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Exploring the Relationship Among Preservice Teachers' E-Learning Readiness, Learning Engagement, and Learning Performance in HyFlex Learning Environments

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Abstract

This study investigated the relationship among e-learning readiness, learning engagement, and learning performance of preservice teachers in HyFlex learning environments. To identify the causal relationship, data collected from 776 preservice teachers at four universities in the Philippines were analyzed using structural equation modeling (SEM). The results indicated that e-learning readiness and learning engagement are significantly related to students' perceived learning performance. In addition, e-learning readiness mediates the relationship between learning engagement and learning performance. Given that the educational landscape has been transcending conventional delivery methods and now includes the HyFlex modality, education designers and learning facilitators must create dynamic and holistic learning delivery to enhance students' e-learning readiness and learning engagement. Moreover, a student's learning engagement may not be sufficient to predict the learning outcomes solely without the help of e-learning readiness in HyFlex learning environments. Findings shed light on which e-learning readiness construct is paramount for effective HyFlex learning environment design in education.

Keywords: HyFlex learning environment, learning engagement, e-learning readiness, learning performance, preservice teachers

Introduction

The ever-evolving 21st century presents significant challenges to traditional education models. Economic instability (Calder, 2019; Kroher et al., 2022; McClellan & Argue, 2022), global pandemics (Gilead & Dishon, 2021; OHHLEP, 2023), and escalating conflicts (Bendavid et al., 2021) disrupt learning continuity and necessitate adaptable teaching methods. In this context, preservice teachers must have multimodal competencies to address these challenges effectively. Preparing preservice teachers for the complexities of modern education ensures they can implement innovative and flexible teaching strategies, meeting the diverse needs of learners in an evolving educational landscape.

HyFlex learning offers a promising solution by enabling flexible and inclusive education across various delivery modes, thus improving access for students in remote areas (Beatty, 2014; Wong et al., 2023). HyFlex learning is an innovative educational approach that seamlessly integrates face-to-face, online synchronous, and asynchronous learning into a unified framework (Beatty, 2019). This model empowers students with the flexibility to choose their mode of participation based on their individual needs and preferences.

In response to the challenges posed by the COVID-19 pandemic and the limitations of traditional face-to-face and fully online modalities, numerous universities shifted to the HyFlex learning environment. While blended learning provides a combination of in-person and online learning, it lacks the flexibility that HyFlex offers. In the HyFlex learning environment, students have the agency to choose their mode of participation based on their individual needs, whether in-person, synchronous, or asynchronous, making it a more adaptable and inclusive approach. HyFlex empowers students with greater autonomy over their educational choices and fosters dynamic engagement, which contributes to improved learning performance (Mahande et al., 2024; Miller et al., 2021; Nelson et al., 2022; O'Ceallaigh et al., 2023).

Student engagement in HyFlex learning environments is crucial for active learning and achievement. Central to the HyFlex framework is the principle of fostering meaningful participation and engagement across all modalities, ensuring equitable opportunities to meet learning objectives (Beatty, 2019; Maloney & Kim, 2020). The HyFlex model merges in-person and online modalities, ensuring academic rigor and inclusivity for diverse student populations (Amiruddin et al., 2024; Mahande et al., 2024). However, there is a pressing need for a deeper understanding of how engagement affects students, considering the complexity of their learning experiences, the limitations of their educational settings, diverse learning styles, and different levels of tech skills.

On the other hand, e-learning readiness is a cognitive construct that prepares a student for online and HyFlex learning environments (Beatty, 2014; Çebi, 2022). This readiness aids students' online engagement, which influences their progress (Loock et al., 2022) and outcomes (Dikbas Torun, 2020), as reflected in grades, test scores, and cohort performances. HyFlex creates a fluid learning continuum transcending class disruptions from unforeseen natural and anthropological events by providing teachers and students with alternative learning routes (Beatty, 2014). In this way, HyFlex learning design ensures continuity of education during challenging times (Moorhouse & Tiet, 2021).

Exploring the impact of e-learning readiness and learning engagement is essential due to observed discrepancies in student performance between online and traditional face-to-face settings (Dendir, 2018). While students in online environments may achieve higher grades and test scores, they often exhibit less dynamic learning progress compared to their counterparts in face-to-face classes. This highlights the importance of e-learning readiness, influenced by factors such as individual aptitude, socioeconomic status, and gender, in enhancing online and hybrid learning experiences (Sinecen, 2018). Moreover, universities offering HyFlex models have seen declining graduation and completion rates over the past four years in Southeast Asian countries, including the Philippines, Vietnam, Cambodia, and Thailand, with 35.4% of university students dropping out annually (Yeung, 2022). Critical reasons for student attrition in these settings include lack of personal interest, technological challenges, and isolation (Parreño, 2023; Takács et al., 2023; Willging & Johnson, 2019).

Recent research underscores the importance of active student engagement and classroom collaboration in boosting motivation (Korpershoek et al., 2020) and academic competence (Demir & Karabeyoglu, 2016). Despite this, there is a significant gap in understanding these dynamics within HyFlex learning environments, where the role of online engagement in enhancing learning outcomes still needs to be explored (Beatty, 2014; Wong et al., 2023). Furthermore, the potential of e-learning readiness to predict academic success has yet to be extensively studied (Sukor et al., 2021). This highlights the need for more focused research in these areas, considering their implications for student performance.

This research unveils the mediating role of e-learning readiness in predicting learning engagement and performance among preservice teachers. Specifically, this research seeks to explore the following:

1. What is the relationship among preservice teachers' learning engagement, e-learning readiness, and learning performance in HyFlex learning environments?

2. What is the mediating effect of e-learning readiness between preservice teachers' learning engagement and performance in HyFlex learning environments?

Literature Review

Learning Engagement and Performance in HyFlex Learning Environments

The need for a more flexible modality that supports the complexities of the learning environment necessitates institutions to ideate a model providing multiple pathways to access course content, with the HyFlex learning environment seen as paramount. As institutions increasingly adopt this model, it plays a vital role in shaping students' performance. Consequently, preservice teachers must be equipped to navigate these nuances, with HyFlex as a viable tool for 21st-century educational progression.

Understanding and fostering learning engagement within HyFlex environments is critical. Learning engagement is a multifaceted construct that includes cognitive, emotional, and behavioral components, influencing students' active participation in the educational process (Calonge et al., 2024; Pietarinen et al., 2014; Rosen, 2021). These dimensions are interrelated and collectively shape students' learning experiences. Cognitive engagement involves the mental processes employed during learning activities, such as critical thinking, problem-solving, and deep information processing (Asay & Curry, 2003; Li et al., 2021). Research suggests challenging tasks and intellectual stimulation promote cognitive engagement, improving learning outcomes (Shin & Bolkan, 2020). Emotional engagement encompasses the affective aspects of learning, such as students' attitudes, interests, and motivation towards a particular subject area (Li & Lerner, 2012). Emotional engagement is closely tied to motivation: when students feel a sense of belonging or personal relevance in their learning, they are more likely to be emotionally invested, resulting in increased motivation and improved learning outcomes (Ozkan Bekiroglu et al., 2021; Pietarinen et al., 2014).

Various elements influence the degree of student engagement in the learning process. Teacher-student relationships, classroom environment, and motivation are significant in student engagement (Dikbas Torun, 2020). In HyFlex learning environments, engagement can be particularly challenging due to the diverse modes of participation, such as in-person, online synchronous, and online asynchronous. Studies suggest that well-designed HyFlex courses, which provide clear communication, structured activities, and support across all modalities, can foster high levels of engagement (Beatty, 2019; Miller et al., 2021).

This thoughtful integration is crucial for not only enhancing engagement but also improving learning performance. Learning performance in the HyFlex model encompasses a range of metrics designed to evaluate the efficacy of this educational approach. Several studies investigated HyFlex and its influences on students' academic performance and perceived learning satisfaction (Amiruddin et al., 2024; Matta, 2022). For example, Beatty (2019) used a mixed-method approach to assess academic outcomes in HyFlex courses, finding that students performed comparably to their peers in traditional settings while expressing higher satisfaction levels due to the flexible learning options. Similarly, Stewart and Bishop (2020) conducted a longitudinal study that revealed improved retention rates among HyFlex students, attributing this to the increased autonomy and accessibility of course materials. However, not all findings are uniformly positive; some research indicates potential challenges in maintaining consistent instructional quality and student engagement across modalities (Ugwu, 2021).

E-Learning Readiness and Learning Performance in HyFlex Learning Environments

The escalating prevalence of HyFlex learning modalities has generated scholarly interest in elucidating the influence of e-learning readiness on student learning performance (Wang et al., 2022). E-learning readiness endows students with a foundational comprehension of technology, fostering a sense of familiarity with the digital tools integral to HyFlex environments. According to Wagiran et al. (2022), augmented technological competence empowers students to participate in classroom interactions actively facilitating a more seamless technology integration into their educational milieu. Empirical studies suggest that students with well-developed e-learning readiness exhibit heightened classroom engagement, manifested through enhanced participation and adept use of technological resources (Karagöz et al., 2023). Moreover, individuals with a higher degree of e-learning readiness tend to demonstrate elevated levels of agency and self-efficacy (Dikbas Torun, 2020). This intrinsic self-regulation, coupled with a robust motivational orientation towards academic success, amplifies performance within the dynamic milieu of HyFlex learning environments (Kabir et al., 2021). Karagöz et al. (2023) affirmed that motivated students are more likely to adapt to the flexible nature inherent in HyFlex courses, establishing a positive correlation between e-learning readiness and academic achievement.

Beyond technological adeptness and self-regulation, e-learning readiness is pivotal in shaping the pedagogical dimensions of instruction and learning within HyFlex environments. Students with sophisticated e-learning readiness demonstrate a discerning comprehension of digital education's pedagogical strategies (Karagöz et al., 2023; Wagiran et al., 2023). This familiarity significantly influences their educational outcomes, enabling them to proficiently navigate and leverage technology to enhance their comprehension of course content (Dikbas Torun, 2020). The HyFlex model, which integrates in-person and online learning pathways, relies on students' preparedness to engage with digital learning platforms and tools (Karagöz et al., 2023; Wagiran et al., 2022; Wang et al., 2022).

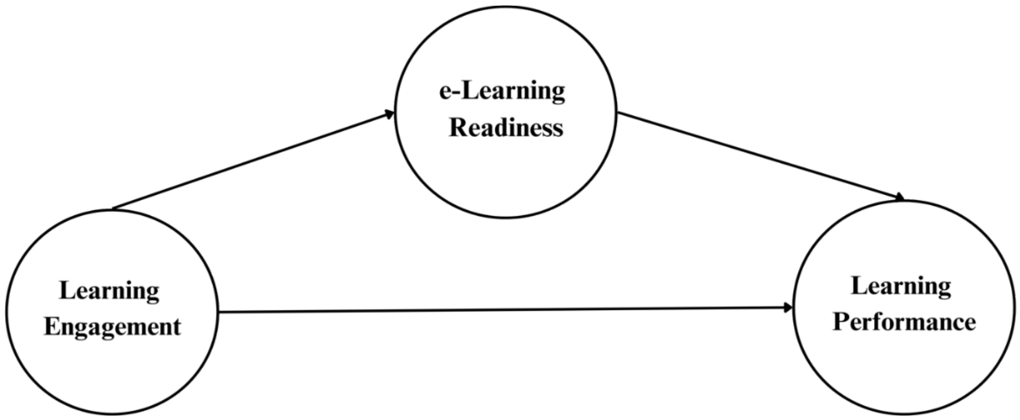
E-learning readiness fosters autonomy, empowering students to self-regulate, think critically, and adapt to hybrid learning (Ucar & Yusuf, 2023). This autonomy is central to HyFlex environments, where students control how and when they learn, making readiness a key to success (Beatty, 2014; O'Ceallaigh et al., 2023). E-learning readiness enhances interactions with peers and teachers across online and in-person settings by bridging engagement and performance. These stronger connections drive improved learning outcomes in HyFlex environments.

E-learning readiness is indispensable for fruitful online engagement and academic success in HyFlex environments. Ji et al. (2022) found a substantial positive link between students' e-learning readiness, engagement, and satisfaction. Their study indicated that higher readiness led to greater satisfaction at the start of the semester, while learner engagement was a key predictor of sustained satisfaction toward the end of the course. This enhanced level of interaction catalyzes deeper academic engagement (Knapp, 2020), directly improving learning outcomes (Anwar et al., 2022). Therefore, students with robust e-learning capabilities are uniquely poised to excel in HyFlex learning modalities. The essence of the HyFlex learning model underscores the transformative impact students' perceptions of learning have on their academic performance. Indicators such as student satisfaction with the learning experience and their determination to persist are pivotal in determining the effectiveness of HyFlex learning environments. E-learning readiness skills are crucial for amplifying student engagement and demonstrating autonomy in merging learning engagement with e-learning readiness.

This research focuses on the pivotal role of e-learning readiness in enhancing student performance within HyFlex models. Acknowledging the multitude of factors affecting student success, this study examines how preparedness for e-learning fundamentally equips students with the necessary technological skills and self-directed learning abilities. These competencies are crucial for active learning engagement and critical drivers for effective participation and knowledge acquisition in HyFlex settings. Based on findings from previous studies about the relationships among learning engagement, e-learning readiness, and learning performance in HyFlex environments, we proposed the research model shown in Figure 1 and two hypotheses.

Figure 1

Hypothesized Research Model



H_1. Learning engagement will directly influence preservice teachers' learning performance in HyFlex learning environments.

H_2. E-learning readiness will mediate the relationship between preservice teachers' learning engagement and learning performance in HyFlex learning environments.

Theoretical Framework

This study draws on self-determination theory (SDT; Deci & Ryan, 1985), which posits that the fulfillment of autonomy, competence, and relatedness is essential for cultivating intrinsic motivation and facilitating optimal functioning in educational settings. SDT proposes that optimal engagement and performance are contingent upon the satisfaction of individuals' basic psychological needs. In the context of HyFlex learning environments, the theoretical tenets of SDT offer a robust framework for elucidating the complex interplay between e-learning readiness, learning engagement, and learning performance. Within HyFlex models, autonomy is a central tenet, enabling students to exercise choice regarding the temporal, spatial, and modal aspects of their learning engagement. E-learning readiness facilitates this autonomy by providing students with the technological proficiency and self-directed learning skills required for effective navigation of flexible learning modalities. Students demonstrate competence in HyFlex environments by mastering their technological and cognitive demands. High e-learning readiness builds competence by increasing confidence in using digital tools, managing time, and adapting to HyFlex instruction. Relatedness encompasses students' ability to form meaningful relationships with peers and instructors irrespective of the learning platform, whether face-to-face or online. This study hypothesizes that greater e-learning readiness leads to higher learning engagement and performance through facilitated interaction in hybrid settings. SDT provides a particularly apt theoretical lens for this study, as it highlights the intrinsic motivations and skills necessary for effective engagement in HyFlex learning contexts. By considering e-learning readiness as a mediator, this framework explains how students' psychological needs and technological preparedness affect engagement and academic performance.

Method

Participants

This study engaged preservice teachers from four universities in the Philippines, who were enrolled in HyFlex learning environments. In these learning environments, students had the autonomy to choose their mode of participation—face-to-face, online (synchronous or asynchronous), or a hybrid format relative to their needs and circumstances. This flexibility enabled students to engage with the course either through on-campus attendance or remotely via the learning management system (LMS) or synchronous online sessions.

Out of 1,197 preservice teachers enrolled across four universities, a total of 776 students participated in the study. One hundred students attended face-to-face classes on campus, 64 participated in synchronous online sessions via video conferencing, 32 accessed self-paced materials through the LMS, and 1,001 alternated between face-to-face and online participation, based on their needs. Among the respondents, 452 (58%) were male and 324 (42%) were female. The participants' ages ranged from 19 to 25 (see Table 1). The four universities facilitated HyFlex learning environments by offering face-to-face and synchronous online classes concurrently, enabling real-time interaction across both modes. Asynchronous learners engaged independently through the LMS but had access to the same resources and support structures as their peers. Additionally, specific academic activities (i.e., assessments, practicum sessions, and other critical in-person requirements) necessitated on-campus attendance for all students, regardless of their primary participation mode. This structure preserved flexibility while incorporating essential face-to-face components, ensuring meaningful interaction with instructors, peers, and course content.

A proportional stratified sampling technique was adopted to determine the total number of participants from the Bachelor of Secondary Education and Bachelor of Elementary Education programs across the universities. An online questionnaire was distributed to students via email and in-class facilitation. The questionnaire, consisting of 36 items concerning demographic characteristics, perceived learning engagement, e-learning readiness, and learning performance, took 15–20 minutes to complete. It was distributed via Microsoft Forms through the LMS and institutional email, with reminders sent three days before the deadline to encourage participation. Students were informed during virtual classes and group chats to ensure accessibility.

Table 1

Demographic Characteristics of Participants

Characteristic	*n*	%
Gender		
Male	452	58
Female	324	42
Age		
19–20	240	31

21–22	338	43
23–25	198	26
Program Level		
First year	166	21
Second year	120	16
Third year	236	30
Fourth year	254	33

Note. N = 776.

Measures and Data Analysis

This study employed six scales to measure the three constructs: learning engagement, e-learning readiness, and learning performance. Learning engagement was evaluated using Dixson's (2015) questionnaire, focusing on collaborative and performance engagement. The survey statements included, for example, "I actively participate in group discussions or peer feedback activities." E-learning readiness was assessed based on students' technological confidence, training, abilities, and technology access, adapted from Doculan (2016). Examples of the survey statements included: "I have attended workshops on online learning"; and "I can modify and add content using a learning management system."

Meanwhile, learning performance was measured by students' perceived learning satisfaction, career preparedness, and learning persistence. These factors were deemed more appropriate than achievement to measure students' learning performance. This is because the study focuses on a HyFlex learning environment, where students engage through various modes of participation. Direct measures of learning (i.e., assessment and task performance) may not fully capture the diverse and flexible ways in which students interact with their peers, teachers, and course content. That is why these measures better capture vital dimensions of their robust learning experience, participation, and long-term success. Sample survey statements included: "I feel a sense of accomplishment while studying with HyFlex learning"; and "HyFlex learning enhances my academic standing."

Learning satisfaction refers to the degree to which learners perceive HyFlex learning positively. Career preparedness measures the impact of exposure to various instructional formats in the HyFlex learning environment on future teaching style and approach. Learning persistence assesses the degree to which learners are committed to continuing and completing courses in a HyFlex learning environment. Perception of learning is a strong predictor of both continued engagement and learning transfer, which are crucial for preservice teachers transitioning into in-service roles. As future-ready educators, they must effectively apply their learning in the 21st-century classroom (Lee & Lee, 2018). The scales were pilot tested with 80 students from three universities. The computed Cronbach's alpha values for e-learning readiness, learning engagement, and learning performance were .819, .889, and .931, respectively (see Table 2).

Structural equation modeling was used to test the hypothesized research model and the proposed hypotheses. Data collected from the questionnaire were analyzed using IBM SPSS (Version 26.0) for descriptive statistical analysis and IBM SPSS AMOS (Version 23.0) for structural equation modeling.

Table 2

HyFlex Learning Environment Survey Instrument Variables and Their Reliability

Variable		Description	Reference	Items,	Reliability
Latent	Measured			*n*	coefficient
E-learning readiness	Technology access	The level of students' access to computers, mobile devices, applications, and connections for Hyflex learning.	Doculan (2016)	4	.71
	Technology confidence	The level of students' confidence in operating apps on computers or mobile devices relative to the Hyflex environment.		4	.72
	Training	The level of students' training in Internet surfing relative to online synchronous and asynchronous learning.		4	.83
	Ability	The level of a student's ability to operate and interact inside a Hyflex environment.		5	.82
Learning engagement	Collaborative	Students work within a small group, group discussion, and in-class activities.	Dixson (2015)	7	.72
	Performance	Achieving a good class standing during exams, quizzes, or any activities.		5	.78
	Emotional	The students' affective response toward the facilitation of learning	Zhu et al. (2023)	5	.92

		in a Hyflex environment.			
Learning performance	Satisfaction	The degree to which a learner perceives positively regarding Hyflex learning.	Shin & Chan (2004)	5	.86
	Persistence	The degree to which a learner deems to continue and finish a course in a Hyflex environment.	Guiffrida et al. (2013)	7	.89
	Career preparedness	The extent to which students perceive that the Hyflex environment adequately equips them for their chosen career path.	Wang et al. (2023)	5	.85

Results

Descriptive Statistics and Correlations of Measured Variables

The measured variables' means, standard deviations, skewness, and kurtosis were analyzed to identify whether the data met the multivariate normality assumption. Correlations were also examined to check the strength of the relationships among the measured variables of the latent constructs (i.e., learning engagement, e-learning readiness, and learning performance).

Table 3 shows the mean, standard deviation, skewness, and kurtosis values of the measured variables. The results confirm that the data meet the normality assumption for structural equation modeling (Browne & Cudek, 1992; Sovey et al., 2022). Moreover, e-learning readiness and learning engagement show a significant correlation at the alpha level of .01.

The Direct Effect of E-Learning Readiness and Learning Engagement on Preservice Teachers' Learning Performance

Anderson and Gerbing (1988) recommended a two-step approach. The first step was to confirm the adequacy of the measurement model, and the second was to test the structural model. We began by adjusting the items for each measured variable using the item-parceling method. Given that the study's scales contained 51 items, which were grouped into 10 parcels, each parcel consisted of four to seven items.

Table 3

Descriptive Statistics and Correlations of Measured Variables

Variable	1	2	3	4	5	6	7	8	9	10
1. TA	-									
2. TC	.815**	-								
3. T	.792**	.780**	-							
4. A	.384**	.383**	.429**	-						
5. CE	.615**	.505**	.509**	.370**	-					
6. PE	.763**	.729**	.728**	.361**	.543**	-				
7. EE	.747**	.712**	.696**	.376**	.517**	.823**	-			
8. LS	.762**	.720**	.711**	.424**	.495**	.721**	.761**	-		
9. LP	.786**	.761**	.726**	.386**	.525**	.765**	.762**	.798**	-	
10. CP	.808**	.753**	.765**	.412**	.535**	.769**	.745**	.816**	.834**	-
M	3.404	3.302	3.458	3.304	3.673	3.440	3.392	3.537	3.500	3.717
SD	.874	.849	.811	.813	.881	.778	.875	.866	.815	.895
Skewness	-.483	-.372	-.561	-.218	-.400	-.335	-.290	-.601	-.374	-.664
Kurtosis	.198	.124	.533	-.178	-.189	.600	.011	.145	.130	.232

Note. TA = technology access; TC = technology confidence; T = training; A = ability; CE = collaborative engagement; PE = performance engagement; EE = emotional engagement; LS = learning satisfaction; LP = learning persistence; CP = career preparedness.
** $p < .01$

Next, fit indices of the measurement model and factor loadings between the measured variables and latent construct were examined to assess the goodness and validity of the models based on this item-parceling (Lee & Lee, 2018). Factor loadings, first used to verify that the measured variables had a reasonable level of convergent validity to assess the latent variable, are shown in Table 4.

Table 4

Factor Loading Estimates in the Measurement Model

Variable		*B*	*β*	*SE*	*t*
E-Learning readiness	→ Technology access	1.140	.920	.022	37.385***
	→ Technology confidence	1.063	.884	.031	34.415***
	→ Training	1.000	.869	.030	37.851*
	→ Ability	.520	.451	.040	14.161***

Learning engagement	→ Collaborative engagement	.685	.610	.036	19.255***
	→ Performance engagement	.902	.910	.024	38.172***
	→ Emotional engagement	1.000	.896	.024	36.217***
Learning performance	→ Learning satisfaction	1.000	.880	.032	39.897***
	→ Learning persistence	.969	.907	.026	37.813***
	→ Career preparedness	1.080	.922	.028	39.219***

*$p < .05$. ***$p < .001$.

Then we selected four criterion indices to measure fit: chi-square value, Tucker-Lewis index (TLI), comparative fit index (CFI), and root-mean-square error of approximation (RMSEA). These indices were chosen primarily because they are less sensitive to sample size despite the complexity of the model. The goodness of fit indices for the measurement model were used to estimate the convergent and discriminant validity of the measured variables.

The correlation coefficients among the latent variables ranged from .374 to .822, indicating that each latent variable was distinct. Since all variables in the measurement model were adequate for estimating the structural model, the hypothesized structural model was examined. As shown in Table 5, the fit indices of the structural model indicated a good fit for the data.

Table 5

Goodness of Fit Measure for Hypothesized Structural Model

Fit measure	X^2	*df*	TLI	CFI	RMSEA	
					Value	95% CI
Value	159.614 (p = .000)	32	.975	.982	.072	[.061, .083]
Recommended values			>.900	>.900	<.080	

Note. TLI = Tucker-Lewis index; CFI = comparative fit index; RMSEA = root-mean-square error of approximation. CI = confidence interval.

Based on the fit of the structural model, the statistical significance of all path coefficients in the original structure was examined. Table 6 shows that all path coefficients (i.e., learning engagement → e-learning readiness; learning engagement → learning performance; e-learning readiness → learning performance) were statistically significant. Therefore, there was no need for model trimming (Lee & Lee, 2018).

Table 6

Path Coefficients of the Hypothesized Structural Model

Variable		*B*	*β*	*SE*	*t*
Learning engagement	→ E-learning readiness	.914	.822	.028	29.457***
	→ Learning performance	.384	.374	.059	6.371***
E-Learning readiness	→ Learning performance	.590	.638	.066	9.65***

****p* < .001.

Mediating Effect of E-Learning Readiness

Since e-learning readiness seemed to play a pivotal role in the final structural model, the mediating effect of this construct was tested using bootstrapping. Table 7 displays the overall path estimates on the direct, indirect, and total impact on e-learning readiness, learning engagement, and learning performance.

Table 7

The Direct, Indirect, and Total Effect of E-Learning Readiness on Learning Engagement and Learning Performance

Path		*B*			*β*		
		Direct effect	Indirect effect	Total	Direct effect	Indirect effect	Total
Learning engagement	→ E-learning readiness	.822		.822**	.914		.914**
Learning engagement	→ Learning performance	.374		.374	.384		.384
E-learning readiness	→ Learning performance	.638	.525	.638**	.59	.539	.590**

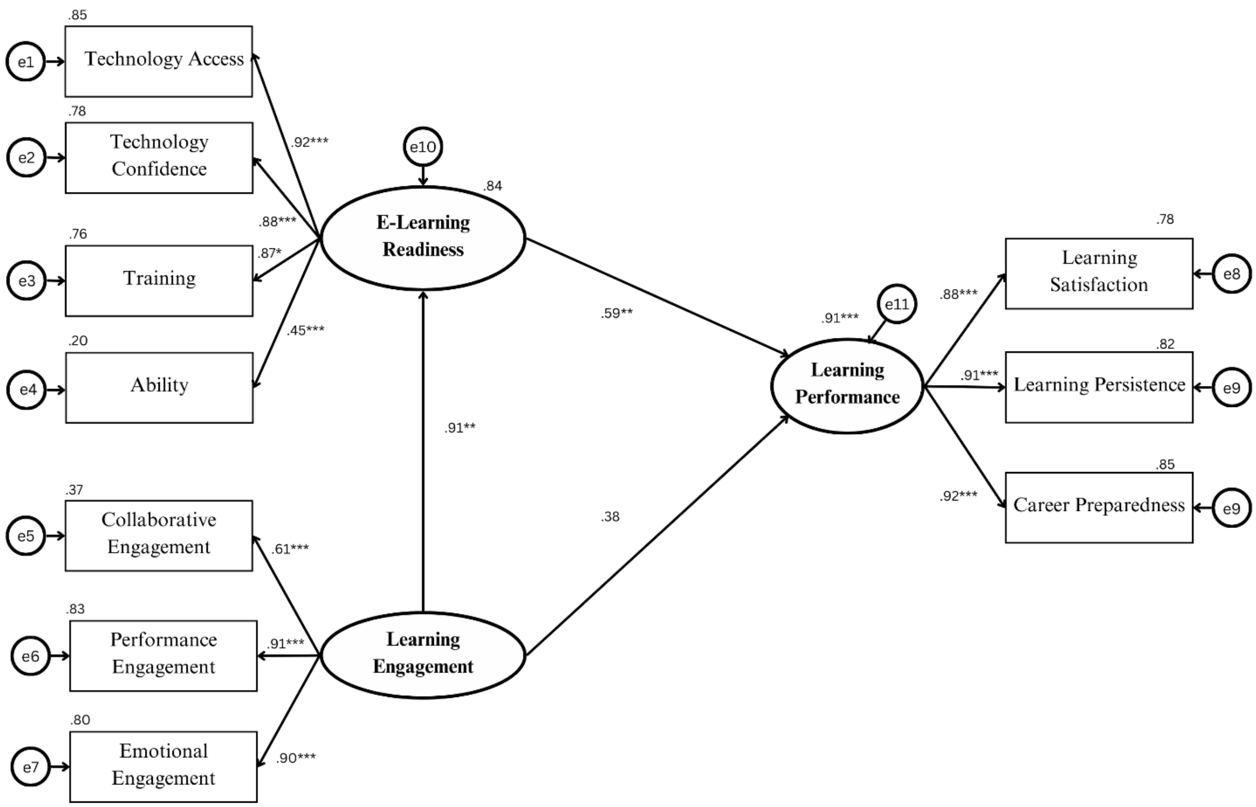
***p* < .01.

Table 7 also shows the mediating role of e-learning readiness. E-learning readiness was statistically significant on learning engagement and learning performance. The direct effect of learning engagement on learning performance was not statistically significant when e-learning readiness was included, indicating that e-learning readiness had a full mediating effect between learning engagement and learning performance.

As a result of this analysis, all path coefficients in the final statistical model and the relationship among learning engagement, e-learning readiness, and learning performance were identified and are presented in Figure 2.

Figure 2

Standardized Path Coefficients in the Statistical Model



Note. The statistical model demonstrates a mediating effect involving e-learning readiness, learning engagement, and learning performance. Specifically, learning engagement indirectly influences learning performance (β = .38) when mediated by e-learning readiness (β = .59, p < .01). The error terms (e1–e11) represent the residual variances for each observed variable in the model.

**p < .05; **p<.01; ***p < .001.*

Discussion and Conclusion

This study investigated the relationship among learning engagement, e-learning readiness, and learning performance in HyFlex learning environments in the context of preservice teachers.

While previous research has suggested a direct link between learning engagement and learning performance (Nelson et al., 2022), this study reveals a more nuanced picture. The findings indicate that learning engagement indirectly affects learning performance, mediated by e-learning readiness. Students who are highly engaged may only outperform their less engaged peers if they are also prepared for the learning environment and possess strong technology skills, time management, and self-directed learning abilities. This aligns with Rosen's (2021) research, which suggested that e-learning readiness amplifies the benefits of online engagement, leading to more robust academic performance. Students actively involved in learning and possessing the necessary technological skills to navigate the online environment effectively are more likely to achieve better learning performance (i.e., learning satisfaction, learning persistence, and career preparedness).

E-learning readiness directly affects perceived learning performance, consistent with previous research on the importance of e-learning readiness in HyFlex learning environments (Çebi, 2022; Dikbas Torun, 2020; Wagiran et al., 2022; Wang et al., 2022). E-learning readiness fully mediates the relationship between students' learning engagement and learning performance. It helps create a collaborative and engaging learning experience within a HyFlex environment, improving students' learning performance (Kim et al., 2019). Therefore, e-learning readiness should be crucial in preparing students for e-learning in the HyFlex learning environment.

E-learning readiness emerges as a decisive factor directly influencing academic achievement. Given its mediating role between learning engagement and academic performance, educators should prioritize initiatives that enhance students' technological access, competence, training, and overall e-learning proficiency. In the HyFlex environment, educational institutions are encouraged to invest strategically in comprehensive training programs, ensuring equitable access to technological resources and fostering an environment conducive to effective navigation of online platforms (Çebi, 2022).

The study revealed the complex link between learning engagement and performance, with e-learning readiness playing a crucial mediating role. Educators and instructional designers must foster a HyFlex environment that fully integrates technological elements for optimal academic results. Emphasizing technology access, skill development, and training is critical to enabling students to navigate learning challenges effectively.

The findings of this study have several implications for enhancing e-learning readiness, learning engagement, and learning performance of preservice teachers in HyFlex learning environments. First, educational stakeholders, including instructors, designers, and curriculum managers, are advised to adopt a comprehensive strategy that addresses facets of both learning engagement (performance, collaboration, and emotion) and e-learning readiness (technology access, skills, and training). By strategically supporting HyFlex learning environment, they can enhance the learning experience for preservice teachers. Additionally, ongoing evaluation and flexibility to adapt strategies in response to the evolving online education landscape are crucial for long-term success. Second, educational institutions are encouraged to invest in developing and implementing training programs that improve students' readiness for e-learning. These programs should address technological access, competence, and proficiency. Third, educators and facilitators should actively engage learners in classrooms and virtual environments (Bonk & Wiley, 2020). Fourth, educators can cultivate a supportive and inclusive learning environment conducive to enhanced engagement and academic performance by implementing pedagogical strategies that foster collaboration and encourage active participation. Addressing various aspects of the learning process, such as emotional and cognitive dimensions, effectively supports students' learning journeys and optimizes their educational outcomes. Fifth, instructional designers should integrate technology into the learning experience by designing user-friendly online platforms, providing technical assistance, and incorporating interactive learning tools. By working together, educational stakeholders can optimize student learning experiences in the evolving e-learning landscape while fostering academic success.

In conclusion, the current study clarifies how e-learning readiness and learning engagement are significant for preservice teachers' learning performance in HyFlex learning environments. The indirect effects of e-learning readiness on learning engagement and learning performance have been identified. The findings recommend that facilitators of learners, instructional designers, and curriculum managers focus on improving learning engagement (i.e., performance, collaboration, and emotion), technology accessibility, competence, and training to scaffold a thriving HyFlex learning environment for preservice teachers.

This study has some limitations and recommendations. First, the findings on learning engagement, e-learning readiness, and learning performance rely on self-reported data, which may be affected by the overconfidence effect, potentially inflating actual performance. Although learning performance can be assessed through metrics such as learning satisfaction, persistence, and career preparedness, it is important to consider additional variables that may influence learning outcomes. Future research could expand on the current study by incorporating measures of learning achievement or academic success. Second, e-learning readiness may have been influenced by the participants' universities (e.g., private, public, and state colleges), with varying technological support and preparedness strategies for the HyFlex learning environment. Therefore, university-specific practices and characteristics may have impacted the reported data. Further research should include more qualitative data, such as interviews with all students in the class, to identify how their perceptions may differ regarding learning engagement, e-learning readiness, and learning performance in HyFlex learning environments.

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