.817			
IS	0.667	0.656	0.640	0.673	0.497	0.763		
PP	0.448	0.611	0.527	0.446	0.329	0.585	0.783	
ST	0.716	0.720	0.608	0.698	0.526	0.676	0.575	0.806

Table 3. *Discriminant Validity: Heterotrait-Monotrait Ratio*

	AT	CN	CI	EX	IQ	IS	PP	ST
AT								
CN	0.623							
CI	0.648	0.771						
EX	0.723	0.679	0.726					
IQ	0.496	0.591	0.652	0.762				
IS	0.733	0.723	0.720	0.759	0.579			
PP	0.426	0.752	0.558	0.446	0.347	0.663		
ST	0.770	0.769	0.661	0.758	0.595	0.747	0.588	

Structural Model Evaluation

Table 4 presents the goodness-of-fit indices for the structural model. The Standardized Root Mean Square Residual (SRMR = 0.062) is below the recommended threshold of 0.08, indicating an acceptable fit between the observed and predicted correlations (Hu & Bentley, 1999). The adjusted chi-square ratio ($\chi^2/df = 4.03$) also falls within the acceptable range (< 5.0), suggesting that the model achieves an adequate level of parsimony and accuracy (Hu & Bentley, 1999). Furthermore, the Normed Fit Index (NFI = 0.921) exceeds the minimum cut-off value of 0.90, confirming a strong overall model fit (Gumasing & Sobrevilla, 2023). Collectively, these results demonstrate that the extended Expectation-Confirmation Model achieves satisfactory model adequacy, supporting the reliability of the structural relationships among the latent constructs.

Table 4. *Model Fit*

Model Fit for SEM	Parameter Estimates	Minimum cut-off	Reference
SRMR	0.062	< 0.08	Hu & Bentler, 1999
(Adjusted) Chi-square/dF	4.03	<5.0	Gumasing & Sobrevilla, 2023
Normal Fit Index (NFI)	0.921	> 0.90	

The structural model was assessed to test the hypothesized relationships among constructs. Figure 3 illustrates the final model, including standardized path coefficients and significance levels. All paths were estimated using bootstrapping with 5,000 resamples at a 95% confidence level.

The model explained substantial variance in key endogenous variables: $R^2 = 0.55$ for Continuance Intention, $R^2 = 0.47$ for Satisfaction, and $R^2 = 0.64$ for Confirmation, indicating moderate to strong explanatory power according to criteria of Hair et al. (2021). The computed effect sizes (f^2) ranged from small to large (0.02–0.56), demonstrating varying contributions of predictors across constructs.

The Q2 statistics, obtained through blindfolding, were 0.39 for Continuance Intention, 0.32 for Satisfaction, and 0.45 for Confirmation, all exceeding the threshold of zero and confirming the model's predictive relevance.

In terms of relative path strength, Satisfaction → Continuance Intention ($\beta = 0.745$, $p < 0.001$) was the most influential relationship, indicating that emotional and experiential satisfaction is the strongest determinant of students' intention to continue using Tri-X. This result mirrors findings from Li et al. (2022) and Dai et al. (2020), where satisfaction consistently emerged as the most proximal predictor of technology continuance. The paths Perceived Performance → Confirmation ($\beta = 0.794$, $p < 0.001$) and Perceived Performance → Satisfaction ($\beta = 0.455$, $p < 0.001$) also exhibited strong practical significance, demonstrating that positive learning performance validates students' expectations and strengthens their emotional satisfaction.

Meanwhile, Information Quality ($\beta = 0.415$, $p < 0.001$), Access to Technology ($\beta = 0.174$, $p = 0.029$), and Institutional Support ($\beta = 0.261$, $p = 0.023$) contributed indirectly to continuance intention through perceived performance, highlighting the interdependence between technological and institutional enablers in hybrid learning contexts. Compared with Dai et al. (2020), who found similar medium-strength paths between system quality and satisfaction, the Tri-X model demonstrates comparable predictive accuracy and theoretical consistency across contexts.

Overall, the model's strong R^2, large effect sizes for key predictors, and high Q^2 values collectively affirm the robust explanatory and predictive capability of the extended Expectation-Confirmation Model in understanding students' post-adoption behavior toward the Tri-X HyFlex modality. The summary of hypothesis testing is shown in Table 5.

Table 5. *Hypothesis Test*

No	Relationship	Beta coefficient	p-value	f2 (effect size)	Result	Hypothesis
1	IQ→EX	0.007	0.962	0.00	Not Significant	Reject
2	IQ→PP	0.415	<0.001	0.07	Significant	Accept
3	AT→EX	0.528	<0.001	0.21	Significant	Accept
4	AT→PP	0.174	0.029	0.12	Significant	Accept
5	IS→EX	0.225	0.050	0.03	Not Significant	Reject
6	IS→PP	0.261	0.023	0.10	Significant	Accept
7	EX→CN	0.095	0.243	0.02	Not Significant	Reject
8	PP→CN	0.794	<0.001	0.56	Significant	Accept
9	PP→ST	0.455	<0.001	0.25	Significant	Accept
10	CN→ST	0.412	<0.001	0.18	Significant	Accept
11	ST→CI	0.745	<0.001	0.48	Significant	Accept

Figure 3 presents the final PLS-SEM path diagram with standardized coefficients and significant paths. Solid arrows represent significant relationships, while dashed arrows denote non-significant ones. The model demonstrates that information quality, access to technology, and institutional support indirectly affect continuance intention through their influence on expectation, perceived performance, confirmation, and satisfaction.

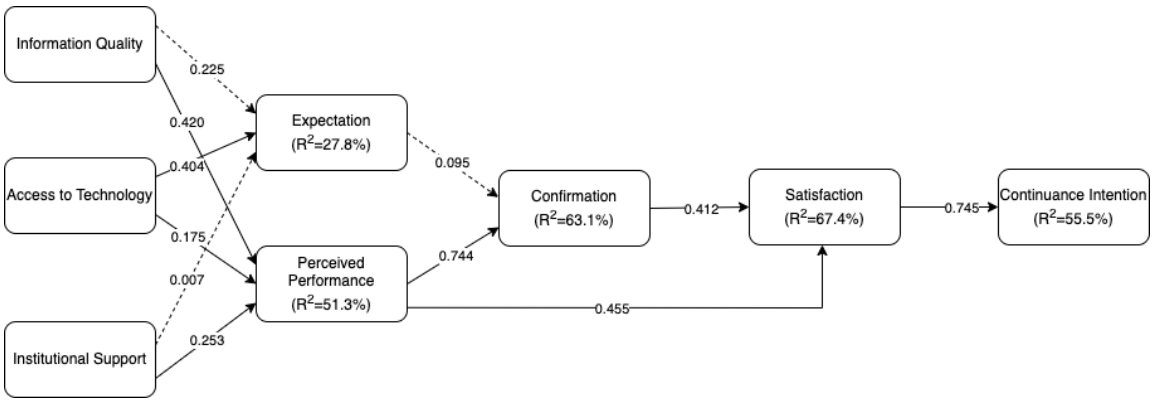

Figure 3. *Final PLS-SEM Model of Tri-X Modality Continuance*

DISCUSSION

The findings of this study demonstrate that students' intention to continue using the Tri-X modality is shaped by the interplay of technological, institutional, and psychological factors within the Expectation-Confirmation Theory (ECT) framework. Eight of the eleven hypothesized paths were supported, highlighting the central role of perceived performance, confirmation, and satisfaction as the primary drivers of continuance intention.

Consistent with Bhattacherjee's (2001) ECT, the results affirm that students' confirmation of expectations and resulting satisfaction are primary drivers of their willingness to continue using the Tri-X modality. Specifically, perceived performance emerged as a critical construct, exerting significant effects on both confirmation ($\beta = 0.794$, $p < 0.001$) and satisfaction ($\beta = 0.455$, $p < 0.001$). This relationship can be explained through self-efficacy theory, where positive performance outcomes reinforce learners' confidence in navigating hybrid environments. As students experience success, their sense of control over the technology increases, which enhances satisfaction and motivates continued use. Furthermore, consistent with cognitive dissonance theory, when students' experiences align with or surpass their initial expectations, psychological discomfort is minimized, fostering positive attitudes toward continued participation.

This implies that when students perceive Tri-X as effective and conducive to their learning, their expectations are validated, leading to a heightened sense of satisfaction. This process reflects the core ECT mechanism: when post-use experiences align with or exceed expectations, confirmation occurs, thereby reinforcing satisfaction and continuance intention. Similar findings were reported by Prifti (2022) and Al-Maroof et al. (2020) in blended and e-learning contexts, where perceived usefulness and performance were shown to strengthen users' continued adoption intentions.

Furthermore, satisfaction was found to significantly predict continuance intention ($\beta = 0.745$, $p < 0.001$), highlighting its affective dimension. This result aligns with Dai et al. (2020) and Bećirović et al. (2022), who established that satisfaction is the most immediate determinant of technology continuance in blended and hybrid learning environments. Within the Tri-X context, satisfied learners are likely to experience increased system trust, a key psychological mechanism in digital learning adoption. Trust reduces uncertainty regarding system reliability and institutional responsiveness (Bøe, 2018), reinforcing students' willingness to persist in using Tri-X as a primary learning platform.

On the other hand, information quality, access to technology, and institutional support indirectly influenced continuance intention through their effects on expectation and perceived performance. The significance of information quality ($\beta = 0.415$, $p < 0.001$) and access to technology ($\beta = 0.174$, $p = 0.029$) supports earlier findings by Islam (2013) and Li et al. (2022), emphasizing that accurate, timely, and accessible content

strengthens learners' cognitive assurance and confidence in digital systems. These findings also resonate with the Technology Acceptance Model (TAM), where system usability and information clarity enhance perceived usefulness and ease of use, which are critical antecedents of satisfaction and continued system use.

Meanwhile, institutional support ($\beta = 0.261$, $p = 0.023$) emerged as a key contextual enabler of perceived performance, emphasizing the role of organizational scaffolding in student success. However, institutional support in this study should be interpreted beyond general administrative assistance. It encompasses specific and actionable components such as (1) faculty digital pedagogy training, (2) stable IT infrastructure and bandwidth support, and (3) the implementation of learning analytics systems to monitor and to personalize student engagement. These forms of support reduce barriers to participation, enhance learning flow, and strengthen institutional trust. This aligns with Al Omari et al. (2020), who found that visible institutional responsiveness amplifies perceived system quality and satisfaction in technology-enhanced education.

The positive influence of information quality, technology access, and institutional support highlights the importance of sustained investment in educational infrastructure. Institutions should maintain robust digital platforms, ensure consistent connectivity, and provide responsive technical support for both faculty and students. Establishing continuous feedback and troubleshooting system will allow universities to refine hybrid learning delivery. Additionally, integrating data analytics for tracking student engagement can enhance the responsiveness and personalization of Tri-X learning environments.

In addition, the results emphasize the need for instructional strategies that reinforce satisfaction and expectation confirmation. Faculty should design activities that clearly communicate learning objectives and outcomes, ensuring students' expectations alignment to actual course experiences. Regular feedback mechanisms, reflective activities, and interactive learning designs can enhance perceived performance and satisfaction, leading to stronger continuance intentions. Faculty development programs should also emphasize adaptive pedagogies that support both synchronous and asynchronous learners within the Tri-X framework.

Three hypothesized relationships (H1, H5, and H7) were not supported, providing important theoretical insights. The non-significant path between information quality and expectation ($\beta = 0.007$, $p = 0.962$) implies that while students value accurate and relevant information, their expectations are shaped more by technology access and institutional factors than by content quality alone. This finding diverges from Li and Zhu (2022), who observed significant effects in fully online environments, suggesting that in hybrid or HyFlex models, expectations may depend more on the overall learning experience rather than a single content dimension.

The lack of a significant effect between institutional support and expectation ($\beta = 0.225$, $p = 0.050$) could be attributed to students' perception of institutional assistance as a baseline service rather than an expectation-shaping factor. Finally, the non-significant relationship between expectation and confirmation ($\beta = 0.095$, $p = 0.243$) contrasts with classical ECT predictions but can be explained by the dynamic nature of expectation formation in HyFlex settings. In this modality, students' expectations evolve continuously as they alternate between online and face-to-face participation, making post-use confirmation less directly dependent on pre-use expectations.

Compared with prior HyFlex and blended learning research, the present findings reinforce established patterns while articulating ECT to a new educational context. Similar to Makhija et al. (2025), this study demonstrates that technological and institutional readiness significantly influence learner satisfaction and persistence. However, unlike purely online models, the Tri-X framework introduces greater variability in learners' experiences across participation modes, which may explain the weaker direct effects of expectation-related constructs. This finding supports calls by Sharma and Giannakos (2020) for more nuanced examinations of student behavior in multimodal learning environments.

The study provides a contextual extension of Expectation-Confirmation Theory by incorporating environmental and institutional dimensions relevant to digital education in the Philippines. It demonstrates that while classical ECT emphasizes psychological processes, continuance intention in hybrid systems is also shaped by structural enablers, technological accessibility, institutional reliability, and instructional quality. This nuanced understanding advances theory by bridging technology acceptance, satisfaction models, and educational innovation research.

Despite its contributions, this study is subject to several limitations. First, the use of purposive sampling restricts generalizability, as the participants were limited to Mapúa University STEM students. Future research could employ probability sampling or multi-institutional datasets to enhance external validity. Second, the study's cross-sectional design limits causal inference; longitudinal studies are recommended to capture changes

in expectation, confirmation, and satisfaction over time. Third, contextual factors such as socioeconomic status or prior digital literacy were not examined and may have influenced perceived performance and satisfaction. Lastly, the reliance on purposive sampling and self-reported measures poses inherent limitations related to potential response bias and limited generalizability. The exclusion of demographic controls restricts the interpretive depth of the findings across subpopulations. Nonetheless, the methodological rigor, through validated instruments, adequate sample size, and robust PLS-SEM analysis, supports the internal reliability and validity of the model's conclusions.

Future studies may extend this work by integrating additional psychological constructs (e.g., perceived autonomy, engagement) or by comparing continuance behaviors across different HyFlex or hybrid implementations. Qualitative studies may also provide deeper insights into how students negotiate expectations and satisfaction across shifting learning environments.

CONCLUSION

This study demonstrates that the sustainability of HyFlex learning systems such as Tri-X depends not merely on their flexibility, but on the quality of learning experiences they consistently produce. Students' continuance intention is shaped primarily by perceived performance and satisfaction, underscoring that persistence in multimodal learning environments is an experiential outcome rather than a function of initial expectations alone. In the dynamic context of HyFlex education, where learners continuously alternate between participation modes, confirmation emerges as an ongoing evaluative process grounded in actual performance, thereby attenuating the role of static expectations assumed in classical Expectation-Confirmation Theory. The findings further highlight that access to technology and institutional support operate as foundational enablers that condition students' capacity to experience instructional value, build trust in the system, and sustain engagement over time. For higher education institutions, particularly in developing-country contexts, the results suggest that HyFlex innovations will endure only if investments extend beyond platform deployment toward ensuring pedagogical coherence, infrastructural reliability, and responsive institutional ecosystems that prioritize the lived learning experience.

Author Contributions

Gumasing, M. J. J.: Conceptualization, Methodology, Data curation, Software, Visualization, Investigation, Writing-Reviewing and Editing; **Aguilar, A. L. B.:** Data curation, Writing- Original draft preparation, Software; **Delos Santos, D. M. T.:** Data curation, Writing- Original draft preparation, Software; **Fajatin, S. P. S.:** Data curation, Writing- Original draft preparation, Software; **Magtoto, D. J. V.:** Data curation, Writing- Original draft preparation, Software; **Oaing, L. D.:** Visualization, Investigation, Supervision, Writing-Reviewing and Editing; **Ong, A. K. S.:** Visualization, Investigation, Supervision, Writing-Reviewing and Editing.

Funding

This research received no external funding

Ethical Approval

Informed consent was obtained from all subjects involved in the study.

Competing interest

The authors declare no conflicts of interest.

Data Availability

Data will be made available by the corresponding author on request.

Declaration of Artificial Intelligence Use

In this work, the authors utilized artificial intelligence (AI) tools and methodologies, CHATGPT to improve readability and grammar. After using this tool/service, the authors evaluated and revised the content as necessary and take full responsibility for the published content.

REFERENCES

Al-Busaidi, K. A. (2013). An empirical investigation linking learners' adoption of blended learning to their intention of full e-learning. Behaviour & Information Technology, 32(11), 1105–1117. https://doi.org/10.1080/0144929X.2013.774047

Al-Maroof, R. S., Alhumaid, K., & Salloum, S. (2020). The continuous intention to use e-learning, from two different perspectives. Education Sciences, 11(1), 6. https://doi.org/10.3390/educsci11010006

Al Omari, O., Al Sabei, S., Al Rawajfah, O., Abu Sharour, L., Aljohani, K., Alomari, K., Shkman, L., Al Dameery, K., Saifan, A., Al Zubidi, B., & Anwar, S. (2020). Prevalence and predictors of depression, anxiety, and stress among youth at the time of COVID-19: An online cross-sectional multicountry study. Depression Research and Treatment, 2020, 8887727. https://doi.org/10.1155/2020/8887727

Almaiah, M. A., Alfaisal, R., Salloum, S. A., Al-Otaibi, S., Al Sawafi, O. S., Al-Maroof, R. S., Lutfi, A., Alrawad, M., Mulhem, A. A., & Awad, A. B. (2022). Determinants influencing the continuous intention to use digital technologies in higher education. Electronics, 11(18), 2827. https://doi.org/10.3390/electronics11182827

Almusharraf, N., & Khahro, S. (2020). Students' satisfaction with online learning experiences during the COVID-19 pandemic. International Journal of Emerging Technologies in Learning, 15(21), 246–267. https://doi.org/10.3991/ijet.v15i21.15647

Ali, R., & Georgiou, H. (2025). A process for institutional adoption and diffusion of blended learning in higher education. Higher Education Policy, 38(3), 523–544. https://doi.org/10.1057/s41307-024-00359-y

Azouri, M., & Karam, J. (2023). From in-person to hybrid learning mode. In Governance in higher education: Global reform and trends in the MENA region (pp. 61–88). Springer Nature. https://doi.org/10.1007/978-3-031-40586-0_4

Barkley, E. F., & Major, C. H. (2020). Student engagement techniques: A handbook for college faculty. John Wiley & Sons.

Bartley, S. J., & Golek, J. H. (2004). Evaluating the cost effectiveness of online and face-to-face instruction. Journal of Educational Technology & Society, 7(4), 167–175. https://www.jstor.org/stable/jeductechsoci.7.4.167

Bøe, T. (2018). E-learning technology and higher education: The impact of organizational trust. Tertiary Education and Management, 24(4), 362–376. https://doi.org/10.1080/13583883.2018.1465991

Bećirović, S., Ahmetović, E., & Skopljak, A. (2022). An examination of students' online learning satisfaction, interaction, self-efficacy, and self-regulated learning. European Journal of Contemporary Education, 11(1), 16–35. https://doi.org/10.13187/ejced.2022.1.16

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. MIS Quarterly, 25(3), 351–370. https://doi.org/10.2307/3250921

Bockorny, K. M., Giannavola, T. M., Mathew, S., & Walters, H. D. (2024). Effective engagement strategies in HyFlex modality based on intrinsic motivation in students. Active Learning in Higher Education, 25(3), 455–472. https://doi.org/10.1177/14697874231161364

Cheng, C., Lau, H. P., & Chan, M. P. (2014). Coping flexibility and psychological adjustment to stressful life changes: A meta-analytic review. Psychological Bulletin, 140(6), 1582–1607. https://doi.org/10.1037/a0037913

Cheng, M., & Yuen, A. H. (2018). Student continuance of learning management system use: A longitudinal exploration. Computers & Education, 120, 241–253. https://doi.org/10.1016/j.compedu.2018.02.004

Cheng, Y. M. (2020). Quality antecedents and performance outcome of cloud-based hospital information system continuance intention. Journal of Enterprise Information Management, 33(3), 654–683. https://doi.org/10.1108/JEIM-04-2019-0107

Cheng, Y. M. (2023). Which quality determinants cause MOOCs continuance intention? A hybrid extending the expectation-confirmation model with learning engagement and information systems success. Library Hi Tech, 41(6), 1748–1780. https://doi.org/10.1108/LHT-11-2021-0391

Chitrakar, N., & Nisanth, P. M. (2023). Frustration and its influences on student motivation and academic performance. International Journal of Scientific Research in Modern Science and Technology, 2(11), 1–9. https://ijsrmst.com/index.php/ijsrmst/article/view/158

Dai, H. M., Teo, T., Rappa, N. A., & Huang, F. (2020). Explaining Chinese university students' continuance learning intention in the MOOC setting: A modified expectation confirmation model perspective. Computers & Education, 150, 103850. https://doi.org/10.1016/j.compedu.2020.103850

Gumasing, M. J., & Sobrevilla, M. D. (2023). Determining factors affecting the protective behavior of Filipinos in urban areas for natural calamities using an integration of protection motivation theory, theory of planned behavior, and ergonomic appraisal: A sustainable disaster preparedness approach. Sustainability, 15(8), 6427. https://doi.org/10.3390/su15086427

Hair, J. F., Hult, G. T., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). Partial least squares structural equation modeling (PLS-SEM) using R: A workbook. Springer Nature. https://doi.org/10.1007/978-3-030-80519-7

Hentea, M., Shea, M. J., & Pennington, L. (2003). A perspective on fulfilling the expectations of distance education. In Proceedings of the 4th conference on information technology curriculum (pp. 160–167). https://doi.org/10.1145/947121.947158

Hidayati, N., Sindangsari, L. P., & Mustika, N. (2025). Optimizing HyFlex learning: Pedagogical, technological, and policy perspectives. Sinergi International Journal of Education, 3(1), 13–25. https://doi.org/10.61194/education.v3i1.700

Hodges, C. B. (2008). Self-efficacy in the context of online learning environments: A review of the literature and directions for research. Performance Improvement Quarterly, 20(3–4), 7–25. https://doi.org/10.1002/piq.20001

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal, 6(1), 1–55. https://doi.org/10.1080/10705519909540118

Islam, A. N. (2013). Investigating e-learning system usage outcomes in the university context. Computers & Education, 69, 387–399. https://doi.org/10.1016/j.compedu.2013.07.037

Khan, I. U., Hameed, Z., Yu, Y., & Khan, S. U. (2017). Assessing the determinants of flow experience in the adoption of learning management systems: The moderating role of perceived institutional support. Behaviour & Information Technology, 36(11), 1162–1176. https://doi.org/10.1080/0144929X.2017.1362475

Lee, L. F., Liu, X., & Lin, X. (2010). Specification and estimation of social interaction models with network structures. The Econometrics Journal, 13(2), 145–176. https://doi.org/10.1111/j.1368-423X.2010.00310.x

Li, L., Wang, Q., & Li, J. (2022). Examining continuance intention of online learning during COVID-19 pandemic: Incorporating the theory of planned behavior into the expectation–confirmation model. Frontiers in Psychology, 13, 1046407. https://doi.org/10.3389/fpsyg.2022.1046407

Li, X., & Zhu, W. (2022). System quality, information quality, satisfaction and acceptance of online learning platform among college students in the context of online learning and blended learning. Frontiers in Psychology, 13, 1054691. https://doi.org/10.3389/fpsyg.2022.1054691

Mapua University. (2025). Tri-X. https://www.mapua.edu.ph/pages/academics/tri-x

Makhija, R., Aggarwal, S., & Gupta, R. (2025). Perception of hybrid learning platform self-efficacy: Technological readiness on student satisfaction using emotional engagement as mediator. In Insights in banking analytics and regulatory compliance using AI (pp. 237–258). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3373-0209-6.ch012

Mirriahi, N., Alonzo, D., & Fox, B. (2015). A blended learning framework for curriculum design and professional development. Research in Learning Technology, 23, 28451. https://doi.org/10.3402/rlt.v23.28451

Moldez, J. (2024). Level of convenience to teachers, acceptability and challenges experienced by the learners on HyFlex (hybrid and flexible) learning modality. Educational Research (IJMCER), 6(3), 784–820. https://www.ijmcer.com/wp-content/uploads/2024/06/IJMCER_LL0630784820.pdf

Ojo, O. (2010). The relationship between service quality and customer satisfaction in the telecommunication industry: Evidence from Nigeria. BRAND: Broad Research in Accounting, Negotiation, and Distribution, 1(1), 88–100. https://brain.edusoft.ro/index.php/brand/article/view/121

Ong, A. K., Cuales, J. C., Custodio, J. P., Gumasing, E. Y., Pascual, P. N., & Gumasing, M. J. (2023). Investigating preceding determinants affecting primary school students' online learning experience utilizing deep learning neural network. Sustainability, 15(4), 3517. https://doi.org/10.3390/su15043517

Pan, G., Mao, Y., Song, Z., & Nie, H. (2024). Research on the influencing factors of adult learners' intent to use online education platforms based on expectation confirmation theory. Scientific Reports, 14, 12762. https://doi.org/10.1038/s41598-024-63747-9

Pickering, R. M. (2020). Emotionally charged news in the classroom. In American Psychological Association eBooks (pp. 119–132). https://doi.org/10.1037/0000216-009

Prifti, R. (2022). Self–efficacy and student satisfaction in the context of blended learning courses. Open Learning: The Journal of Open, Distance and e-Learning, 37(2), 111–125. https://doi.org/10.1080/02680513.2020.1755642

Rahi, S., & Abd. Ghani, M. (2019). Integration of expectation confirmation theory and self-determination theory in internet banking continuance intention. Journal of Science and Technology Policy Management, 10(3), 533–550. https://doi.org/10.1108/jstpm-06-2018-0057

Rodriguez, M. C., Ooms, A., & Montañez, M. (2008). Students' perceptions of online-learning quality given comfort, motivation, satisfaction, and experience. Journal of Interactive Online Learning, 7(2), 105–125. https://www.ncolr.org/jiol/issues/pdf/7.2.2.pdf

Sahin, I., & Shelley, M. (2008). Considering students' perceptions: The distance education student satisfaction model. Journal of Educational Technology & Society, 11(3), 216–223. https://www.jstor.org/stable/jeductechsoci.11.3.216

Sankey, M. D., Huijser, H., & Fitzgerald, R. (Eds.). (2023). Technology-enhanced learning and the virtual university. Springer.

Sharma, K., & Giannakos, M. (2020). Multimodal data capabilities for learning: What can multimodal data tell us about learning? British Journal of Educational Technology, 51(5), 1450–1484. https://doi.org/10.1111/bjet.12993

Singh, J., Evans, E., Reed, A., Karch, L., Qualey, K., Singh, L., & Wiersma, H. (2022). Online, hybrid, and face-to-face learning through the eyes of faculty, students, administrators, and instructional designers: Lessons learned and directions for the post-vaccine and post-pandemic/COVID-19 world. Journal of Educational Technology Systems, 50(3), 301–326. https://doi.org/10.1177/00472395211063754

Smith, S. J., & Basham, J. D. (2014). Designing online learning opportunities for students with disabilities. Teaching Exceptional Children, 46(5), 127–137. https://doi.org/10.1177/0040059914530102

Wang, T., Lin, C. L., & Su, Y. S. (2021). Continuance intention of university students and online learning during the COVID-19 pandemic: A modified expectation confirmation model perspective. Sustainability, 13(8), 4586. https://doi.org/10.3390/su13084586

Wisdom, J. P., & Agnor, C. (2007). Family heritage and depression guides: Family and peer views influence adolescent attitudes about depression. Journal of Adolescence, 30(2), 333–346. https://doi.org/10.1016/j.adolescence.2006.04.001

Wu, J. H., Tennyson, R. D., & Hsia, T. L. (2010). A study of student satisfaction in a blended e-learning system environment. Computers & Education, 55(1), 155–164. https://doi.org/10.1016/j.compedu.2009.12.012

Ye, J. H., Lee, Y. S., Wang, C. L., Nong, W, Ye, J. N., & Sun, Y. (2023). The continuous use intention for the online learning of Chinese vocational students in the post-epidemic era: The extended technology acceptance model and expectation confirmation theory. Sustainability, 15(3), 1819. https://doi.org/10.3390/su15031819

Zheng, Y., Zhao, K., & Stylianou, A. (2013). The impacts of information quality and system quality on users' continuance intention in information-exchange virtual communities: An empirical investigation. Decision Support Systems, 56, 513–524. https://doi.org/10.1016/j.dss.2012.11.008

How to cite this article:
Gumasing, M. J. J., Aguilar, A. L. B., Delos Santos, D. M. T., Fajatin, S. P. S., Magtoto, D. J. V., Oaing, L. D., & Ong, A. K. S. (2025). Tri-X Modality Continuance: A Digital Learning Innovation in the Context of the New Normal. Recoletos Multidisciplinary Research Journal 13(2Si), 63-74. https://doi.org/10.32871/rmrj1302si.i2504