Development of an E-Learning Implementation Model with an Omnichannel Approach in Secondary Schools of Tehran

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Purpose: This study aims to develop and validate a model for implementing e-learning with an omnichannel approach in secondary schools in Tehran.

Methodology: A mixed-methods approach was employed in this study, integrating qualitative and quantitative research methods. The qualitative phase involved semi-structured interviews with 16 experts in educational technology and e-learning, selected through purposive sampling. The quantitative phase involved a survey of 256 secondary school teachers and administrators in Tehran, using a structured questionnaire. Data from the qualitative phase were analyzed using thematic analysis, while the quantitative data were subjected to Confirmatory Factor Analysis (CFA) to validate the proposed e-learning model.

Findings: The study identified several critical themes essential for the effective implementation of e-learning, including technology infrastructure, security and privacy, access management, content management, communication and collaboration, user experience, continuous management, and financial management. The findings revealed that robust technological infrastructure, secure platforms, effective access control, and engaging content are crucial for the success of e-learning initiatives. Additionally, the study emphasized the importance of continuous management and financial planning in sustaining e-learning systems. The CFA results confirmed the validity of the proposed model, with all identified themes showing strong positive relationships with successful e-learning implementation.

Conclusion: The study provides a comprehensive framework for the implementation of e-learning with an omnichannel approach in secondary schools. The findings highlight the critical factors that educational institutions must consider to ensure the success and sustainability of e-learning systems. The proposed model offers valuable insights for educators, administrators, and policymakers seeking to enhance the quality and accessibility of online education in the digital age.

Keywords: E-learning, Omnichannel, Secondary Schools, Technology Infrastructure, Security and Privacy, Access Management, User Experience, Educational Technology.

1. Introduction

T he rapid advancement of technology over the past few decades has significantly impacted various sectors,

including education. The emergence and evolution of e-learning have transformed traditional educational paradigms, offering new possibilities for both educators and learners (Bezi et al., 2024; Delghandi et al., 2024; Por Jafari shir Joposht et al., 2024; Shariati et al., 2024). This shift has been further accelerated by the global COVID-19 pandemic, which necessitated the widespread adoption of online learning platforms to ensure the continuity of education during times of crisis (Maatuk et al., 2021; Pourkarimi, 2023). Consequently, the study of e-learning systems, their implementation, and their effectiveness has become a focal point of research in educational technology.

E-learning, defined as the use of electronic media and information and communication technologies (ICT) in education, offers several advantages over traditional classroom-based learning. These include flexibility in time and location, access to a vast range of resources, and the ability to personalize learning experiences (Wei et al., 2021). However, the transition from traditional to online education is not without challenges. These challenges include issues related to technology infrastructure, access to the internet, digital literacy among students and teachers, and maintaining student engagement in a virtual environment (Akbari, 2021; Ghasemi, 2023).

The COVID-19 pandemic highlighted the urgent need for educational institutions to develop and implement effective e-learning strategies. In response, many institutions rapidly transitioned to online learning platforms, such as Blackboard, Moodle, and other learning management systems (LMS), to continue delivering education during lockdowns and social distancing measures (Albar, 2023; Ferdosipour & Gholami, 2022). However, this sudden shift also exposed the limitations and gaps in existing e-learning systems, particularly in terms of accessibility, equity, and the overall quality of education provided (Ordoo & Pourkarimi, 2022; Zarei & Javadipour, 2021).

One of the critical factors affecting the success of e-learning is the readiness of institutions, educators, and students to adopt and effectively use online learning platforms. E-learning readiness encompasses several dimensions, including technological infrastructure, digital literacy, and the availability of resources to support online learning (Özen et al., 2020). A study by Zine (2023) emphasized the importance of assessing e-learning readiness using machine learning methods to identify potential challenges and opportunities for improvement (Zine, 2023). Similarly, Ghasemi et al. (2022) investigated the factors influencing the quality of e-learning in higher education

institutions, highlighting the need for robust technological infrastructure and effective pedagogical strategies to enhance the online learning experience (Ghasemi, 2023).

In the context of Tehran's secondary schools, the implementation of e-learning systems during the pandemic revealed significant disparities in access to technology and internet connectivity, which affected students' ability to participate in online learning. This situation underscored the need for a comprehensive approach to e-learning that addresses not only technological barriers but also pedagogical and social challenges (Baghestani et al., 2023). Moreover, the shift to online learning has prompted educators to rethink traditional teaching methods and explore new approaches that leverage the unique capabilities of digital platforms (Akbari-Chehrehbargh & Tavafian, 2022; Setyaningsih et al., 2019).

The effectiveness of e-learning depends not only on the availability of technology but also on the quality of the content delivered and the methods used to engage students. Studies have shown that interactive and multimedia-rich content can significantly enhance the learning experience and improve student outcomes (Aalaa et al., 2021; Kurnaedi et al., 2022). For example, the use of video podcasts in pre-hospital education was found to be as effective as live lectures in terms of student learning outcomes, suggesting that e-learning can be a viable alternative to traditional teaching methods (Aghababaeian et al., 2019). However, the success of such approaches depends on careful planning and the integration of pedagogical principles that support active learning and student engagement (Keshavarz et al., 2022; Triyono et al., 2018).

The implementation of e-learning in educational institutions also requires addressing security and privacy concerns, particularly when dealing with sensitive student data. Ensuring the confidentiality and integrity of online learning environments is crucial for maintaining trust and protecting students' rights (Ghezeljeh et al., 2022; Ghezeljeh et al., 2021). In this regard, the development of secure and reliable e-learning platforms is essential to prevent unauthorized access and data breaches, which could undermine the effectiveness of online education (Ghasemi et al., 2022; Sheikholeslami & Zanjani, 2019).

In addition to security concerns, the user experience (UX) of e-learning platforms plays a significant role in determining their effectiveness. A well-designed interface that is intuitive and easy to navigate can greatly enhance the learning experience and reduce the cognitive load on students (Foroughi et al., 2019; Givi et al., 2022).

Conversely, poorly designed platforms that are difficult to use can frustrate students and hinder their ability to learn effectively. Therefore, the design and development of e-learning platforms should prioritize user-centered approaches that focus on the needs and preferences of students and educators (Khari et al., 2022).

The role of educators in e-learning is also a critical factor in its success. Teachers need to be equipped with the necessary skills and knowledge to effectively facilitate online learning and support their students in a virtual environment (Ertürk, 2022; Solichin & Munandar, 2018). Professional development programs that focus on digital literacy, online pedagogy, and the use of e-learning tools are essential for preparing teachers to navigate the challenges of online education (Shirazi et al., 2019). Moreover, the shift to online learning requires a rethinking of assessment methods to ensure that they accurately measure student learning in a digital context (Akbari, 2021; Herwiana & Anam, 2022).

Despite the challenges associated with e-learning, it also offers significant opportunities for innovation in education. The flexibility and accessibility of online learning platforms can help bridge the gap between formal and informal education, providing students with a more personalized and self-directed learning experience (Hajimaghsoodi & Bolghari, 2019; Masoumifard, 2021). Additionally, e-learning can facilitate lifelong learning by making educational resources available to a wider audience, including those who may not have access to traditional educational institutions (Muhtarom, 2021; Said et al., 2019).

The adoption of e-learning in the wake of the COVID-19 pandemic has also highlighted the need for a more holistic approach to education that integrates technology with traditional pedagogical practices. This approach, often referred to as blended learning, combines the strengths of both online and face-to-face instruction to create a more flexible and effective learning environment (Mehrpouyan & Zakeri, 2021; Mohamad-Esmaeil, 2023). Blended learning can provide students with the best of both worlds, offering the convenience and accessibility of online learning while maintaining the social and interactive aspects of traditional classroom education (Zobeidi et al., 2023).

In conclusion, the shift to e-learning during the COVID-19 pandemic has presented both challenges and opportunities for educators and students. While the rapid transition to online learning has exposed gaps in technology infrastructure and digital literacy, it has also spurred innovation and provided a catalyst for the adoption of new educational practices. To fully realize the potential of e-learning, educational institutions must address the challenges related to technology access, security, and pedagogy while leveraging the opportunities for personalized and flexible learning. As the world continues to adapt to the realities of the pandemic, e-learning will likely play an increasingly important role in shaping the future of education (Dai & Xia, 2020; Rani & Srividhya, 2022). This study aims to contribute to the growing body of research on e-learning by developing and validating a model for implementing e-learning with an omnichannel approach in secondary schools in Tehran.

2. Methods and Materials

2.1. Study Design and Participants

This study was designed as an applied research project, aiming to develop a model for the implementation of e-learning with an omnichannel approach in secondary schools in Tehran. Given the practical implications of the findings, the study adopted a survey methodology, conducted through fieldwork using both questionnaires and interviews. From a methodological perspective, the study is correlational and developmental, as it seeks to explore relationships between variables and develop foundational themes. The research employed a mixed-methods approach, specifically an exploratory sequential design, utilizing both qualitative and quantitative data collection methods to address the research questions.

In the qualitative phase, the study focused on identifying core and foundational themes and necessary infrastructures through interviews with experts actively involved in secondary schools. Participants were selected based on criteria such as a minimum of five years of relevant work experience, academic expertise related to the research topic, and familiarity with technological approaches in education, particularly the omnichannel approach. A snowball sampling method was employed, and the sample size reached theoretical saturation with 16 participants.

For the quantitative phase, the study targeted all teachers and administrators in secondary schools in Tehran during the 2022-2023 academic year. According to data from the Tehran Education Department, the total population consisted of 850 individuals. A stratified sampling method was used, and the sample size was determined to be 256, according to Morgan's table. To ensure generalizability and prevent sample attrition, the sample size was increased by 20%, and the final questionnaire was distributed among this larger group. Participants were randomly selected from various

schools across different regions of Tehran, with the sample distributed proportionally according to the teacher and administrator population in each region.

2.2. Data Collection

The qualitative phase of the study employed semi-structured interviews to identify the foundational themes and infrastructures necessary for implementing e-learning with an omnichannel approach. An interview protocol was developed, including timing, tools, and questions. Interviews averaged 60 minutes in length and were recorded with the participants' consent using a smartphone. The interview began with an introduction of the researcher, the affiliated university, and the research topic. Initial discussions focused on the necessity and objectives of the research. General questions about the interviewees' experiences, their familiarity with the subject, and their previous exposure to relevant topics were followed by specialized questions. These questions sought to explore the necessary infrastructures for e-learning, the potential integration of omnichannel approaches, and the feasibility of implementing such approaches in the existing e-learning systems in the country.

In the quantitative phase, data were collected using a researcher-made questionnaire, structured on a five-point Likert scale. The questionnaire included two main sections: foundational themes and influencing factors, and infrastructure. The section on foundational themes consisted of 30 items, while the infrastructure section included 24 items. The questionnaire was developed based on the results of the qualitative phase and validated by experts in the field.

2.3. Data Analysis

In the qualitative phase, data analysis was conducted using content analysis. Initially, semantic phrases were extracted from the interviews, and then these concepts or codes were identified. Based on semantic, conceptual, and functional similarities, these codes were combined, and the final constructive themes were extracted. The validity of the qualitative phase was assessed using the Content Validity Ratio (CVR), with an average CVR of 86%, exceeding the standard threshold. Cohen's kappa coefficient was also calculated, yielding a value of 0.79, indicating an acceptable level of reliability.

For the quantitative phase, data analysis was conducted in two stages: descriptive and inferential. The descriptive analysis involved frequency, mean, and standard deviation

to describe the demographic variables and foundational themes. In the inferential analysis, Structural Equation Modeling (SEM) was used to confirm the construct validity of the model. Key indices such as RMSEA, GFI, and CFI were extracted to analyze the relationships between variables. Finally, the identified themes were prioritized using the Analytic Hierarchy Process (AHP), ensuring a structured approach to recommending the most effective strategies for implementing e-learning with an omnichannel approach.

3. Findings and Results

In the qualitative phase of this study, data were collected through interviews with 16 experts and informed stakeholders in the field of e-learning implementation. Regarding educational qualifications, 56% of the participants held a Master's degree or higher, while 44% had a Bachelor's degree. In terms of job roles, 44% of the participants were assistant managers, 37% were in management positions, and 19% were specialists. The analysis of work experience revealed that 69% of the participants had over 15 years of experience, 19% had between 10 to 15 years, and 12% had between 5 to 10 years of experience in their respective fields.

For the quantitative phase, the study involved 256 teachers and administrators from secondary schools in Tehran. The gender distribution of the participants showed that 57.81% were male and 42.19% were female. The age distribution was as follows: 30.47% were under 25 years old, 33.98% were between 26 to 35 years old, 17.58% were between 36 to 45 years old, 14.06% were between 46 to 55 years old, and 3.91% were over 56 years old. Regarding educational background, 72.66% of the participants held a Bachelor's degree, 16.80% had a Master's degree or higher, and 10.55% held an Associate's degree.

The findings from this study, which integrates a thematic literature review with qualitative research, reveal critical themes essential for implementing e-learning with an omnichannel approach in secondary schools. These themes were systematically identified and validated through both qualitative interviews with experts and subsequent quantitative analysis.

The study identified several foundational and constructive themes necessary for the effective implementation of e-learning. These themes were categorized into broader constructive themes, each comprising specific foundational elements critical to the

success of an omnichannel e-learning system. The results are summarized in Table 1.

Table 1

Results from the Integration of Thematic Literature Review and Qualitative Research

Constructive Themes	Foundational Themes
Technology and Infrastructure (I)	I1: Technology Infrastructure
	I2: Institutional Support and Equipment Procurement
	I3: Bandwidth, Network Speed, and Internet Access for Students
Security and Privacy (P)	P1: Security Protocols and Measures
	P2: Compliance with Privacy Regulations
	P3: User Authentication Mechanisms
	P4: Regulatory Compliance for E-Learning
Access Management (A)	A1: Access Control Policies
	A2: Scalability of E-Learning Platform
Content Management (C)	C1: Content Customization Tools
	C2: Adaptive Learning Algorithms
Communication and Collaboration (CO)	CO1: Collaboration Features
	CO2: Strategies for Student-Teacher Interaction
User Experience (U)	U1: User Interface Design and Experience
	U2: Real-Time Monitoring and Reporting
Continuous Management (CM)	CM1: Feedback and Evaluation Mechanisms
	CM2: Continuous System Updates and Upgrades
Support and Financial Management (S)	S1: Implementation and Maintenance Costs
	S2: User Support and Helpdesk Services
	S3: Backup and Data Recovery Programs
Learning Management System (LMS) (LM)	LM1: Learning Management System (LMS)
	LM2: Personalized Learning Paths
	LM3: Data Analysis and Reporting
Security (SE)	SE1: Secure Authentication
	SE2: Encryption in Systems
	SE3: Role-Based Access Control (RBAC)
	SE4: Regular Security Audits
	SE5: Compliance with Privacy Protection
	SE6: Content Security
Information Technology (IT)	IT1: Secure File Storage
	IT2: Mobile Compatibility
	IT3: Scalability and Performance
	IT4: Single Sign-On (SSO)
	IT5: API Integrations
Communications and Coordination (CC)	CC1: Communication Tools
	CC2: Video Conferencing
	CC3: Feedback and Assessment Tools
Educational Tools (T)	T1: Gamification Elements
	T2: Accessibility Features
	T3: Virtual Labs and Simulations
	T4: Cloud Infrastructure
	T5: Student Progress Tracking

The above themes were subjected to quantitative validation through Confirmatory Factor Analysis (CFA). Table 2 presents the factor loadings, critical ratios, and significance levels for each of the foundational themes under their respective constructive themes. The results indicate that all foundational themes had significant positive relationships with their respective constructive themes, as all factor loadings were well above the 0.3 threshold, confirming the validity of the relationships between the latent variables (constructive themes) and the observed variables (foundational themes).

Table 2

Confirmatory Factor Analysis for the E-Learning Model with Omnichannel Approach

Foundational Themes	Factor Loading	Critical Ratio	Significance Level	Status
Technology and Infrastructure (I)	0.52	6.12	0.001	Confirmed
Security and Privacy (P)	0.53	6.18	0.001	Confirmed
Access Management (A)	0.25	7.12	0.001	Confirmed
Content Management (C)	0.52	7.13	0.001	Confirmed
Communication and Collaboration (CO)	0.63	6.14	0.001	Confirmed
User Experience (U)	0.58	8.25	0.002	Confirmed
Continuous Management (CM)	0.57	9.14	0.001	Confirmed
Support and Financial Management (S)	0.58	6.12	0.001	Confirmed
Learning Management System (LMS) (LM)	0.66	7.12	0.001	Confirmed
Security (SE)	0.58	7.15	0.001	Confirmed
Information Technology (IT)	0.52	6.74	0.001	Confirmed
Communications and Coordination (CC)	0.74	8.12	0.002	Confirmed
Educational Tools (T)	0.57	7.28	0.001	Confirmed

As shown in Table 2, the analysis confirms the relationships between all foundational themes and their corresponding constructive themes. Each foundational theme was found to have a statistically significant and positive relationship with its broader constructive theme, validating the conceptual model developed through the qualitative phase.

Further validation of the model's overall fit was performed using several model fit indices. Table 3 shows the values of these indices, indicating an excellent fit of the model. Key indices such as the Root Mean Square Error of Approximation (RMSEA), which was calculated at 0.044, and the chi-square to degrees of freedom ratio ($\chi 2/df$), which was 2.59, are within acceptable ranges, confirming that the model is statistically robust.

Table 3

Model Fit Indices for the Omnichannel E-Learning Model

Fit Index	Value	Status
TLI	-	Confirmed
NFI	0.98	Confirmed
IFI	0.98	Confirmed
CFI	0.94	Confirmed
$\chi 2 /df$	2.59	Confirmed
GFI	0.98	Confirmed
RMSEA	0.044	Confirmed
RMR	0.000	Confirmed

As indicated in Table 3, all fit indices are within the recommended thresholds, indicating that the proposed model is a good fit for the data. The RMSEA value of 0.044 and the $\chi 2/df$ ratio of 2.59 are both within the acceptable range, confirming that the model is statistically sound. Furthermore, all other fit indices, such as NFI, IFI, and CFI, are above 0.9, demonstrating that the model provides a strong representation of the underlying data.

Figure 1

Omnichannel E-Learning Model

4. Discussion and Conclusion
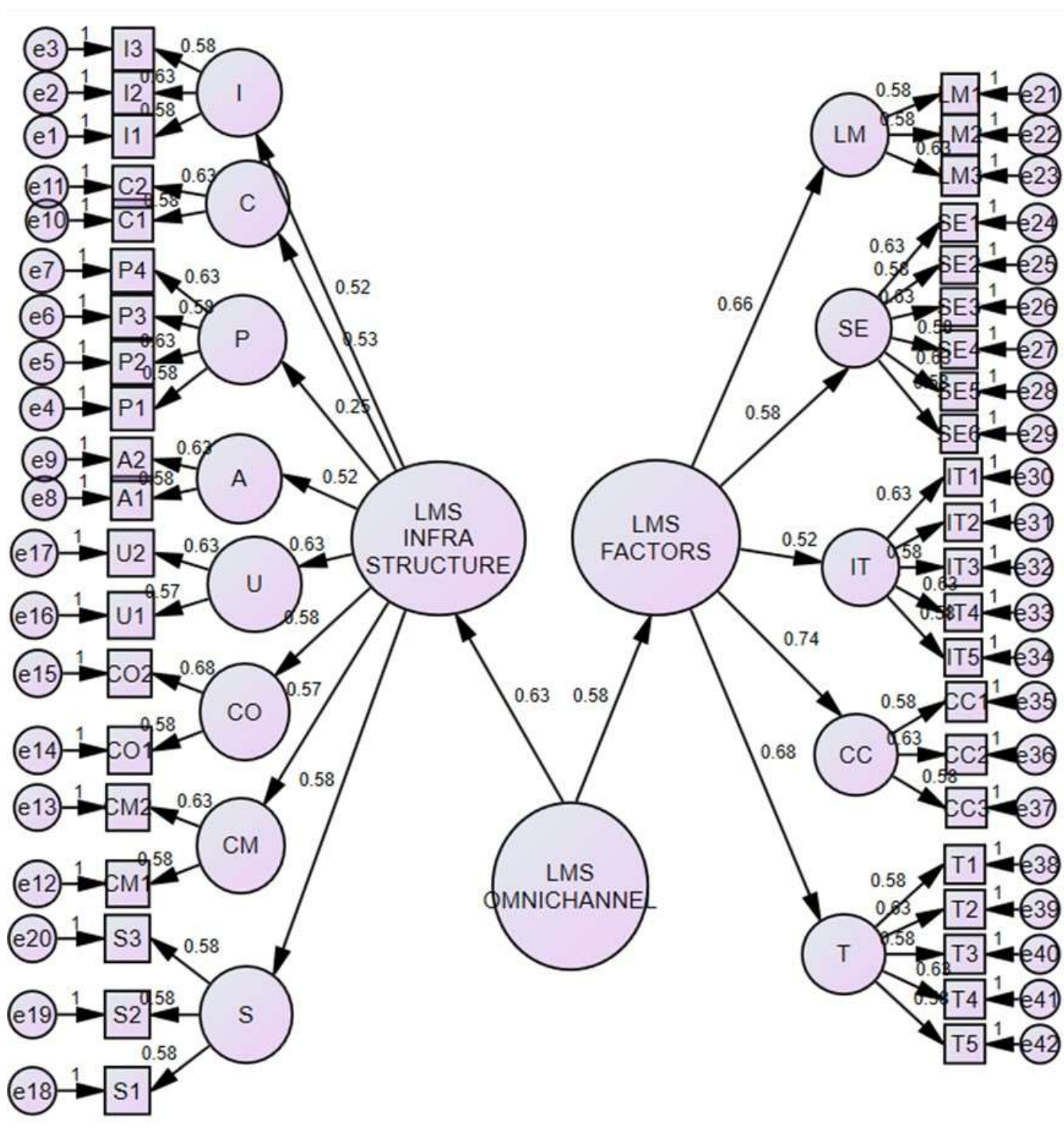
The results of this study highlight the critical factors necessary for the effective implementation of e-learning with an omnichannel approach in secondary schools, particularly in Tehran. Through a comprehensive analysis that integrated both qualitative and quantitative methodologies, the study identified key themes and foundational elements essential for the success of such an educational framework. These findings align with and expand upon existing literature in the field of e-learning,

providing valuable insights into the challenges and opportunities associated with the adoption of digital learning platforms in educational settings.

One of the most significant findings from this study is the importance of technology and infrastructure in supporting e-learning initiatives. The study identified that robust technology infrastructure, including reliable internet access and institutional support for the procurement of necessary equipment, is fundamental to the success of e-learning programs. This finding is consistent with previous research, which has repeatedly emphasized the role of technological readiness in facilitating effective online education (Ghasemi, 2023; Özen et al., 2020). For instance, Zine (2023) found that institutions with well-developed technological infrastructure are better positioned to implement and sustain e-learning initiatives, particularly during crises such as the COVID-19 pandemic (Zine, 2023). Furthermore, the necessity for high-speed internet and accessible technology resources for students was underscored by Baghestani et al. (2023), who noted that disparities in technological access could exacerbate educational inequalities, particularly in urban settings like Tehran (Baghestani et al., 2023).

The study also highlighted the significance of security and privacy in the digital learning environment. With increasing reliance on digital platforms for education, the protection of student data and the enforcement of robust security protocols have become paramount. The findings suggest that educational institutions must prioritize the development and implementation of security measures to protect against data breaches and ensure compliance with privacy regulations. This aligns with the work of Ghezeljeh et al. (2021), who emphasized the critical role of security in maintaining the integrity of e-learning systems and protecting student information (Ghezeljeh et al., 2021). Additionally, Ghasemi et al. (2022) underscored the importance of security in fostering trust among users of e-learning platforms, which is crucial for the widespread adoption and success of these systems (Ghasemi et al., 2022).

Another critical factor identified in the study is the management of access to e-learning platforms. Effective access management, including the development of clear policies for access control and the scalability of e-learning platforms, was found to be essential for maintaining the functionality and accessibility of digital learning environments. This finding is supported by previous studies that have explored the challenges of access management in online education (Sheikholeslami & Zanjani, 2019; Zarei &

Javadipour, 2021). Zarei and Javadipour (2021) noted that inadequate access management could lead to issues such as unauthorized access, which can compromise the security and effectiveness of e-learning platforms (Zarei & Javadipour, 2021). Therefore, the study's emphasis on the need for robust access management protocols is consistent with existing research and highlights an area that requires ongoing attention as e-learning continues to evolve.

The findings also emphasize the importance of content management in e-learning environments. The ability to customize content and utilize adaptive learning algorithms was identified as a key factor in enhancing the learning experience for students. This is consistent with the findings of Triyono et al. (2018), who reported that the effectiveness of e-learning is significantly influenced by the quality and adaptability of the content delivered. Customizable content that can be tailored to the individual needs of students is critical for supporting diverse learning styles and improving educational outcomes (Triyono et al., 2018). Moreover, the use of adaptive learning technologies, which adjust the difficulty and pacing of content based on student performance, has been shown to enhance engagement and retention in online learning environments (Akbari-Chehrehbargh & Tavafian, 2022).

The study's identification of communication and collaboration as vital components of e-learning further supports the growing body of literature that advocates for interactive and collaborative online learning environments. Effective communication tools and strategies for fostering student-teacher interactions are essential for creating a supportive and engaging e-learning environment. This finding is supported by the work of Ferdosipour and Gholami (2022), who found that the quality of communication and interaction in online courses significantly impacts student satisfaction and learning outcomes (Ferdosipour & Gholami, 2022). Similarly, Maatuk et al. (2021) emphasized the importance of collaborative learning in e-learning environments, noting that the ability to work with peers and instructors online is crucial for developing critical thinking and problem-solving skills (Maatuk et al., 2021).

User experience (UX) was another critical theme identified in the study. A well-designed user interface (UI) and real-time monitoring and reporting tools were found to be essential for creating an effective and user-friendly e-learning platform. This finding aligns with the research of Givi et al. (2022), who highlighted the importance of UX in e-learning, noting that a positive user experience is crucial

for maintaining student engagement and satisfaction (Givi et al., 2022). Furthermore, the study's emphasis on real-time monitoring tools supports the findings of Khari et al. (2022), who reported that such tools are essential for providing timely feedback to students and ensuring that they remain on track with their learning objectives (Khari et al., 2022).

Continuous management and support were also identified as critical factors in the success of e-learning initiatives. The study found that ongoing feedback mechanisms, regular system updates, and comprehensive support services, including helpdesk services, are essential for maintaining the effectiveness and reliability of e-learning platforms. This is consistent with the findings of Shirazi et al. (2019), who reported that continuous management and support are necessary for addressing technical issues and ensuring that e-learning systems meet the evolving needs of students and educators (Shirazi et al., 2019). Additionally, Dargahi (2023) emphasized the importance of ongoing support in enhancing learner satisfaction and improving the overall effectiveness of virtual learning systems (Dargahi, 2023).

Finally, the study identified the critical role of financial management in sustaining e-learning initiatives. The costs associated with implementing and maintaining e-learning platforms, as well as the provision of user support services, were found to be significant factors that must be carefully managed to ensure the long-term viability of e-learning programs. This finding aligns with the research of Ghasemi et al. (2022), who highlighted the financial challenges associated with e-learning, particularly in resource-constrained settings (Ghasemi et al., 2022). Moreover, Zine (2023) emphasized the need for careful financial planning and management to ensure that e-learning initiatives are sustainable and can continue to meet the needs of students and educators over time (Zine, 2023).

While this study provides valuable insights into the factors affecting the implementation of e-learning with an omnichannel approach, it is important to acknowledge its limitations. First, the study was conducted in secondary schools in Tehran, which may limit the generalizability of the findings to other regions or educational levels. The specific context of Tehran's educational system, including its technological infrastructure and socio-economic factors, may influence the applicability of the findings to other settings. Future studies could address this limitation by conducting similar research in different regions or educational levels to compare the findings and enhance their generalizability.

Second, the study primarily relied on self-reported data from educators and experts, which may be subject to biases such as social desirability or recall bias. Although qualitative interviews and quantitative surveys are valuable tools for gathering in-depth insights, the reliance on self-reported data may limit the accuracy and objectivity of the findings. Future research could incorporate additional data collection methods, such as observational studies or the analysis of system usage logs, to triangulate the findings and provide a more comprehensive understanding of the factors influencing e-learning implementation.

Third, the study focused on the perspectives of educators and experts, without including input from students, who are the primary users of e-learning platforms. Understanding students' experiences and perceptions of e-learning is crucial for developing effective and user-friendly platforms. Future studies should include students as key stakeholders in the research process, gathering their feedback on the usability, accessibility, and effectiveness of e-learning systems. This would provide a more holistic view of the factors influencing e-learning success and ensure that the needs and preferences of students are adequately addressed.

Building on the findings and limitations of this study, several avenues for future research are suggested. First, future studies could explore the implementation of e-learning with an omnichannel approach in different educational contexts, such as primary schools, higher education institutions, or vocational training centers. This would provide valuable insights into how the factors identified in this study vary across different educational levels and settings, and how they can be adapted to meet the specific needs of different learner populations.

Second, future research could examine the long-term impact of e-learning on student learning outcomes, particularly in relation to traditional classroom-based education. While this study focused on the factors influencing the implementation of e-learning, it would be valuable to explore how these factors translate into tangible educational outcomes, such as academic performance, retention rates, and student satisfaction. Longitudinal studies that track students' progress over time could provide insights into the effectiveness of e-learning in supporting long-term learning and development.

Third, future studies could investigate the role of emerging technologies, such as artificial intelligence (AI), virtual reality (VR), and augmented reality (AR), in enhancing e-learning experiences. As technology continues to evolve, these advanced tools have the potential to

revolutionize the way education is delivered and experienced. Research in this area could explore how these technologies can be integrated into e-learning platforms to create more immersive, personalized, and interactive learning environments, and how they impact student engagement and learning outcomes.

Finally, future research could explore the development of comprehensive frameworks for evaluating the quality and effectiveness of e-learning platforms. While this study identified key factors influencing e-learning implementation, there is a need for standardized tools and metrics to assess the quality of e-learning systems and their impact on educational outcomes. Such frameworks could provide educators, administrators, and policymakers with the tools they need to make informed decisions about the adoption and use of e-learning platforms in their institutions.

Based on the findings of this study, several practical recommendations can be made for educators, administrators, and policymakers involved in the implementation of e-learning systems. First, educational institutions should prioritize the development and maintenance of robust technological infrastructure, including reliable internet access and the provision of necessary equipment for both students and educators. This is essential for ensuring that all students have equal access to e-learning resources and can participate fully in online learning activities.

Second, institutions should invest in the development and implementation of comprehensive security protocols to protect student data and ensure the privacy of online learning environments. This includes regular security audits, the use of encryption technologies, and the development of clear policies for data protection and access management. By prioritizing security, institutions can build trust among students and educators, which is critical for the successful adoption of e-learning platforms.

Third, educators should focus on creating engaging and interactive online learning experiences that cater to the diverse needs of students. This includes the use of customizable content, adaptive learning technologies, and collaborative tools that support active learning and student engagement. Training and professional development programs for educators should also be prioritized to ensure that they are equipped with the skills and knowledge needed to effectively facilitate online learning and support their students in a virtual environment.

Finally, policymakers should support the development of sustainable funding models for e-learning initiatives, particularly in resource-constrained settings. This includes providing financial support for the development and maintenance of e-learning platforms, as well as funding for ongoing professional development for educators. By ensuring that e-learning initiatives are adequately funded and supported, policymakers can help to create a more equitable and effective educational system that leverages the power of technology to enhance learning for all students.

In conclusion, the findings of this study provide valuable insights into the factors influencing the successful implementation of e-learning with an omnichannel approach in secondary schools. By addressing the challenges related to technology infrastructure, security, content management, and user experience, educational institutions can create effective and sustainable e-learning environments that support the diverse needs of students and educators. As e-learning continues to evolve, ongoing research and practical efforts are needed to ensure that these systems are optimized for the benefit of all learners.

Authors' Contributions

Authors equally contributed to this article.

Declaration

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the

institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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