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Examining the Critical Factors Influencing the Development of a User Trust-Based E-Learning for Developing Countries: A Study based on PLS-SEM and the fsQCA

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Abstract: E-learning has significant potential to expand educational access in developing countries, providing unprecedented opportunities to bridge educational gaps. However, user trust in this new learning modality remains critical for its successful adoption. In this case, predicting the user trust in e-learning is challenging. The study aims to validate a proposed model to identify the most critical factors that influence user trust in the e-learning model. The study focuses specifically on Institutions of Higher Learning (IHL) students in three developing countries, which include Libya, Iraq, and Yemen. The model incorporates established factors from existing e-learning acceptance theories and integrates the concept of user trust. The PLS-SEM method has been used to examine the proposed model and to validate the factors that influence user trust in the e-learning model. Besides, fsQCA was used to analyzed the data collected from 381 students across three developing countries. Ten factors namely ease of use, accessibility, flexibility, interface design, enjoyment, usefulness, content quality, self-efficacy, website quality, and user preferences, has been identified and were the most critical factors that influence user trust in e-learning. The findings contribute valuable insights for designing trust-building strategies and promoting the effective use of e-learning in higher education within developing countries.

Keywords: E-Learning, User Trust in E-Learning, Developing countries, PLS-SEM, Fuzzy Set Qualitative Comparative Analysis.

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1. Introduction

Electronic learning, often known as E-learning, is increasingly being seen as a crucial technology that is extensively utilized and adopted by educational institutions and universities worldwide (Al Doghan & Piaralal, 2024). Since 2020, there has been a substantial increase in the pace of e-learning. Zabasta et al., 2024). Universities worldwide adjusted their resources to support various e-learning formats, fundamentally altering the educational landscape for staff and students alike (Ficapal-Cusí et al., 2024). Defined by Belew et al. (2024) as the utilization of technology for communication and material exchange, e-learning creates a virtual setting for instructional activities (Al-Rahmi et al., 2019). This model allows students to build skills remotely, eliminating the need for physical attendance. Its growing popularity stems from its affordability, accessibility, and flexibility, which enable self-paced, location-independent, and continuous learning (Zabasta et al., 2024).

The COVID-19 pandemic spurred a major shift in higher education in developing nations, pushing universities to implement e-learning and mobile learning to improve accessibility, cater to diverse needs, enhance tracking, and ensure cost-effectiveness (Belew et al., 2024). E-learning holds great promise for broadening educational access by using digital technologies such as online courses, virtual classrooms, webinars, and specialized platforms (Al Doghan & Piaralal, 2024) in order to deliver educational content outside of traditional settings. This approach allows for flexible, self-paced study across multiple platforms, saving both time and money, and offering environmental benefits by reducing travel (Yang, 2024). In developing countries, e-learning systems provide advantages like easy access to content, better team collaboration, and timely communication (Salloum et al., 2019), allowing learners to overcome geographical barriers and engage in continuous learning at their own pace (Yuebo et al., 2024). Crucially, e-learning also presents a solution to the scarcity of financial resources and skilled educators that often limits access to higher education in developing countries (Ali et al., 2022). Despite significant institutional investment, however, universities in developing countries have not fully realized the expected benefits of this technology (Almusfar, 2025). Studies indicate that the adoption and effective use of e-learning by learners and instructors face issues and challenges (Almusfar, 2025). This is particularly noticeable in developing economies where institutions might be new to online delivery (Barclay et al., 2018). Consequently, the overall success and usage of e-learning systems in these nations have been limited and deemed unsatisfactory (Salloum et al., 2019), meaning the potential benefits are hindered by various obstacles and restrictions.

The successful evolution of educational systems in developing nations is demonstrably predicated on the effective integration and utilization of Information and Communication Technology (ICT). However, the specific antecedents influencing students' acceptance and subsequent use of e-learning technologies within this context remain an underexplored area of inquiry (Yuebo et al., 2024). This state of research highlights a significant knowledge deficit regarding the critical factors that govern e-learning adoption (Badi & Noor, 2024). Consequently, Badi and Noor (2024) strongly advocate for a comprehensive and rigorous examination of e-learning acceptance and implementation dynamics specifically tailored to the unique challenges and conditions prevalent in developing countries. Thus, it is essential to identify the factors that influence the effectiveness

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use of E-learning in developing countries (Yuebo et al., 2024). In addition, most of the prior studies have focused on examining the impact of particular factors on e-learning adoption. Those factors are usually varied from one study to the other depending on the individuals and context. Thus, it is believed that there is a need for a comprehensive theoretical model that can fully understand the factors affecting e-learning in the context of developing countries (Salloum et al., 2019).

The plan outlined in this paper is as follows: the second section presents a literature review on e-learning, including the Underlying Theories of e-learning and the factors affecting trust in E-learning. The third section discusses the assessment of measurement models in PLS-SEM and fsQCA, and the evaluation of the structural model. The fourth section presents the discussion. The fifth section explains Implications. Finally, the sixth section outlines future work.

2. Related Works

2.1. The Conception of E-Learning

E-learning is now established as an essential technology that is extensively adopted by educational institutions worldwide (Al Doghan & Piaralal, 2024). This proliferation, already accelerating in the current century, was significantly heightened by the mandated, sudden transition to online instruction necessitated by the COVID-19 pandemic across higher education institutions (Zabasta et al., 2024). In response, universities globally adjusted their resource allocation and structural utilization to accommodate various forms of e-learning, initiating a fundamental change in the learning experience for both students and instructors (Ficapal-Cusí et al., 2024). Defined as the internet-based delivery of education for information acquisition and exchange (Jinah et al., 2024), e-learning encompasses a range of modalities beyond the conventional classroom. These include online courses, interactive multimedia, webinars, and virtual classrooms, all leveraging electronic technology to meet educational outcomes (Al Doghan & Piaralal, 2024). Crucially, e-learning systems provide students with the ability to engage in flexible, self-paced study by accessing materials on diverse platforms at any time. This integration of learning and internet technology is the present trajectory of education, poised to generate novel proposals for restructuring and become the dominant educational model (Masalimova et al., 2024).

2.2. Trust in E-Learning

User trust is a critical factor for the successful adoption and continuous use of e-learning platforms (Lewicka & Bollampally, 2022). The contemporary online environment is inherently insecure, exposing students to potential risks like the unwarranted collection and misuse of activity data during routine internet use (Shrivastava et al., 2020), which underscores the necessity of evaluating trust in this context. Consequently, the prediction of user trust in e-learning is considered essential (Said et al., 2023). Trust is fundamentally a social construct arising from an individual's perception and judgment of other parties (Lewicka & Bollampally, 2022). Within the dynamic and decentralized nature of internet ecosystems, trust is a key component of socio-technical interactions (Alzahrani et al., 2023). Specifically, trust in technology is defined as the belief that a system will effectively support an individual in achieving their goals, particularly in situations characterized by ambiguity and vulnerability (Alzahrani et al., 2023). In the e-learning domain, the trust

element encompasses the user's perception of the platform's security, reliability, and information confidentiality (Majjate et al., 2025; Sundresan et al., 2023). The overall efficacy of an e-learning system is multifaceted, depending on factors such as system quality, cultural context, self-efficacy, and the user's level of trust (Balogun et al., 2023). A qualitative study by Ooge, Dereu, and Verbert (2023) highlighted that a majority of participants linked trust in e-learning to their confidence in the platform's ability to customize activities for improved learning, which, in turn, boosts their intention to use the system. Establishing trust in e-learning mandates confidence in the capability and reliability of the underlying technology during both its use and adoption (Alzahrani et al., 2023). Furthermore, in developing nations, trust is vital for fostering user engagement, especially where the assurance of physical quality is difficult. It serves as a key driver for system adoption, ensuring students maintain confidence in the integrity and value of their educational experience (Mohammadkazemi, Golivari, & Goudarzi, 2024). Overall, the trust element plays a crucial role in the continued advancement and development of e-learning (Shrivastava et al., 2020). To accurately measure this construct, Nazaretsky et al. (2025) recently developed a novel instrument designed to assess students' trust in the adoption of AI-EdTech, providing robust statistical validation (using Exploratory Factor Analysis and Confirmatory Factor Analysis on responses from 665 STEM students) to ensure its internal consistency and accurate capture of trust's complex nature.

The theoretical grounding of the extended technology acceptance Model (ETAM), and information system success (ISS) supposed that many factors such as usefulness, ease of use, self-efficacy, enjoyment, web design quality, system quality and others are important drivers of user intention to accept e-learning (Al-Hawamleh, 2024). In the context of ETAM and ISS, trust in e-learning has been theorized as a direct factor influencing the behavioral intention of users, therefore, students should have trust in the e-learning system and the technologies that support it. However, these arguments have not followed up with empirical validation on how trust in e-learning can play a crucial role in driving the adoption of e-learning in the uncertain and constantly evolving environment of the Internet (Said et al., 2023). Thus, theories such as ETAM and ISS lack of empirical validation of trust as a driver of the adoption of e-learning (Paz, Ayalin, & Rosario, 2025). In this context, most of the past studies have considered the relationship between some factors, students' satisfaction and the subsequent use of e-learning (Al-Hawamleh, 2024). In their study, Riandi, Respati and Hidayatullah (2021) found that high service quality has a strong association with increased customer satisfaction and system use. Similarly, Sundresan et al. (2023) study revealed that the website's quality positively influences users' satisfaction with it. The study of Al-Hawamleh (2024) found that factors such as usefulness, ease of use, content quality and information quality positively contribute to higher user satisfaction and trust and encourage continued engagement. However, past studies overlooked or failed to consider the trust in the development of e-learning models (Ooge et al., 2023).

2.3. Underlying Theories of E-Learning

2.3.1. Extended Technology Acceptance Model

In 1985, Davis developed the Technology Acceptance Model (TAM) to provide insight into individual technology adoption decisions within the context of an organization. According to Davis (1985), users' acceptance or rejection of information technology

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is determined by usefulness and ease of use. The TAM model incorporates U, EOU, behavioral intention to use, and actual usage. Usefulness is the extent to which an individual believes that using a certain system would enhance the performance at work. This suggests that individuals are more likely to embrace technology if they believe it will improve their productivity at work (Yang, 2024). However, a person's assessment of how simple it would be to utilize a certain technology is known as ease of use (Davis, 1985). This might mean that people are more likely to want to utilize a technology and anticipate larger benefits from using it when they believe it to be easy to use (Ficapal-Cusí et al., 2024).

Furthermore, according to TAM, students' perceptions of the effort necessary to use the system (EOU) and usefulness (U) affect their attitudes towards adopting technology. Stated differently, U and EOU are the two most crucial factors in the early adoption of technology. Gaining deeper understanding of these factors facilitates the development of effective intervention strategies that motivate more individuals to adopt new information technologies (Majjate et al., 2025). While numerous models exist for evaluating technology adoption, the Technology Acceptance Model (TAM) remains the most frequently utilized theoretical framework in the literature (Eraslan Yalçın, 2018). TAM's popularity over competing frameworks is often attributed to its simplicity and ease of application (Eraslan Yalçın, 2018). However, a key limitation of the original TAM is its omission of several crucial explanatory factors. Consequently, researchers commonly develop Extended TAM (ETAM) models by incorporating additional variables relevant to specific adoption contexts (Yatigammana, Johar, & Gunawardhana, 2013). These extensions aim to provide a more comprehensive determination of the attitude toward accepting a technological innovation (Yatigammana et al., 2013).

For instance, the original TAM was extended by Davis (1985) to include enjoyment, which was found to significantly influence the desire to adopt word processing software. In the context of e-learning, research has demonstrated that TAM can be effectively extended by integrating a variety of factors that influence adoption (Lewicka & Bollampally, 2022). These factors include Self-efficacy (Yang, 2024); Content quality (Fageeh, 2024); User preference (Ali et al., 2022); Accessibility (Salloum et al., 2019); Satisfaction (Al-Hawamleh, 2024); and Trust (Lewicka & Bollampally, 2022). Furthermore, Yatigammana et al. (2013) successfully created and validated an approach for assessing postgraduate students' acceptance of e-learning by extending the original TAM to include relative advantage and complexity..

2.3.2. Information System Success Model

The DeLone and McLean Information System Success (ISS) Model, a widely adopted framework for evaluating the effectiveness of Information Systems (IS) within organizational contexts (Yang, 2024), was originally developed in 1992 by William H. DeLone and Ephraim R. McLean. This paradigm moves beyond a mere assessment of technical functionalities to evaluate the holistic impact of an IS. The model posits that IS success is determined by six interconnected dimensions:

1. System Quality which refers to the technical attributes of the system, including its reliability, responsiveness, and ease of use.
2. Information Quality that assesses the characteristics of the system's output, specifically its accuracy, relevance, and timeliness.
3. Use which quantifies the extent to which the target users adopt and utilize the system.

4. User Satisfaction that measures the users' contentment with the system's features and capabilities.
5. Individual Impact that evaluates the system's effect on the performance and productivity of individual users.
6. Organizational Impact that captures the broader organizational benefits derived from the system, such as enhanced productivity, cost reduction, or improved decision-making (Giang & Nga, 2024).

The Information System Success Model (ISSM) has been extensively applied in e-learning research to scrutinize success factors, often encompassing variables like technology system quality, information quality, service quality, support system quality, learner quality, teacher quality, and perceived usefulness (e.g., Bamaga et al., 2024; Chopra et al., 2019a; Yang, 2024). Current scholarly endeavors in online learning have involved enriching the fundamental ISS framework through integration with complementary theoretical models, such as the Technology Acceptance Model (TAM) and the Expectation Confirmation Model (ECM) (Yang, 2024).. In recent years, researchers have made significant advancements in the field of online learning by expanding the existing Information System Success (ISS) model and integrating it with other relevant theories such as the Technology Acceptance Model (TAM) and the Expectation Confirmation Model (ECM) (Yang, 2024). These studies have explored various factors that contribute to user- satisfaction, trust, usage, and benefits of e-learning (Yuebo et al., 2024). However, most of these studies have focused on universities in developed countries (Yuebo et al., 2024). In the same vein, academic educational surveys have previously forecasted student satisfaction or desire to continue with a certain teaching technique using the ISSM framework, which is nearly identical to TAM. Organisations may benefit from using the DeLone and McLean IS Success Model to evaluate the performance of their information systems and pinpoint areas in need of development.

2.4. User Trust Factor in e-Learning

2.4.1. Ease of Use

Ease of use refers to the degree to which student believe that using e-learning will be free of mental effort (Zabasta et al., 2024). A basic issue addressed by Davis (1985) in the technology acceptance model, or TAM, is the wasted potential of IT in task performance due to human incapacity to adopt and implement such technologies. As the learning curve is lowered, prospective users are more likely to choose technology that is viewed as being easy to use. In the e-learning environment, one evaluation criterion for academic achievements is the ease of use of the e-learning system (Ficapal-Cusí et al., 2024). In this context, Semerci and Goularas (2021) mentioned that when learners perceive that the e-learning system is easy to navigate, their experience and trust in e-learning will increase. This is because ease of use could improve the quality of teaching, and enhance group learning (Eze et al., 2020). The factor ease of use has been demonstrated to be a major predictor of e-learning trust in a few empirical studies. For example, Tsai, Chen and Fang (2024) found that ease of use has a significant influence on trust in using e-Learning for students in Fine Arts and Design Colleges in China. Al Kurdi et al. (2020) found that ease of use has a significant influence on University Students' trust and their behavior towards e-learning acceptance. Eze et al. (2020) found that ease of use, speed, and accessibility, influence students' trust in the usage of e-learning

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facilities. Therefore, it may be concluded from these reasons that ease of use has a positive relationship with trust in e-learning. Therefore, this study hypothesizes that there is a significant relationship between ease of use and trust in e-learning.

2.4.2. Usefulness

Usefulness in this study refers to the extent to which the use of e-learning will help to meet students' needs and improve their academic performance (Al-Hawamleh, 2024). According to the TAM theory, usefulness is a critical construct, that significantly influences learners' acceptance of e-learning technology and their behavioral intention to use it in future scenarios (Al-Hawamleh, 2024). The theory assumes that usefulness is related to a user's perceptions after they have used something; hence, in e-learning, usefulness reflects learners' perception that e-learning would improve academic performance (Al Doghan & Piaralal, 2024). Along these lines, usefulness would influence the user's trust in the e-learning system and then would lead to an improvement in their intention to use e-learning in education. Masalimova et al. (2024) indicate that e-learning could address numerous educational problems such as e-learning contributing to time savings, enhancing accessibility to supplementary learning resources, helping achieve better results, enhancing learner engagement, improving teacher-student interaction, and promoting a better understanding of concepts. Studies in a variety of fields have confirmed the relationship between usefulness and trust in using e-learning. For example, Gunawan et al. (2024) found that usefulness has a positive effect on user satisfaction and trust in e-learning as a sustainable learning style. Similarly, Yang (2024) found that usefulness has a significant influence on college students' satisfaction and trust in E-learning in China. Al Doghan and Piaralal (2024) found that usefulness significantly influences students' experience with E-learning, which in turn enhances their trust in using e-learning. Therefore, this study hypothesizes that there is a significant relationship between usefulness and trust in e-learning.

2.4.3. Enjoyment

In the context of this research, enjoyment is conceptualized as the extent to which a learner experiences pleasure or delight while interacting with an e-learning system (Salloum et al., 2019). Grounded in the Technology Acceptance Model (TAM), enjoyment is recognized as a significant antecedent of the intention to continue using e-learning platforms (Obeid et al., 2024). Specifically, a positive and enjoyable user experience fosters the development of user trust in the platform (Obeid et al., 2024). Scholarly findings support the role of enjoyment in driving user engagement and sustained use. Fageeh (2024) observed that heightened student interest and engagement in e-learning were partially attributable to the pleasure derived from online courses, activities, and tasks, alongside the intrinsic fun experienced during the completion of online learning assignments. Furthermore, Susanti et al. (2024) suggested that students' perceptions of proficiency and connectedness are intertwined with the level of enjoyment and satisfaction they derive from e-learning, indicating that enjoyment strengthens the psychological proximity and trust between students and the e-learning paradigm. Empirical evidence consistently validates the link between enjoyment and trust in e-learning utilization. Obeid et al. (2024) highlighted that enjoyment exhibits the strongest predictive power among various factors contributing to trust in e-learning platform adoption. Similarly, Hunde et al. (2023) demonstrated that enjoyment is positively associated with behavioral

intention, which subsequently mediates the development of trust in the acceptance of mobile learning. Meanwhile, Al Arif, Kurniawan and Handayani (2024) and Hussein (2018) found that enjoyment did not have a significant influence on the actual use of e-learning. Therefore, it may be concluded from these reasons that enjoyment has a positive relationship with trust in e-learning. Therefore, this study hypothesizes that there is a significant relationship between enjoyment and trust in e-learning.

2.4.4. Content Quality

Content quality in this study refers to the availability of materials and services directly related to students' learning outcomes (Salloum et al., 2019). Content quality encompasses the quality of all forms of material and information generated and supplied via electronic means (Ali Jinah et al., 2024). Zhao, Wang and Liu (2022) mentioned that it is crucial for educational institutions to understand how their e-learning content quality is and where targeted enhancements can be made to better meet student needs and increase their trust in using e-learning. This is because course content quality is one of the most used e-learning quality measures to ensure that e-learning is efficient. Content quality enhances student-centric effective Learning via proper design, easy navigation, and multimedia content delivery as critical factors essential to widening acceptance beyond traditional physical classroom environments among higher education learners worldwide (Al Mulhem, 2020b). Past studies have presented empirical validation of the relationship between content quality and trust in e-learning. For example, in their study to examine the efficiency of e-Learning Platforms in Afghanistan Academic Settings, Amiri et al. (2024) found that content quality is essential to enhance user trust in using e-learning for education. Zhao et al. (2022) found that content quality enhances the students' educational experience, and thus increases their satisfaction and trust in e-learning. Ali Jinah et al. (2024) found that content quality was the most critical factor influencing the quality of an e-learning experience. The authors also observed that the most critical factor was the content quality. Al Mulhem (2020a) found that quality factors (course content quality, and website quality) have a positive and significant effect on students' satisfaction and trust in e-learning system quality In Saudi Arabia. Therefore, it may be concluded from these reasons that content quality has a positive relationship with trust in e-learning. Therefore, this study hypothesizes that there is a significant relationship between content quality and trust in e-learning.

2.4.5. Website Quality

Website quality in this study refers to the degree to which students believe that the website is easy to navigate and able to interact consistently. Website quality includes being easy to navigate, providing detailed information, a space for the community, making it easier to communicate with organizations, and easy to interact with services (Putra, Utomo, & Fathoni, 2024). Bhaskaran and Santhi (2019) asserted that the quality of the website can affect the information services, thus website quality is one of the important factors that can increase the user satisfaction and their trust to use e-learning. Website quality as described by Kishabale (2021) can contribute to e-learning system success because students perceive website quality as a very useful way of communication, helps them in career growth and makes them employable. The relationship between website quality and trust in e-learning has been verified in the current literature. For example, Putra et al. (2024) found that website quality in terms of quality of interaction

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with service received the highest score in enhancing students' satisfaction and trust in e-learning. The results of Yuebo et al. (2024) reveal that system quality has a positive influence online learning success by enhancing learners' satisfaction and trust in continuous use. Similarly, results have been confirmed by Fitria et al. (2024) that website quality is crucial in determining the ease of use and usefulness of e-learning systems, which enhance user satisfaction and trust in the use of e-learning. Website quality was also found by Putra et al. (2024) to be a statistically significant predictor of E-learners' satisfaction and trust; which in turn, influenced learning agility. Therefore, it may be concluded from these reasons that website quality has a positive relationship with trust in e-learning. Therefore, this study hypothesizes that there is a significant relationship between website quality and trust in e-learning.

2.4.6. Self-Efficacy

Self-efficacy in this study refers to student perceptions of their ability to use computers in the accomplishment of a task (Salloum et al., 2019; Yuebo et al., 2024). In the context of e-learning, students who exhibit higher self-efficacy are more inclined to complete the course. Self-efficacy has been identified as an important motivational and psychological predictor of e-learning experiences and achievement (Li & Ni, 2024). Rajam, Banerjee and Alok (2024) mentioned that e-learning challenges in developing countries are unique and drive learners differently than in developed countries, in this context self-efficacy is important to enhance user trust in using e-learning in facing these challenges. Umaroh, Musrini and Maulana (2024) explained that when students have higher self-efficacy, they are often highly motivated, goal-oriented and self-regulated learners, and in a voluntary environment, self-regulated learning is the key to successful online learning. Past studies have confirmed the relationship between self-efficacy and trust in using e-learning. For example, Rahmawati (2019) added self-efficacy to the TAM model and found that self-efficacy is important to positively influence the ease of use of the system, and then enhance user trust in the use of e-learning in the language learning environment. Similarly, Umaroh et al. (2024) added self-efficacy to the TAM model and found that self-efficacy positively influences the user trust in the use of e-learning. The study of Al Doghan and Piaralal (2024) revealed that self-efficacy positively influences on e-learning motivation. Therefore, it may be concluded from these reasons that Self-efficacy has a positive relationship with trust in e-learning. Therefore, this study hypothesizes that there is a significant relationship between self-efficacy and trust in e-learning.

2.4.7. User Preference

User preferences in this study refer to the different ways for inferring users' interests or preferences regarding the system's functionality of a particular learning resource, User preference is a necessary construct that predicts a user's intention and behavior toward certain technologies (Ilin, 2022). According to Badi and Noor (2024), user preferences also called the user-centered approach are the foundation of technological development has the potential to redefine learning by personalizing the process according to the users' needs. Usually, the users search for courses that enhance their learning, they consider specific details in the online e-learning system that fit their skills, learning requirements, and experiences. In the e-learning environment, user preferences can achieve the highest usage prediction accuracy when combining these four dimensions: "what to learn", "with whom to learn", "how to learn", and "in which pathway to learn".

Some past studies have confirmed the relationship between User preferences and trust in using e-learning. For example, Ilin (2022) examined how user preferences influence engagement and motivation in online learning between secondary school students in the UK. The study found that user preferences influence engagement positively, and this behavioral pattern reflects user motivation and learning preferences and can be utilized to personalize digital content delivery to increase engagement with online learning materials. The study by Alshehri, Rutter and Smith (2019) found that when the online learning system focusing on user preferences not only improved user learning skills but also made course selection easier, depending on users' interests and preferences, the study found that user preferences are the most important factor that influences the students' use of the e-learning system in Saudi Arabia. Therefore, it may be concluded from these reasons that User preferences have a positive relationship with trust in e-learning. Therefore, this study hypothesizes that there is a significant relationship between user preferences and trust in e-learning.

2.4.8. Flexibility

Flexibility in this study refers to how e-learning websites give students the freedom to choose what, when and where to learn. Further, the ability to react to changes in user needs and requirements quickly (Dumiyati et al., 2024). In this context, an e-learning system should be flexible enough to modify the content, materials, exams, and assignments, and adaptable to other products with which it needs interaction, such as MS Word (Bamaga et al., 2023). According to Dumiyati et al. (2024), e-learning flexibility encourages independent and flexible learning, and creates flexible choices available to students anywhere and anytime, which enriches learning materials stimulates learning, opens up learning and increases efficiency. Teaching and learning processes and encouraging student independence. Thus, flexibility is an attribute that reflects the quality of the e-learning system (Bamaga et al., 2023). Past studies have presented some empirical validations of the relationship between flexibility and trust in using e-learning. For example, Nadella and Pillai (2024) found that flexibility demonstrates significant and positive indirect influences on the 'Overall Influence' experienced by learners in U.S. high schools. Balogun et al. (2023) found that flexibility is a crucial factor that affects student satisfaction and trust in synchronous e-learning. The finding by Kokoç (2019) revealed that flexibility of time and flexibility regarding the content have significant positive effects on behavioral engagement and academic performance, which enhance user trust in e-learning. It can be concluded that flexibility exerts a positive influence on trust within e-learning contexts. Accordingly, this research proposes the hypothesis that a significant relationship exists between flexibility and trust in e-learning.

2.4.9. Interface Design

Interface design, within the context of e-learning, encompasses the aesthetic and functional characteristics of the digital environment, specifically referring to the visual presentation of screens, buttons, icons, images, and text with which the learner directly interacts (Kamaruddin & Sulaiman, 2018). The literature consistently highlights the significance of user interface (UI) design in optimizing the e-learning experience. Effective UI design enhances the accessibility, usability, and interactivity of the platform, thereby accommodating the diverse requirements and learning

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preferences of a heterogeneous learner population (Senevirathne & Manathunga, 2021). Furthermore, a user-centered design approach, which prioritizes meeting user needs, has been shown to improve the ease of accessing e-learning resources (Belew et al., 2024). Consequently, UI design is recognized as a critical factor influencing the overall effectiveness and accessibility of e-learning technology. It is imperative that the design and implementation of e-learning systems be simple and effective to mitigate complexity, increase user trust, and promote engagement (Almusfar, 2025). Prior research has established a direct correlation between interface design and user trust in e-learning platforms. Specifically, a user-friendly design is deemed essential for creating an effective and engaging learning environment that cultivates user trust (Kishabale, 2021). Studies have demonstrated that effectively designed e-learning systems lead to higher levels of user trust, engagement, material comprehension, and satisfaction (Almusfar, 2025). Moreover, the trust a learner develops over time is influenced by key design elements such as the portal's navigation structure, the presentation and search-ability of learning materials, and the site's speed and responsiveness (Chopra et al., 2019b). Therefore, it can be concluded from these reasons that interface design has a positive relationship with trust in e-learning. Therefore, this study hypothesizes that there is a significant relationship between interface design and trust in e-learning.

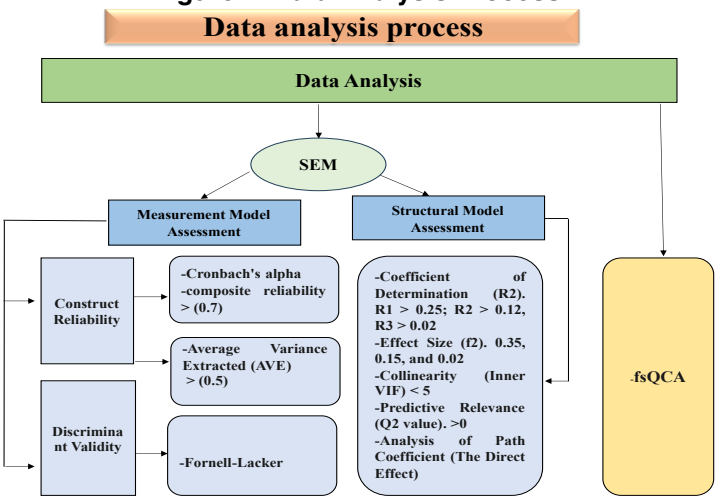
2.4.10. Accessibility

In this study, accessibility is conceptualized as the extent to which learners are able to lead a satisfactory learning experience through the support of the e-learning system, encompassing their perceptions, experiences, and expectations of accessible use (Salloum et al., 2019). The level of accessibility to the tools and resources required for task completion is viewed as a key facilitating condition that strengthens users' trust in adopting e-learning solutions. Accessibility enables learners to effortlessly obtain resources and navigate essential learning activities, promoting sustained engagement and optimizing the educational benefits offered by these platforms (Belew et al., 2024). Moreover, accessibility features have the potential to empower women in developing countries by expanding opportunities for higher education, allowing learners to retrieve course materials remotely according to their individual needs and interests, which subsequently enhances their trust in e-learning systems (Khairunnisa et al., 2025). Previous research has consistently demonstrated a significant association between accessibility and trust in the use of e-learning. For instance, Belew et al. (2024) reported that accessibility exerted a positive and direct influence on postgraduate students' perceived ease of use and their trust in adopting e-learning technologies. Similarly, Belew et al. (2024) found that accessibility can improve the ease of accessing e-learning based on user needs, which enhances user trust in e-learning. The results of Wang (2014) revealed that user trust that accessibility of E-learning has the potential to expand educational opportunities. Therefore, it may be concluded from these reasons that accessibility has a positive relationship with trust in e-learning. Therefore, this study hypothesizes that there is a significant relationship between accessibility and trust in e-learning.

3. Overall Process

The general process of the study is presented in this section, as shown in Figure 1.

Figure 1: Data Analysis Process.



3.1. Survey Finding

The subsequent sections present the results of the user survey. The quantitative findings begin with a description of the data collection procedures and respondent count, followed by an overview of the respondents' demographic characteristics and an assessment of data reliability. This section also includes the descriptive statistics and outcomes of data screening. Furthermore, the reliability and validity of the constructs are examined. Finally, the section reports the validation results for the critical factors of the proposed e-learning model from the users' perspective.

3.1.1. Response Rate

The Google Docs service was used to design the questionnaire; participants were requested to use the URL address provided in the email to access the Google Docs online survey questionnaire. Probability sampling using multi stages cluster sampling technique was used in this study. Three academic staff from Libya, Iraq and Yemen were requested to distribute the questionnaire among the undergraduate student in their countries. A total of 381responses were received and used in the subsequent analysis. All responses to this academic survey are confidential and will be used solely for research. Respondent privacy is guaranteed by the exclusion of all personal identification.

3.1.2. Demographic Analysis

Table 1 depicts the respondents' profiles. In terms of gender, Table 1 shows that (63.33%) of students were male, (36.67%) were female. In terms of age group, Table 1 shows that 50.00% of respondents were in the age group between 21-23, 22.33% of respondents were in the age group between 24-26, 19.00% of respondents were in the age group 18 - 20, while 8.67% of respondents were in the age group more than 26 years old. Table 1 also shows that 40.33% of the respondents have used e-learning websites for education at least once per month, 17.00% of respondents have used

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e-learning websites for education twice per month, three times per month at 15.67%, four times per month at 15.00%, five times per month 5.33%, and 6.67% of respondents have used e-learning websites for education more than five times. Table 1 shows that (43.67%) of the respondents were second-year students at the university, (28.67%) of the respondents were third-year students at the university, (20.00%) of the respondents were first-year students at the university, and (7.67%) of the respondents were graduation year students at the university. In terms of nationality, Table 1 also shows that (26.25%) of respondents were from Libya, (40.68%) of respondents were from Iraq, and (33.07%) of respondents were from Yemen.

Table 1: Respondents Profile (N=381).

Demographic Information	Categories	Frequency	Percent %
Gender	Male	241	63.33
	Female	140	36.67
Age group (Year)	18 – 20 years old	72	19.00
	21 – 23 years old	190	50.00
	24 – 26 years old	85	22.33
	More than 26	34	8.67
Use e-learning websites for education? (Per month)?	Once	153	40.33
	Twice	65	17.00
	Three Time	59	15.67
	Four Time	57	15.00
	Five Time	21	5.33
	More than five time	26	6.67
Study level	First-year student	76	20.00
	Second-year student	166	43.67
	Third-year student	109	28.67
	Graduation year student	30	7.67
Nationality	Iraqi	155	40.68
	Yemeni	126	33.07
	Libyan	100	26.25

3.2. Assessing the Measurement Models in PLS-SEM

Internal consistency was the primary criterion for analysing and ensuring the e-learning model. Cronbach's Alpha was used to evaluate the internal consistency of the entire factors scale by comparing items/observed factors. The underlying latent factors explain item variance, which reflects item reliability (Götz, Liehr-Gobbers, & Krafft, 2010). Cronbach's Alpha is accepted to be 0.70. However, a Cronbach's Alpha coefficient of 0.6 is appropriate for exploratory study. Construct's reliability evaluation is also recommended by researchers in order to monitor the reliability of a set of items under the same factor. Items inside the same factor are expected to have a stronger association among themselves, as shown by factor-level reliability. Table 1 reveals that the composite reliability (CR) ranged from 0.850 to 0.937, which was greater than 0.70 , and the Cronbach's alpha (CA), which ranged from 0.775 to 0.920, which was greater than the recommended value of 0.7 (Hair et al., 2017). Convergent validity was assessed in this study using the "Average Variance Extracted" (AVE) technique, as recommended by Hair et al. (2014). The average percentage value of the variance extracted commonly among the observed items of a factor is referred to as the AVE. The AVE for each factor was more than the required value of 0.5 (50%), indicating that on average, each factor could explain more than half of the variance to its measuring items (Hair et al., 2017).

Table 2: Internal Consistency and Convergence Validity Results.

Factors	CA	CR	AVE
Ease of Use	0.890	0.919	0.696
Usefulness	0.920	0.937	0.681
Enjoyment	0.795	0.867	0.620
Content Quality	0.887	0.917	0.689
Website Quality	0.775	0.850	0.588
Self-efficacy	0.863	0.907	0.709
User's preferences	0.901	0.923	0.669
Flexibility	0.834	0.883	0.603
Interface Design	0.885	0.908	0.555
Accessibility	0.833	0.889	0.668
Trust	0.866	0.903	0.671

CA= Cronbach's alpha, CR= Composite reliability, AVE= Average Variance Extracted.

Table 3: Discriminant Validity – Fornell and Lacker Criterion.

Constructs	Content Quality	Enjoyment	Flexibility	Interface Design	Accessibility	Ease of Use	Usefulness	Self-Efficacy	User's Preferences	Website Quality	Trust
Content Quality	0.766										
Enjoyment	0.708	0.817									
Flexibility	0.687	0.691	0.745								
Interface Design	0.666	0.718	0.692	0.830							
Accessibility	0.639	0.643	0.610	0.625	0.788						
Ease of Use	0.655	0.684	0.626	0.547	0.591	0.842					
Usefulness	0.635	0.683	0.623	0.579	0.586	0.619	0.818				
Self-efficacy	0.612	0.668	0.629	0.664	0.655	0.672	0.679	0.776			
User's preferences	0.625	0.681	0.629	0.622	0.602	0.719	0.713	0.727	0.826		
Website Quality	0.656	0.712	0.719	0.526	0.585	0.656	0.641	0.636	0.672	0.833	
Trust	0.734	0.716	0.713	0.621	0.632	0.711	0.753	0.721	0.802	0.682	0.834

The extent to which a group of items estimates only one factor and how this factor is uniquely estimated is referred to as discriminant validity. The criterion used in this study to confirm discriminant validity was Fornell-Lacker. A factor must represent greater variation in its items than other items in the model (Rönkkö & Cho, 2022). As a result, the value of one construct's square root of average variance extracted (AVE) must be greater than the value of intercorrelations between the factors. According to Table 3, the square roots of the AVE of all factors were greater than their corresponding inter-correlations. As a result, the discriminant validity study revealed that the model validity is acceptable.

3.3. Assessment of the Structural Model

The R square reflects the variance in the endogenous variable/construct(s) that is explained by the exogenous variable/construct(s), in other word, the amount of variance in the construct in question (trust in e-learning) that is explained by the model. The coefficient of determination (R^2) is the central criterion for the evaluation of structural model's quality. Three criterions are used to evaluate R^2 value for each endogenous variable, substantial level (0.26 and above), moderate level (from 0.13 to 0.25), and weak level (from 0.02 to 0.12). Table 4 shows the R^2 values for endogenous variable. The R^2 value for trust in e-learning was is 0.840, The R^2 value for the endogenous was above 25%, which are at the substantial level, thus, demonstrates a high prediction level as recommended by Supriadi and Mesra (2023).

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Table 4: R^2 Result.

Endogenous Factors	R Square	R Square Adjusted
Trust in E-learning	0.840	0.833

Substantial > 0.25; Moderate > 0.12, Weak > 0.02

The Effect size uses to determine the change in R2 value when a specific predictor construct is omitted from the model. Effect size value helps to distinguish whether the impact of a particular exogenous latent construct on an endogenous latent construct has substantive impact. Specially, it assesses how strongly one exogenous construct contributes to explaining a certain endogenous construct in terms of the change in the R^2 value. Three criterions used in this study to evaluate f^2 which are 0.35, 0.15 and 0.02 that considered large, medium, and small effect sizes respectively as recommended by Supriadi and Mesra (2023). Table 5 shows that one relationship showed large effect. Flexibility has large effects on trust in e-learning (f^2 = 0.563). ease of use, accessibility, interface design, enjoyment, usefulness, content quality, self-efficacy, and user preferences have medium effect on trust in e-learning. Moreover, website quality has small effect on trust in E-learning (f^2 = 003).

Table 5: f^2 Result.

Exogenous Variables	Trust in e-learning
Ease of use	0.245
Accessibility	0.025
Flexibility	0.563
Interface design	0.025
Enjoyment	0.032
Usefulness	0.184
Content quality	0.177
Self -efficacy	0.181
Website quality	0.003
User preferences	0.091

f^2: Large effect size > 0.35; Medium effect > 0.15; Small: > 0.02

Multicollinearity should be tested before proceeding with the model testing, which is highly recommended by Bai, Zhang and Tian (2020). When two independent variables are highly correlated, then it is issue of collinearity, while when more than two independent variables are highly correlated, then it is an issue of multicollinearity (Omah, 2020). In this study, to identify if there was high correlation between independent variables, VIF was conducted to test the multicollinearity. Variance inflation factor (VIF) is a measure of the amount of multicollinearity in a set of multiple regression variables. In Smart-PLS, VIF evaluated by running a multiple regression of each variable in the structural model on all the other variables of the model (Cheng et al., 2022). As a rule of thumb, VIF value must not be greater than 5, because VIF values above 5 are indicative of collinearity among the predictor variables. Table 6 shows the inner VIF values for the structural model. Table 5 shows that the highest VIF value was 3.065 and the lowest VIF value was 1.506 which indicated the absence of multicollinearity within the independent constructs in the model.

Table 6: Result of Multicollinearity – Inner VIF Values.

Exogenous Variables	Trust in e-learning
Ease of use	1.930
Accessibility	2.080
Flexibility	1.659
Interface design	2.042
Enjoyment	1.506
Usefulness	1.928
Content quality	1.999
Self -efficacy	2.986
Website quality	3.065
User preference	2.831

As a rule of thumb, the model has predictive relevance if the Q^2 value larger than zero for a particular endogenous variable, which indicate that the path model's predictive accuracy is acceptable for this particular construct (Cheng et al., 2022). Table 7 shows that the structural model in this study has high predictive relevance as the Q^2 value (0.559) is higher than zero for all the endogenous variables.

Table 7: Result of Predictive Relevance.

Endogenous Variables	SSO	SSE	Q^2 (=1-SSE/SSO)
Trust in E-Learning	1400.000	617.125	0.559

SSO= the sum of squares of observations, SSE= the sum of squares of error

Table 8 shows the path coefficient assessment results for the proposed direct relationships in the structural model. It shows that all direct relationships were significant. Ten out of ten direct hypotheses were supported. Seven supported hypotheses were significant at level $p<0.01$ (exceeding the standardised value of 2.58), in positive sign directions, and three hypotheses were significant at level $p<0.05$ (exceeding the standardised value of 1.96). The path coefficient value (β) for the ten hypotheses was between 0.100 to 0.354. The highest significant path (p=0.000) was found between user preference and trust in e-learning (β=0.354 and t= 16.316), while the least significant relationship (p=0.043) was found between self-efficacy and trust in e-learning (β=0.033 and t=2.423). The second significant path (p=0.000) was found between content quality and trust in e-learning (β=0.325 and t= 11.923), the third significant path (p=0.002) was between enjoyment and trust in e-learning (β=0.219 or 22% and t= 6.106), the fourth significant path (p=0.010) was between website quality and trust in e-learning (β=-0.107 and t= 3.998), the fifth significant path (p=0.019) was between system usefulness and trust in e-learning (β=0.168 and t= 3.436). The sixth significant path (p=0.023) was found between ease of use and trust in e-learning (β=0.129 and t= 3.436), the seventh significant path (p=0.034) was between flexibility and trust in e-learning (β=0.014 and t= 2.668), the eighth significant path (p=0.041) was between interface design and trust in e-learning (β=-0.056 and t= 2.477). The ninth significant path (p=0.041) was between accessibility and trust in e-learning (β=-0.100 and t= 2.476). Figure 2 shows the inner loadings (t value) of the paths in the structural model, the value of t between independent variables and dependent variables were between 2.423 and 16.316. These results proved that hypotheses H1-H10 were supported.

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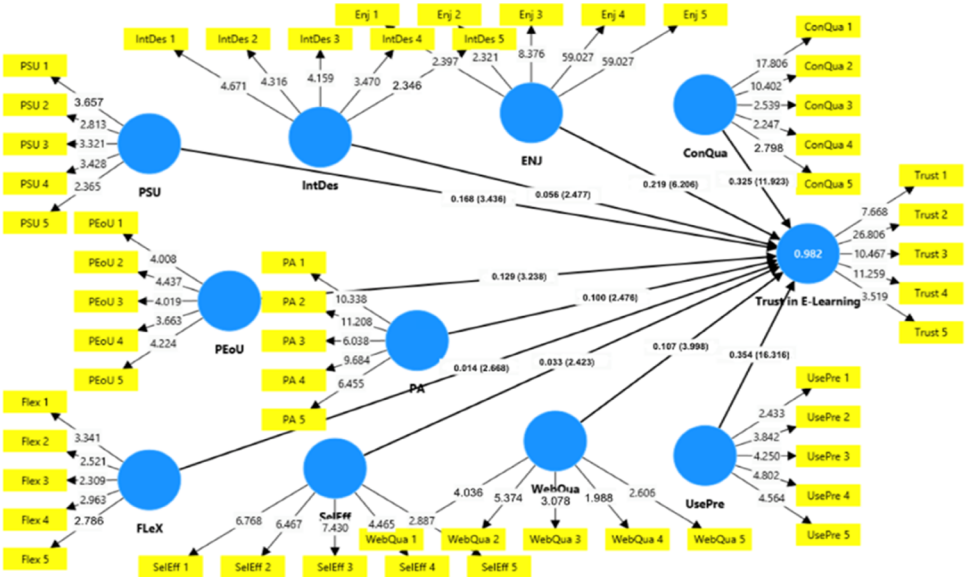
Table 8: Path Coefficient Result (Direct effect).

Hypotheses	OS/Beta	SM	SD	T	P	Decision
User preference -> Trust in e-learning	0.354	0.348	0.022	16.316**	0.000	Supported
Ease of use -> Trust in e-learning	0.129	0.001	0.040	3.238**	0.023	Supported
Usefulness -> Trust in e-learning	0.168	0.198	0.049	3.436**	0.019	Supported
Accessibility -> Trust in e-learning	0.100	0.044	0.040	2.476*	0.041	Supported
Website quality -> Trust in e-learning	0.107	0.103	0.027	3.998**	0.010	Supported
Content Quality -> Trust in e-learning	0.325	0.350	0.027	11.923**	0.000	Supported
Flexibility -> Trust in e-learning	0.014	0.013	0.020	2.668**	0.034	Supported
Enjoyment -> Trust in e-learning	0.219	0.214	0.036	6.206**	0.002	Supported
Interface Design -> Trust in e-learning	0.056	0.074	0.023	2.477*	0.041	Supported
Self -efficacy -> Trust in e-learning	0.033	0.015	0.014	2.423*	0.043	Supported

Significant: **p < 0.01, *p < 0.05

Figure 2 shows the inner loadings (t value) of the paths in the structural model, the value of t between independent variables and dependent variables were between 2.423 and 16.316. These results proved that hypotheses H1-H10 were supported.

Figure 2: Structural Model with β -values (Bootstrapping result).



4. Fuzzy Set Qualitative Comparative Analysis (fsQCA)

To discover complex causal relationships, FsQCA was conducted. FsQCA version 3.0 software has been used to analyse the configurations with 381 samples regarding trust in e-learning in developing countries. While SEM assumes symmetrical connections between independent and dependent variables, FsQCA assumes that these relationships might be asymmetric (Pappas & Bley, 2023). Hence, FsQCA is highly valuable in determining if trust in e-learning may be produced via different paths.

4.1. Calibration

The first phase of the FsQCA requires calibration of the causal factors and the

outcome. FsQCA deals with fuzzy sets ranging from 0 to 1, and calibration transforms values of factors into fuzzy sets. Therefore, calibration is necessary because our variables were measured with 5-point Likert scales ranging from 1 to 5. The data was shown on a 5-point Likert scale (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree). The factors were calibrated to convert raw values into Boolean values (i.e., set membership values) from 0 to 1. All construct data averages were thus subject to calibration. The direct technique converted the variables' total summations into fuzzy membership scores. Consider a fuzzy set as a group, then 1 represents the full member of the set, 0 represents the full non-member, and 0.5 represents the middle point (i.e., the intermediate set) and has maximum ambiguity regarding the case' member. To calibrate, the values of n1, n2, and n3 were replaced with the maximum, average, and minimum values of each factor. Thus, the results ranged from 0 to 1. The configuration that would be sent for further research was also determined by sorting the frequency and consistency values. As a result, this analysis employed the raw consistency criteria of 0.5 and the minimum frequency of three instances used in other investigations (Palacios-Marqués, Roig-Dobón, & Comeig, 2017). During the calibration, the researcher needs to choose the three points to represent the full member, the intermediate set, and the non-member. The values for calibration are presented in Table 9.

Table 9: Factor Calibration.

Factor	Mean	SD	Calibration
Ease of use (EoU)	4.17	0.66	(4.22, 4.17, 4.11)
Accessibility (A)	4.08	0.59	(4.26, 4.08, 3.89)
Flexibility (Flex)	4.00	0.63	(4.33, 4.00, 3.67)
Interface design (ID)	4.12	0.69	(4.41, 4.12, 3.83)
Enjoyment (Enj)	4.05	0.72	(4.29, 4.05, 3.81)
Usefulness (U)	3.97	0.64	(4.12, 3.99, 3.86)
Content quality (CQ)	3.96	0.62	(4.09, 3.96, 3.82)
Self -efficacy (SE)	3.92	0.65	(4.04, 3.92, 3.79)
Website quality (WQ)	4.07	0.63	(4.24, 4.07, 3.89)
User preferences (UP)	4.23	0.66	(4.34, 4.23, 4.11)
Trust in E-Learning (TR)	4.18	0.71	(4.17, 4.01, 4.37)

4.2. Truth Table Assessment/Sufficiency Analysis

In the fsQCA assessment process, the correlations between independent and dependent outcomes need to be examined by considering their pairings. This procedure is commonly known as the truth table evaluation or sufficiency analysis. The outcomes of the truth table consist of a collection of appropriate conditions, often known as configurations or causal models. Initially, the study executes the fuzzy set algorithm of the FsQCA software. This technique utilises every possible combination of predictors. The findings of the FsQCA analysis indicated a sufficient number of causative variables to predict the determinants. Based on the truth table, the frequency was set to 1 for both the high and low values of the dependent variable. Subsequently, the FsQCA analysis yielded three solutions: complex, parsimonious, and intermediate (Nikou et al., 2024).

The three solutions also varied in terms of their level of enlightenment and universality. More precisely, the complex solution was highly thorough, but it had limited universality, leading to a lack of application and generalisability of the conclusion.

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The most economical answer was the most straightforward one. However, due to the absence of some details, the conclusion lacked important information and may have been in opposition to the real scenario. The intermediate answer had a level of explanatory power that fell between the two previous solutions. Given its completeness, interpretability, comprehensiveness and clarity, the intermediate solution was chosen for this study's interpretation. In order to ascertain the factor of fit for the configurational model, consistency and coverage measurements were also utilised. The correlation and coefficient of determination were evaluated using threshold values of >0.2 and >0.9 respectively.

The investigation yielded seven distinct path solutions in the complex analysis. The solution coverage and solution consistency were 0.786450 and 0.852887, respectively. Regarding the parsimonious solution, there were five possible paths, and the solution coverage and solution consistency were 0.767658 and 0.816628, respectively. Furthermore, the intermediate solution consisted of a total of seven pathways. These solutions are given in Table 9. There were seven configurations with which students at developing countries could trust in e-learning. The overall consistency of these seven configurations was higher than 0.8 (0.852887), which indicated that these seven configurations fully explained trust in e-learning in developing countries. The coverage of the solution was 0.786450, which means that these seven configurations accounted for nearly 79% of the trust in e-learning among higher education students in developing countries.

The results of the fuzzy-set analysis were depicted using specific software symbols. More precisely, black circles(⬭) indicated the existence of a certain condition, whereas crossed-out circles (⬬) indicated its non-existence. The core elements of a setup were denoted by large circles, whereas the peripheral elements were denoted by small circles. Furthermore, blanks denoted a state of indifference in which the causative condition might be either present or absent. Consistency was quantified as the extent to which each condition variable was included in the outcome variable, whereas coverage assessed the practical significance of a consistent subset (Pappas & Bley, 2023). These solutions are given in Table 10.

The first solution recommended a higher level of ease of use, accessibility, flexibility, interface design, enjoyment, content quality, self-efficacy, website quality and user preferences would be necessary to enhance user trust in e-learning. The second solution showed that when ease of use, accessibility, flexibility, interface design, enjoyment, system usefulness, content quality, self-efficacy, and website quality are high, user trust in e-learning can be achieved. Similarly, the third solution showed that when ease of use, accessibility, flexibility, interface design, content quality, self-efficacy, website quality and user preferences are high, user trust in e-learning can be achieved. In solution four, a higher level of flexibility, interface design, enjoyment, system usefulness content quality, self-efficacy, website quality and user preferences would be necessary to enhance user trust in e-learning. In Solution 5, the absence of flexibility, interface design, enjoyment, system usefulness, content quality, self-efficacy and the presence of ease of use, and accessibility, website quality and user preferences were core elements determining user trust in e-learning. In Solution 6, the absence of ease of use, accessibility, flexibility, interface design, enjoyment, system usefulness and the presence of content quality, self-efficacy, website quality and user preferences were core elements determining user trust in e-learning. In Solution 7, the

absence of accessibility, flexibility, interface design, enjoyment, system usefulness, content quality and self-efficacy and the presence of ease of use, website quality and user preferences were core elements determining user trust in e-learning.

Table 9: FsQCA Result of Sufficiency Analysis (Complex solution, parsimonious solution, and intermediate solution).

Item	Path of Solution	Raw Coverage	Unique Coverage	Consistency
Complex Solution	PA*Flex*ID*Enj*PSU*CQ*SE*WQ*UP	0.62476	0.02936	0.898624
	PEOU* PA*Flex*ID*Enj*PSU*CQ* **WQ*UP**	0.59463	0.02997	0.891422
	PA*Flex*ID*Enj*PSU*CQ*UP	0.60889	0.04887	0.883157
	Enj*PSU*CQ*SE*WQ*UP	0.39875	0.05416	0.889860
	PA*~Flex*~ID*Enj*PSU*~CQ*SE*~WQ*UP	0.39980	0.04602	0.886394
	PA*Flex*~ID*Enj*PSU*CQ*~SE*WQ*~UP	0.29638	0.03895	0.885781
	PA*Flex*ID*~Enj*~PSU*~CQ*~SE*~WQ*~UP	0.27780	0.02769	0.884327
	Solution Coverage: 0.786450			
	Solution consistency: 0.852887			
Parsimonious solution	~ID*SE*UP	0.52338	0.06914	0.815952
	WQ*SE*Enj	0.73928	0.28493	0.857747
	PEOU* PA~ID	0.49623	0.06546	0.871023
	Flex* UP~ID	0.58745	0.23152	0.860150
	PA*ID~ PSU	0.43261	0.04298	0.852371
	Solution Coverage: 0.767658			
	Solution consistency: 0.816628			
Intermediate Solution	PEOU*PA*Flex*ID*Enj*CQ*SE*WQ*UP	0.61476	0.02937	0.89862
	PEOU*PA*Flex*ID*Enj*PSU*CQ*SE*WQ	0.59463	0.02997	0.89152
	PEOU*PA*Flex*ID*CQ*SE*WQ*UP	0.60880	0.05864	0.87316
	Flex*ID*Enj*PSU*CQ*SE*WQ*UP	0.39875	0.05440	0.88998
	PEOU*PA*~Flex*~ID*~Enj*~PSU*~CQ*~SE*UP	0.39980	0.04683	0.88638
	~ PEOU*~ PA*~ Flex*~ ID*~ Enj*~ PSU*CQ*SE*WQ*UP	0.48974	0.05319	0.89763
	PEOU*~PA*~Flex*~ID*~Enj*~PSU*~CQ*~SE*W Q*UP	0.56743	0.04986	0.88784

Solution Coverage: 0.786450
Solution consistency: 0.852887
"*" Represent "Plus"

Table 10: Configurations with high trust in e-learning in fsQCA.

	Trust in E-learning						
Condition Variable	**Solution 1**	**Solution 2**	**Solution 3**	**Solution 4**	**Solution 5**	**Solution 6**	**Solution 7**
PEoU	●	•	•		▬	⊙	▬
PA	●	•	▬		▬	⊙	⊙
Flex	▬	●	▬	•	⊙	⊙	⊙
ID	•	●	●	•	⊙	⊙	⊙
Enj	▬	●		▬	⊙	⊙	⊙
PSU		●		▬	⊙	⊙	⊙
CQ	•	▬	▬	▬	⊙	•	⊙
SE	●	▬	▬	●	⊙	•	⊙
WQ	●	●	●	●	•	▬	▬
UP	●		•	●	•	▬	▬
Raw Coverage	0.61476	0.59463	0.60880	0.39875	0.39980	0.48974	0.56743
Unique coverage	0.02937	0.02997	0.05864	0.05440	0.04683	0.05319	0.04986
Consistency	0.089862	0.89152	0.87316	0.88998	0.88638	0.89763	0.88784

Solution Coverage: 0.786450
Solution consistency: 0.852887

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5. Discussion

To achieve the study's objective, 10 factors were extracted from the literature that influence user trust in e-learning. A structured literature review has been conducted for academic articles to review e-Learning Adoption Models, tools and theories, with the aim was to identifying the best list of critical factors affecting user trust in E-learning. The findings confirmed positive significant relationships between ease of use, accessibility, flexibility, interface design, enjoyment, usefulness, content quality, self-efficacy, website quality, user preferences and trust in e-Learning. Hence, the study contributed to the body of knowledge on the importance of firm ease of use, accessibility, flexibility, interface design, enjoyment, usefulness, content quality, self-efficacy, website quality, and user preferences as predictors of trust in e-learning in developing countries. Additionally, empirical evidence is provided to support the ETAM and ISS theories, namely that ease of use, accessibility, flexibility, interface design, enjoyment, usefulness, content quality, self-efficacy, website quality, and user preferences have a horizontal relationship with trust in e-learning in developing countries (Al-Hawamleh, 2024; Yang, 2024).

In terms of the extended technology acceptance model (ETAM). The findings provide robust support for the core constructs of the Extended Technology Acceptance Model (ETAM) and significantly expand its explanatory power in the context of e-learning, particularly in developing countries. The Technology Acceptance Model (TAM) asserts that perceived usefulness and perceived ease of use are the primary determinants of user acceptance of a given technology. The present study corroborates these foundational constructs by demonstrating their significant influence on trust, a pivotal element in technology adoption. The positive associations identified between these constructs and trust reaffirm their centrality, as originally articulated by the Extended TAM (ETAM). Beyond validating the core model, the findings extend TAM by showing that additional factors including accessibility, flexibility, interface design, enjoyment, and self-efficacy also exert substantial effects on trust. These results indicate that determinants beyond usefulness and ease of use play an important role in shaping trust, thereby broadening the ETAM's applicability, particularly in contexts such as developing countries where technology adoption is influenced by a more diverse set of user needs and environmental conditions.

Within the framework of the Information System Success Model (ISSM), the findings further reveal that interface design, flexibility, and content quality significantly contribute to perceptions of system quality and, in turn, trust. This expands the conceptualization of system quality beyond technical performance to include user experience and design-related factors. The observed positive relationship between user preferences and trust highlights the importance of systems that are closely aligned with users' expectations, thereby reinforcing the user-centred principles embedded in ISSM. Moreover, the demonstrated influence of multiple system-related factors on trust strengthens the theoretical linkage between system quality and user acceptance, underscoring the multidimensional nature of system success.

The Fuzzy Set Qualitative Comparative Analysis (FsQCA) offers additional insights into the complex, configurational pathways that lead to the development of user trust in e-learning environments. By testing all possible combinations of antecedent conditions, the FsQCA results reveal multiple sufficient causal configurations that predict trust.

Based on a truth table with a frequency threshold of one for both high and low trust levels, three solutions; complex, parsimonious, and intermediate were generated, with the intermediate solution selected for interpretation. This solution identified seven distinct pathways capable of producing high trust in e-learning, each with a consistency level exceeding 0.8 (0.852887), indicating strong explanatory power. The overall solution coverage of 0.785704 suggests that these configurations account for approximately 79% of the variance in trust among higher education learners in developing countries. Collectively, the FsQCA results establish that the ten examined factors are both sufficient and necessary to foster trust in e-learning within these contexts.

5.1. Implications

This study reveals a strong positive relationship between multiple factors including ease of use, accessibility, flexibility, interface design, enjoyment, system usefulness, content quality, self-efficacy, website quality, and user preferences, and trust in e-learning systems within developing countries. These findings suggest that these factors play a crucial role in fostering user trust, which is essential for technology adoption. By incorporating these determinants, this study proposes an extended technology acceptance model that provides a more comprehensive explanation of trust formation, moving beyond the traditional utilitarian focus of the ETAM. Notably, the results highlight the importance of self-efficacy and user enjoyment factors not originally emphasized in the ETAM, underscoring the value of aligning e-learning systems with user needs and preferences to enhance adoption. Moreover, the findings emphasize the significance of contextual influences in developing countries, indicating that socio-cultural and technological conditions may affect the relationship between technology-related factors and trust. This suggests that models like the ETAM may require adaptation to effectively account for the unique characteristics of diverse regions. This study also provides empirical support for the Information System Success Model (ISSM), particularly regarding the role of website quality, interface design, and content quality as key determinants of system success. By extending the concept of system quality, the research offers practical guidance for stakeholders to improve trust and adoption in e-learning platforms. From a practical perspective, the findings underscore the need for educational institutions in developing countries to prioritize user experience and system quality. Recommendations include designing user-friendly and accessible interfaces, enhancing flexibility to accommodate diverse learning preferences, incorporating interactive multimedia elements, ensuring content quality and currency, and optimizing website performance. E-learning developers are encouraged to adopt user-centered design practices, conduct usability testing, and curate high-quality content, while institutions should invest in infrastructure, training, and professional development for content creators. Policymakers are advised to promote digital literacy, accessibility, and infrastructure development to support effective e-learning adoption. Overall, this study advances a holistic understanding of technology acceptance, highlighting how multiple interrelated factors collectively shape trust in e-learning systems within developing countries.

5.2. Future Research

Future research should consider expanding the current study model by incorporating additional factors drawn from other theoretical frameworks to examine user trust in

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e-learning within developing countries. These additional factors may exert a significant influence on trust and provide a more comprehensive understanding of the phenomenon. Moreover, the perspectives of top management and curriculum directors in educational institutions should be included in subsequent studies, as their insights may reveal unique determinants of user trust. Incorporating these viewpoints could enhance the accuracy and reliability of findings regarding the factors that shape trust in e-learning. To further strengthen the robustness of research outcomes, multiple data sources such as input from senior managers and IT specialists at educational institutions should be utilized. This approach can help mitigate potential biases in assessing trust in e-learning and provide a more balanced evaluation of influential factors. Additionally, employing qualitative methods, such as in-depth interviews, may offer richer insights into the elements that foster user trust. Such methods allow respondents to freely articulate their perceptions and experiences, beyond the constraints of structured questionnaires, thereby yielding deeper and more nuanced understanding of trust in e-learning within developing country contexts.

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