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Teachers' Perceptions of E-learning and Their Professional Competencies in the Béni Mellal-Khénifra Region in Morocco

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Abstract

Background: Recently, e-learning has emerged as a prominent tool for professional development in the education sector.

Objective: The aim of this study was to examine teachers' perceptions of improving their professional skills through e-learning in the Béni Mellal-Khénifra region of Morocco.

Methods: The research utilized a questionnaire survey method to collect primary data from 518 teachers. The variables in the proposed model were assessed using a self-tailored five-point Likert scale. Data analysis was performed through confirmatory factor analysis and structural equation modelling using analysis of moment structures (AMOS).

Results: The results indicate the impact of teachers' satisfaction with their use of e-learning on the development of their professional competencies, without any direct effect of the actual use of e-learning on these skills. This suggests that satisfaction plays a mediating role between actual use and the development of teachers' professional competencies. The study also found that overall quality significantly affects both user satisfaction and actual use by teachers within an online learning context.

Conclusion: As a practical implication, stakeholders should focus on the technical, semantic and efficient features of e-learning to maximize the opportunity for better results among teachers in terms of developing both technical and non-technical skills.

Index Terms

AMOS; Educational technology; Edutech; E-learning; Professional competencies; Teachers.

1 INTRODUCTION

The rapid integration of technology in education has transformed teaching and learning practices globally (Haleem et al., 2022). Among these innovations, e-learning has emerged as a prominent tool for professional development in the education sector (Y. Chen et al., 2009). As a means of delivering training, sharing resources and fostering collaboration, e-learning platforms are increasingly being utilized to enhance teachers' professional competencies (Gameil & Al-Abdullatif, 2023). This shift aligns with broader trends in educational technology, which emphasize personalized learning, accessibility and lifelong professional development. Despite these advancements, questions remain regarding the efficacy of e-learning in equipping teachers with the skills and knowledge necessary for effective classroom practice.

In the Moroccan context, where the education system is gradually integrating digital technology, it is crucial to understand the impact of e-learning on enhancing teachers' skills. This is particularly true given the resistance of some teachers to this mode of learning and the lack of alternatives to meet the professional development challenges facing Moroccan teachers.

Existing literature highlights the potential benefits of e-learning in improving teachers' knowledge, pedagogical techniques and technological skills. Studies have shown that e-learning offers flexibility (Kokoç, 2019), cost-effectiveness (Elida et al., 2012) and opportunities for collaboration across geographical boundaries (Basahel & Basahel, 2018; Kamraju et al., 2024; van der Wouden & Youn, 2023). Furthermore, Byungura et al. (2022) underscored the role of online platforms in fostering continuous professional growth, while other studies have suggested that e-learning environment refers to the skills needed to operate productively in a knowledge economy and can lead to meaningful professional transformations in the educational model (Collis, 2005). However, significant gaps persist in understanding to what extent e-learning affects various dimensions of teachers' professional competencies, particularly in terms of practical classroom application and the development of higher-order skills.

The present study aims to fill these gaps by examining the extent to which e-learning enhances teachers' professional competencies. At a deeper level, it aims to assess the effectiveness of e-learning platforms in improving teaching strategies, technological integration and collaborative practices among teachers by adopting DeLone and McLean's information system success model as a framework for analysis (DeLone & McLean, 2016). As a result, this study follows in the footsteps of numerous empirical studies that have closely examined how individuals adopt and use digital technologies (Al-Busaidi, 2013; A. H. Aldholay et al., 2018; Islam, 2016). The research is guided by the following question: How do teachers' perceptions of overall e-learning quality, use and satisfaction shape their professional competencies?

The significance of this study lies in its potential to provide evidence-based insights into the role of e-learning in enhancing professional skills of educators. By addressing these research questions, this paper contributes to the academic discourse on educational technology and its impact on teaching effectiveness. The findings aim to inform policymakers, educational institutions and platform developers about the design and implementation of e-learning initiatives that support meaningful professional growth.

This paper uses a questionnaire survey method to collect primary data from 518 teachers. The concepts of the proposed model were assessed using a five-point Likert scale. Data analysis was carried out using confirmatory factor analysis and structural equation modelling using analysis of moment structures (AMOS). The structure of the paper is as follows: Section 2 reviews the relevant literature, identifying key themes and gaps; Section 3 describes the methodology employed in the study; Section 4 presents the results, followed by a discussion of their implications in Section 5; and Section 6 concludes with recommendations for future research and practice.

By contextualizing this study within the broader discourse on educational technology, its findings provide valuable insights for Moroccan educational stakeholders on the transformative potential of e-learning in shaping the future of teachers' professional development.

2 LITERATURE REVIEW

2.1 DeLone and McLean's information system success model (ISSM)

Originally created by DeLone and McLean (1992), the information system success model (ISSM) is also known as the DeLone and McLean information system success model (D&M ISSM) (Viontita & Mahendrawathi, 2024). It is considered one of the most often referenced study frameworks in the information system (IS) domain (Lowry et al., 2007). Numerous studies on the ISSM were carried out following its publication. Subsequently, DeLone and McLean (2003a) suggested an updated ISSM based on the findings of the feedback given by some of these studies. Using this revised model, the success of an IS can be assessed and measured using a variety of criteria including system quality, information quality, service quality, actual use and user satisfaction. The research model used in this paper will make extensive reference to this framework.

2.2 Overall quality (OQ)

Considering the technological advancements and the increasing challenges associated with information systems, educators are eager to enhance the quality and functionality of these new systems to better harness their developmental potential (W.-T. Wang & Lai, 2014). Overall quality has been examined as a second-order construct that encompasses system quality, information quality and service quality (A. Aldholay et al., 2018).

The quality of a system can be defined as the level of its technical efficiency (Michel & Cocula, 2014). It is one of the instruments that measure technical success (Mardiana et al., 2015). It can also be regarded as the extent to which users perceive a system as easy to use, user-friendly, simple to learn, easy to connect to and enjoyable to interact with (A. Aldholay et al., 2018; Petter & McLean, 2009). McKinney et al. (2002) showed that system quality (SYSQ) has a significant influence on satisfaction. McGill et al. (2003) found the same result, underlining the strong relationship between these two constructs. On the other hand, Almazán et al. (2017) reported that SYSQ affects significantly actual use.

Information quality (INFQ) refers to how well users perceive e-learning information as being up-to-date, accurate, relevant, comprehensive and well-organized (A. Aldholay et al., 2018). It is one of the instruments built to measure semantic success of information systems (Mardiana et al., 2015). This construct is one the key factors that influences both user satisfaction and actual use (A. Aldholay et al., 2018; Aparicio et al., 2016).

Service quality (SERQ) refers to the quality of help and support obtained by the user and generated by the e-learning system (DeLone & McLean, 2003b). It is characterized by aspects such as reliability, responsiveness, assurance, functionality, interactivity and empathy (A. Aldholay et al., 2018; DeLone & McLean, 2003b; Lin et al., 2011; Pituch & Lee, 2006). A. Aldholay et al. (2018) reported that SERQ has a significant impact on user satisfaction and actual use.

Numerous studies have demonstrated that overall quality has a positive influence on satisfaction and actual use (A. Aldholay et al., 2018; Sun et al., 2008; Y.-S. Wang & Liao, 2008). Consequently, the following hypotheses are proposed:

H1: Overall quality positively influences actual use.

H2: Overall quality positively influences user satisfaction.

The purpose of measuring the overall quality constructs in this paper is to examine in depth whether the features of e-learning, characteristics of the information and the level of service provided can meet the teachers' needs.

2.3 Actual use

Actual use denotes how extensively individuals engage with the functionalities of an information system, evaluated by the frequency, nature and duration of use (Al-Busaidi, 2013). In the context of e-learning, actual use particularly focuses on the frequency and duration of system use (A. Aldholay et al., 2018; Kim et al., 2007).

Numerous studies have demonstrated the interconnection between actual use, skills and satisfaction (Abdelrady & Akram, 2022; A. Aldholay et al., 2018; D'Ambra et al., 2013; Hou, 2012; Son et al., 2012). In contrast, other researchers have found this relationship to be negligible (Cho et al., 2015; Wu & Wang, 2006). This study examines the extent to which actual use affects satisfaction and teachers' professional competencies, leading to the formulation of the following hypotheses:

H3: Actual use positively influences user satisfaction.

H4: Actual use positively influences teachers' professional competencies.

The purpose of assessing the actual use is to measure the extent to which teachers utilize the e-learning system and reveal how often and how intensely they use it.

2.4 User satisfaction

User satisfaction reflects the extent to which a user finds a system valuable and their inclination to reuse it (Xinli, 2015). It can also be described as the result of evaluating the perceived benefits of a product or service against the user's expectations, leading to either a sense of satisfaction or disappointment (T. Chen et al., 2020).

Multiple studies have demonstrated a strong positive correlation between user satisfaction and competencies across various contexts (Balaban & Sobodić, 2021; Napitupulu & Dalimunthe, 2015; Owolabi et al., 2024; Rajarathinam & Mangalam, 2013). As a result, this study examines the effect of user satisfaction on teachers' professional competencies. Consequently, the following hypothesis is proposed:

H5: User satisfaction positively influences teachers' professional competencies.

The aim of assessing user satisfaction variables in this study is to determine how satisfied users are with their experience of the e-learning system.

2.5 Professional competencies

Professional competencies can be defined as an individual's ability to solve specific problems and carry out particular tasks within their field of expertise (Miloslavskaya & Tolstoy, 2015). These competencies are generally composed of a set of observable and measurable knowledge, skills and abilities, which are three integral and necessary parameters of a specific competency to perform a job successfully (Miloslavskaya & Tolstoy, 2015). In our case, these parameters are related to teachers. Numerous studies underline the need to enable teachers to improve their skills and innovate by using technology in their learning and to strengthen the professional profile of the teaching profession (Benali et al., 2018).

In this article, teachers' professional skills refer to the skills needed to provide quality teaching, covering subject content knowledge, pedagogy, didactics, classroom management, interpersonal skills, educational technology and continuing training. All these components can be developed through lifelong e-learning.

Furthermore, regarding the link between concepts, knowledge provides the foundation for developing skills, while competencies represent the application of those skills and knowledge in real-world situations. Fostering growth in all three areas can lead to greater effectiveness and adaptability of teachers in personal and professional contexts. This approach is in line with the definition of competencies based on a practical perspective (Calhau et al., 2024).

3 METHODS

3.1 Research model

In this article, the suggested variables and their interrelationships within the model are grounded in the existing literature. The proposed research model is illustrated in Figure 1. When analysing the proposed model, overall quality affects the actual use and user satisfaction constructs, which both predict professional competencies. The link between these variables has been established based on the existing literature mentioned above. The suggested research model studies the relationship between overall quality as the antecedent variable to user satisfaction and actual use, which in turn explains professional competencies as an output variable among teachers who have used e-learning in public schools belonging to the Béni Mellal-Khénifra region in Morocco. The research model has five hypotheses to test.

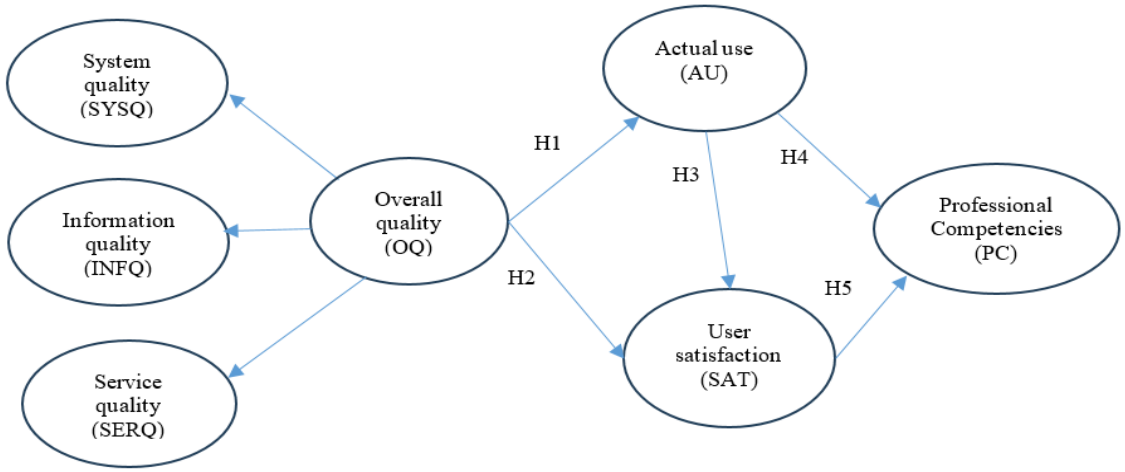


Figure 1. *Proposed research model.*

3.2 Development of instrument

A 20-item questionnaire was developed for this study as shown in Table A in Appendix A. The variables were measured using the five-point Likert scale, with 5 being "strongly agree" and 1 being "strongly disagree", except for the actual use measured on a six-point scale. Since the respondents were Arabic speakers, it was crucial to translate the questionnaire from English to Arabic accurately. To ensure the translation accuracy in this survey, a back-translation process was employed, which is a common method for confirming translation accuracy (A. Aldholay et al., 2018).

3.3 Data collection

Data collection was conducted through a self-administered paper questionnaire, distributed in person between November and December 2024. In-person distribution makes it possible to check whether the participant is using or has used e-learning as part of their lifelong learning. However, online distribution may not make it possible to know whether the respondent is a teacher or not. For these two reasons, we opted for in-person distribution.

The target population consisted of teachers from public schools belonging to the Béni Mellal-Khénifra region in Morocco, who have used e-learning as part of their self-directed learning activities through tow e-learning platforms (e-Takwine-Tanmia and FADEEP). The questionnaire was assessed for clarity by a pilot group of 20 faculty members, who were later excluded from the final sample used for data collection. After verifying whether the participants had used or were currently using e-learning, they were provided with a questionnaire to complete and were instructed to leave it in the same place for collection later that day. In total, 1800 questionnaires were distributed and 548 were returned, of which 518 responses were deemed valid for analysis. A total of 30 questionnaires were excluded from the analysis. Among these, 21 were removed due to missing responses exceeding 10% of the total questions, while nine were excluded due to evidence of straight lining behaviour. The demographic characteristics of respondents are presented in Table 1.

4 EMPIRICAL FINDINGS

4.1 Measurement model evaluation and confirmatory factor analysis (CFA)

Table 2 shows that all the goodness-of-fit indices are above the accepted levels found in previous research. This indicates that the measurement model fits the collected data well. Therefore, we can assess the psychometric properties of the model, including construct reliability, indicator reliability, convergent validity and discriminant validity.

Table 1. *Demographic profile of respondents (N = 518).*

Demographic item	*Frequency*	*Percentage*
Sex		
Female	252	48.6
Male	266	51.4
Matrimonial status		
Single	208	40.2
Divorced	9	1.7
Married	299	57.7
Widowed	2	0.4
Age		
< 30	17	33,6
30-40	123	23,7
40-50	174	33,6
≥ 50	47	9,1

Demographic item	*Frequency*	*Percentage*
Level of education		
Baccalaureate	22	4.2
GASD	17	3.3
Bachelor	343	66.2
DAHS	1	0.2
Master	115	22.2
Doctorate	20	3.9
Medium of work		
Urban	223	43.1
Rural	295	56.9

Notes: GASD = General academic studies degree (two-year university degree), DAHS = Diploma of advanced higher studies.

***Table 2**. GOF indices for the measurement model adapted from A. Aldholay et al. (2018).*

Fit index	Cited	Admissibility	Result	Fit (Yes/No)
$\chi 2$	—	—	387.781	—
DF	—	—	155	—
p-value	—	>0.05	0.00	No
$\chi 2$/DF	Kline (2010)	1–5	2.502	Yes
RMSEA	Steiger (1990) o0.08	<0.08	0.054	Yes
SRMR	Hu and Bentler (1999)	<0.08	0.049	Yes
GFI	Jöreskog and Sörbom (1998)	>0.90	0.923	Yes
AGFI	Jöreskog and Sörbom (1998)	>0.80	0.896	Yes
NFI	Bentler and Bonnet (1980)	>0.80	0.933	Yes
PNFI	Bentler and Bonnet (1980)	>0.05	0.761	Yes
IFI	Bollen (1990)	>0.90	0.958	Yes
TLI	Tucker and Lewis (1973)	>0.90	0.949	Yes
CFI	Byrne (2016)	>0.90	0.958	Yes
PGFI	James et al. (1982)	>0.50	0.681	Yes

To evaluate construct reliability, we examined the individual Cronbach's α coefficients for each variable in the measurement model. The findings indicate that the Cronbach's α coefficients for the seven constructs range from 0.718 to 0.911. Those values surpass the recommended level of 0.7 (A. Aldholay et al., 2018; Kannan & Tan, 2005; Nunnally & Bernstein, 1994). Furthermore, when testing construct reliability, all the composite reliability (CR) values range from 0.752 to 0.911, significantly exceeding the 0.7 level (A. Aldholay et al., 2018; Gefen et al., 2000). This indicates that construct reliability is adequately fulfilled, as presented in Table 3.

Factor loading was employed to evaluate indicator reliability. Elevated loadings on a specific construct suggest that the associated indicators share a substantial degree of commonality, which is effectively captured and represented by the construct (Hair et al., 2014). According to Hair et al. (2010), factor loadings exceeding 0.50 are considered highly significant. As shown in Table 3, all the model items have factor loadings greater than the recommended level of 0.50, thus meeting the required criteria after removing from the scale the QINF4 indicator with a factor loading of 0.454. The low SERQ loading value (<0.5) indicates that perceived service quality may not contribute significantly to the overall quality of e-learning. It could also mean that e-learning does not effectively meet teachers' needs in terms of the help and support provided by those responsible for the system. It may also be explained by the number or nature of the items used to measure this variable, especially as deleting one of the items does not increase the loading value.

To assess convergent validity, we employed the average variance extracted (AVE) as an indicator. The AVE values ranged between 0.512 and 0.773, generally surpassing the recommended threshold of 0.50 (Hair et al., 2010), with the exception of SYSQ, which exhibited a value of 0.474, slightly below the suggested limit. Nevertheless, all the other related metrics demonstrated satisfactory levels, supporting the conclusion that convergent validity is adequately established, as demonstrated in Table 3.

***Table 3**. Mean, standard deviation, loading, Cronbach's α, CR and AVE.*

Construct	Item	Loading	M	SD	A (>0.7)	CR (>0.7)	AVE (>0.5)
SYSQ	SYSQ1	0.680	3.457	0.96841	0.782	0.782	0.474
	SYSQ2	0.738					
	SYSQ3	0.643					
	SYSQ4	0.690					
INFQ	INFQ1	0.789	3.3185	0.83222	0.781	0.813	0.591
	INFQ2	0.766					
	INFQ3	0.752					
SERQ	SERQ3	0.787	2.786	1.0328	0.860	0.860	0.673
	SERQ2	0.819					
	SERQ1	0.854					
OQ (2nd order construct)	SYSQ	0.994	3.1873	0.75806	0.718	0.832	0.643
	INFQ	0.859					
	SERQ	0.452					
SAT	SAT3	0.904	3.5309	1.03257	0.911	0.911	0.773
	SAT2	0.888					
	SAT1	0.846					
AU	UR1	0.869	2.5489	1.04203	0.738	0.752	0.512
	UR2	0.711					
	UR3	0.525					
PC	PC1	0.863	3.7876	1.043	0.887	0.888	0.725
	PC2	0.891					
	PC3	0.798					

To test the discriminant validity of the measurement model, we used the Fornell-Larker criterion. Table 4 indicates that the correlations between the items are less than the square root of the AVE, which fall between 0.716 to 0.879. This shows that the constructs are more closely related to their corresponding indicators than with the indicators of other constructs in the model (Fornell & Larcker, 1981). Hence, the concepts have sufficient discriminant validity.

***Table 4.** Discriminant validity using Fornell–Larcker criterion.*

Construct	OQ	AU	SAT	PC
OQ	**0.802**			
AU	0.249	**0.716**		
SAT	0.601	0.401	**0.879**	
PC	0.541	0.296	0.671	**0.851**

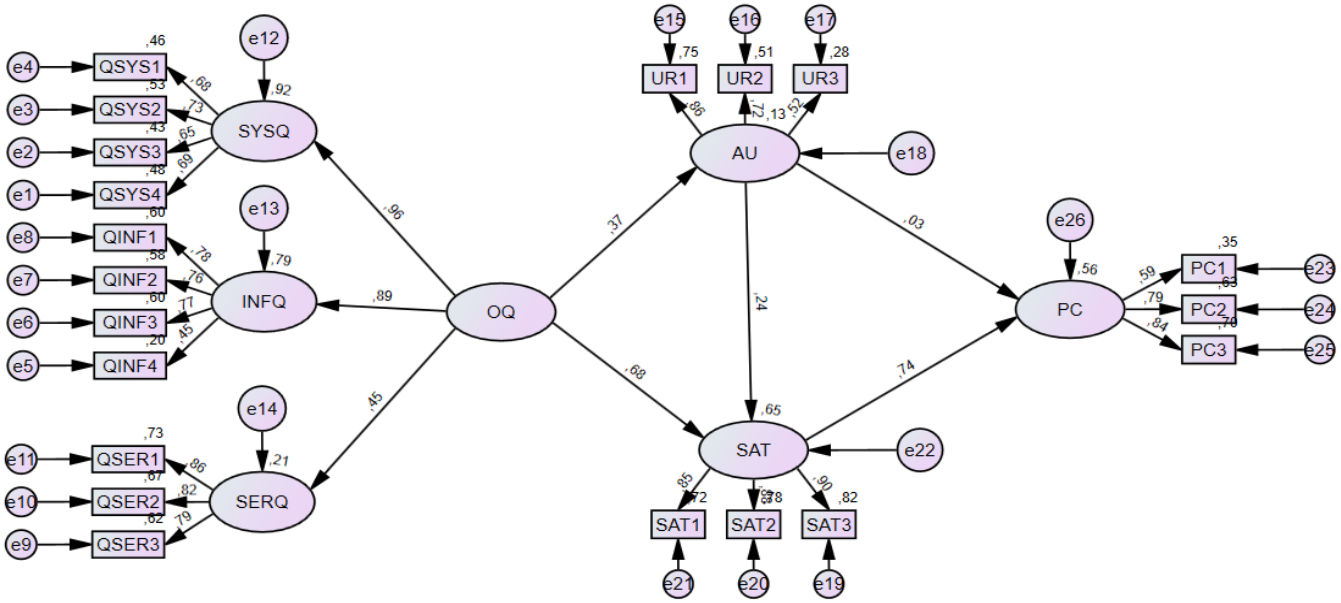
Notes: Diagonals represent the square root of the AVE while the other values represent correlations.

4.2 Structural model assessment

The goodness-of-fit for the structural model was similar to the previous CFA measurement model, with values recorded as $\chi 2/df = 2.393$, CFI = 0.955 and RMSEA = 0.052. These fit indices show a satisfactory alignment between

the hypothesized model and the observed data (A. Aldholay et al., 2018; Byrne, 2013). Consequently, the path coefficients of the structural model can be analysed.

The hypotheses of this study were evaluated using SEM with AMOS, as shown in Figure 2. The assessment of the structural model, detailed in Table 5, presents the results of the hypothesis tests.



Notes: $\chi^2 = 387.781$, df = 162, $p < 0.001$, CFI = 0.955, RMSEA = 0.052, GFI = 0.922, AGFI = 0.899, NFI = 0.926, PNFI = 0.627, IFI = 0.955, TLI = 0.947, PGFI = 0.711

Figure 2. *Research structural model results.*

The hypotheses of this study were evaluated by structural equation modelling using AMOS, as illustrated in Figure 2. The assessment of the structural model using standardized estimates, as detailed in Table 5, indicates the results of the hypothesis tests, confirming that four hypotheses are supported, while a single is unsupported, namely H4 ($\beta = 0.03$, $t = 1.071$, p insignificant). OQ predicts AU and SAT; thus, H1 and H2 are supported ($\beta = 0.37$, $t = 1.878$, $p < 0.001$; and $\beta = 0.68$, $t = 3.238$, $p < 0.001$, respectively). AU also has a significant impact on user satisfaction, thus supporting H3 ($\beta = 0.24$, $t = 6.857$, $p < 0.001$). H5 is similarly accepted as SAT significantly predicts PC ($\beta = 0.74$, $t = 15.745$, $p < 0.001$).

Table 5. *Structural path analysis results.*

Hypothesis	Relationship	β	SE	T-value	p	Decision	R^2
H1	OQ→AU	0.37	0.197	1.878	***	Supported	0.135
H2	OQ→SAT	0.68	0.21	3.238	***	Supported	0.650
H3	AU→SAT	0.24	0.035	6.857	***	Supported	
H4	AU→PC	0.03	0.028	1.071	0.576	Unsupported	0.563
H5	SAT→PC	0.74	0.047	15.745	***	Supported	

Note: ***p<0.001

As H4 is unsupported, we decide to evaluate the indirect effect of actual use on the development of professional competencies. As demonstrated in Table 6, the values suggest a strong and statistically significant indirect effect, meaning that AU significantly influences PC through SAT. Since the confidence interval does not include zero and the p-value is very small, we can be confident in this mediation effect.

Table 6. *Indirect effects of AU on PC.*

					95% confidence interval	
	Estimate	**Std. error**	**z-value**	**p**	**Lower**	**Upper**
AU → SAT → PC	0.264	0.028	9.501	< .001	0.209	0.318

Note: The study uses the standardized estimates with maximum likelihood estimation (MLE).

5 DISCUSSION

This study aimed to determine the extent to which e-learning improves professional competencies of teachers belonging to the Béni Mellal-Khénifra region in Morocco. The research examined overall quality using three dimensions and 11 indicators, and the results indicated that overall quality of e-learning has a significant impact on both user satisfaction and actual use, which aligns with previous studies (A. Aldholay et al., 2018; Almazán et al., 2017; Aparicio et al., 2016; Chiu et al., 2016). This shows that the higher the quality of the e-learning system in terms of ease of use, flexibility and structuring, the higher the actual use and satisfaction of teachers because they perceive it as meeting their expectations. The fact that teachers in the Béni Mellal-Khénifra region consider the information offered by e-learning to be useful, understandable, relevant and reliable should encourage educational leaders to invest more in the in-service training of teachers in an e-learning context. In terms of service quality, teachers generally rated the services offered by e-learning in terms of support and sufficient knowledge to help participants by tutors and designers when needed, and this is reflected in their level of satisfaction and use of e-learning.

The findings indicate that overall quality positively influences actual use. This means that as the quality of e-learning improves – considering factors such as ease of use, flexibility, structuring, usefulness, understandability, relevance, reliability, support and help when expected and assistance efficiency – the frequency and duration of teachers' engagement with online learning increases. This is in line with previous studies (A. Aldholay et al., 2018; Dağhan & Akkoyunlu, 2016; W.-T. Wang & Lai, 2014).

In terms of actual use, the findings reveal that it has a significant effect on user satisfaction, which aligns with earlier research (A. Aldholay et al., 2018; Stefanovic et al., 2016). This can be attributed to the fact that when actual use of e-learning among teachers in the Béni Mellal-Khénifra region increases, the quality of their learning improves in three dimensions: efficiency (completing tasks quickly, easily), knowledge (gaining new knowledge and skills, fostering innovative ideas) and competence (reducing errors and achieving future goals) (A. Aldholay et al., 2018). Meanwhile, other researchers have found this relationship to be insignificant (Cho et al., 2015; Wu & Wang, 2006).

In addition, the study indicates that higher overall quality plays a key role in improving user satisfaction. Higher overall quality can be achieved through ease of use, flexibility, structuring, usefulness, understandability, relevance, reliability, support and help when expected and assistance efficiency. As a result, teachers find that these factors meet their expectations, increasing their level of satisfaction with e-learning. These findings are in line with previous studies (A. Aldholay et al., 2018; Almazán et al., 2017; Chiu et al., 2016).

The results also show that user satisfaction has a significant influence on teachers' professional competencies. This indicates that the more satisfied teachers are with the actual use of e-learning, the more they enhance their professional competencies, especially their digital skills (Benali et al., 2018), communicative skills (Tobola Couchepin & Périsset, 2021), didactic and evaluative skills (Fagnant, 2023), which improves teachers' ability to solve specific problems and carry out particular tasks in the classroom.

On the other hand, actual use had no impact on the professional skills of teachers in the Béni Mellal-Khénifra region. This result is in line with several previous research studies (Cho et al., 2015; Khayun & Ractham, 2011; Wu & Wang, 2006). Several factors could contribute to this outcome. Firstly, these conflicting results could be attributed to variations in the study contexts and the different variables employed to assess actual use (A. Aldholay et al., 2018). Secondly, actual use may possibly lead to greater professional competencies only if users are satisfied with the system. Thirdly, this result can be explained by the engagement levels of teachers who use these e-learning systems passively or sporadically, rather than actively engaging with them, thus reducing the potential for skill enhancement.

As for the mediating role of satisfaction between actual use and the development of teachers' professional competencies, satisfaction can be seen as a psychological state resulting from teachers' experience of e-learning, which may influence the way they perceive the effectiveness of e-learning in developing their professional skills. Furthermore, when teachers find e-learning engaging and beneficial, their motivation to use these platforms increases and they become more likely to perceive learning as valuable, leading them to invest more effort in their professional development. Actually, satisfied teachers may provide feedback and collaborate with peers, promoting an e-community of practice that further supports competency growth.

Based on DeLone and McLean's information system success model, this study improves our understanding of the roles played by technical, semantic and system effectiveness characteristics in the process of e-learning adoption and use among teachers belonging to the Béni Mellal-Khénifra region, thus highlighting implications and proposals for managing the continuing education of this population and for realizing the positive outcomes of e-learning.

In terms of the implications of this study, the results can be used as a guideline for the Human Resources Department—which is a government body—to focus on e-learning in order to increase the frequency and duration of its actual use among teachers to develop their skills in rationally exploiting the potential of e-learning. This study also shows that total e-learning quality predicts user satisfaction and actual use, which in turn explains 56% of the variance in professional skills. It is therefore essential for the Human Resources Department to focus on these factors to support e-learning outcomes and develop effective educational plans that build teachers' capacity to keep up with technological development and respond to the new challenges facing Moroccan schools in the digital age and artificial intelligence.

This study has several limitations that should be considered when interpreting the findings. Firstly, the sample is limited to teachers belonging to the Béni Mellal-Khénifra region of Morocco, while excluding other regions and stakeholders comprising designers, tutors and administrative managers. It is advisable to conduct further research with a larger group of contributors to validate these initial results. Secondly, the study relied on teachers' self-perception to assess the proposed research model rather than actual data regarding their level of professional competencies. To overcome this limitation, future research should focus on creating and implementing a certification tool. Additionally, we exclusively utilized quantitative data to evaluate teachers' professional competencies. Although these quantitative findings are useful for assessment, incorporating qualitative data through interviews or observations would greatly strengthen the validity of the results.

6 CONCLUSION

E-learning can effectively support and facilitate teacher professional development programmes aimed at fostering inclusive, equitable quality education and lifelong learning for everyone (Huang et al., 2024). In striving to assess the impact of e-learning on professional competencies, we collected data from among teachers belonging to the Béni Mellal-Khénifra region in Morocco. The results indicate the impact of teachers' satisfaction with their use of e-learning on the development of their professional skills, without any direct effect of the actual use of e-learning on these skills. This suggests that satisfaction plays a mediating role between actual use and the development of teachers' professional competencies. The study also found that overall quality significantly affects both user satisfaction and actual use by teachers within an online learning context. Consequently, stakeholders should focus on the technical, semantic and efficient features of e-learning to maximize the opportunity for better results among teachers in terms of developing both technical and non-technical skills.

These results therefore provide significant support for stakeholders in the Moroccan education system in general to bridge the gap between the use of e-learning and skill enhancement. These stakeholders should implement strategies to improve the effectiveness of e-learning systems through assessment of specific teacher training needs, integration of interactive and collaborative elements into e-learning systems that could increase engagement and, consequently, skill development, and finally, through appropriate training on how to use e-learning systems effectively to achieve all these goals.

ADDITIONAL INFORMATION AND DECLARATIONS

Conflict of Interests: The authors declare no conflict of interest

Author Contributions: E.M.E.A.: Conceptualization, Methodology, Writing – Original draft, Data curation. M.J.E.A.: Writing – Review & editing, Supervision. M. Z.: Data curation, Writing – Review & editing. M.E.A.: Supervision, Writing – Review & editing.

Statement on the Use of Artificial Intelligence Tools: The authors declare that they didn't use artificial intelligence tools for text or other media generation in this article.

Data Availability: The data that supports the findings of this study are available from the corresponding author.

APPENDIX A

Table A. *Instrument for variables.*

Construct	Measures	Source
System quality (SYSQ)	QSYS1: I find that e-learning allows flexible interaction.	Aparicio et al., (2017)
	QSYS2: The e-learning system makes it easy for me to find the information I'm looking for.	
	QSYS3: The e-learning system is well structured.	
	QSYS4: The e-learning system is easy to use.	
Information quality (INFQ)	QINF1: The information provided by the e-learning system is useful.	Urbach et al., (2010)
	QINF2: The information provided by the e-learning system is useful.	
	QINF3: The information provided by the e-learning system is relevant.	
	QINF4: The information provided by the e-learning system is reliable.	
Service quality (SERQ)	QSER1: Responsible service personnel are always ready to help me when I need support with the e-learning system.	Aparicio et al., (2017)
	QSER2: Responsible service personnel provide services related to the e-learning system when expected.	
	QSER3: The staff responsible for the service are knowledgeable enough to answer my questions about the e-learning system.	
Actual use (AU)	UR1: On average, how often do you use e-learning?	A. Aldholay et al., (2018) ; UR3 is own measure
	UR2: On average, how much time do you spend using e-learning?	
	UR3: Which e-learning modalities do you use most?	
User satisfaction (SAT)	SAT1: My decision to use e-learning was a wise one.	A. Aldholay et al., (2018)
	SAT2: E-learning meets my expectations.	
	SAT3: Overall, I am satisfied with e-learning.	
Professional competencies (PC)	PC1: I'm developing useful skills through e-learning.	Bélisle et al., (2022)
	PC2: E-learning enables me to acquire useful knowledge for my profession.	
	PC3: I'm practicing skills that are useful in my profession.	

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