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Evaluation Model of E-Learning Quality (Case Study: Payam Noor University of Arak)

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Purpose: The objective was to propose a quality evaluation model for the e-learning system at Payam Noor University of Arak.

Methods and Materials: The research method was applied in terms of objective and employed a mixed qualitative–quantitative data collection approach. In the qualitative section, after reviewing the literature and prior studies and formulating a preliminary conceptual model, the model was completed through semi-structured interviews with experts using thematic analysis or grounded theory. After the identified components were validated by experts through the Delphi method, the quantitative section proceeded with a descriptive-survey method to test the model's fit. The qualitative study population consisted of e-learning experts, from which 12 individuals were selected using the non-random snowball sampling method until theoretical saturation was achieved. The quantitative study population consisted of 274 graduates of Payam Noor University of Arak who had received electronic instruction and were selected through simple random sampling. The data collection tool in the quantitative phase was a researcher-made questionnaire with 44 items. To assess reliability, Cronbach's alpha, rho-A, composite reliability (CR), and Average Variance Extracted (AVE) as an indicator of convergent validity were used. The critical value for the reliability indices was set at 0.7 and for convergent validity at 0.5. Data analysis involved using the Kappa coefficient in the qualitative phase, and structural equation modeling (SEM) in the quantitative phase. The GOF index was applied to evaluate model efficiency using SPSS and PLS3 software.

Findings: The results indicated that the main dimensions of quality included four categories: behavioral capability, academic capability, cognitive capability, and virtual learning experience. Additionally, six factors—cultural, pedagogical, learner-related, communicational, infrastructural, and institutional—were identified as determinants of the quality of the e-learning system at Payam Noor University. Therefore, the university can achieve four key outcomes—competitiveness, employability, economic benefits, and reputation—by establishing a high-quality educational system with the identified characteristics.

Conclusion: It can be concluded that the quality evaluation model of e-learning at Payam Noor University follows a process-oriented approach in which factors, quality indicators, and outcomes are examined and assessed. This process will succeed in achieving its objectives only when it not only transforms the learner but also provides them with a valuable virtual learning experience; and, in terms of outcomes, all stakeholders within the higher education ecosystem will benefit from a valuable e-learning system.

Keywords: E-learning quality, educational quality evaluation, virtual education, model, Payam Noor University.

1. Introduction

The quality of education remains a cornerstone of sustainable development, personal empowerment, and national competitiveness in a global knowledge economy. As education systems increasingly undergo reform to adapt to rapid technological advancements, social demands, and international standards, the concept of "education quality" has evolved from traditional metrics of performance to more multidimensional models that encompass pedagogy, leadership, technology integration, and stakeholder satisfaction (Noaman et al., 2017). The global shift toward inclusive, accountable, and outcomes-based educational practices has underscored the need to define, evaluate, and enhance educational quality across all institutional levels (Adriansen et al., 2025).

In contemporary discourse, the assessment and enhancement of education quality is a multi-layered undertaking that incorporates the alignment of curriculum with learner needs, the professional competencies of educators, institutional leadership, access to learning technologies, and policy frameworks that ensure equity and effectiveness (Farmonovna, 2023; Feili Ardalan et al., 2021; Mahardhani, 2023). Studies have consistently shown that leadership style plays a decisive role in shaping educational outcomes and quality improvement efforts (Ghozelin & Syaifudin, 2022; Ismaya et al., 2023). Inclusive and transformational leadership practices, in particular, have been identified as critical to fostering environments conducive to educational excellence (Crisol Moya et al., 2020; Palar et al., 2023).

At the same time, the integration of digital tools and smart systems into educational ecosystems has further redefined quality standards. Models utilizing Internet of Things (IoT) and cloud computing approaches have demonstrated significant promise in improving efficiency, transparency, and responsiveness in school management and instruction delivery (Nouri Hasanabadi et al., 2021; Sobhani et al., 2020). Such technological interventions are no longer merely supportive but have become central to shaping learning experiences and organizational performance (Goldhaber, 2021; Logachev et al., 2021). Especially in the wake of the COVID-19 pandemic, the adoption of e-learning frameworks has served both as a challenge and an opportunity for quality enhancement (Hamdan, 2022; Maryati et al., 2024).

Numerous empirical studies across varying educational contexts affirm that quality education is not a static outcome but a dynamic construct influenced by continuous improvement mechanisms, stakeholder engagement, and responsive governance (Alfian et al., 2022; Amiri Roshkhar et al., 2021; Yazdanshenasi, 2024). For instance, Alfian et al. (2022) identify leadership style and customer satisfaction as two of the most influential factors in educational quality management systems. Similarly, Adabi et al. (2022) emphasize the use of grounded theory to develop localized quality models responsive to regional educational challenges and student expectations (Adabi et al., 2022).

In Iran, recent studies have also spotlighted fiscal decentralization as a structural determinant of educational performance across provinces, advocating for differentiated resource allocation models tailored to local needs (Alizadeh et al., 2022). Moreover, grounded approaches to curriculum planning and development have shown to improve instructional coherence and student achievement (Jafari, 2023; Raz et al., 2023). The role of teacher responsibility and ethical conduct has likewise been linked to the promotion of student learning and institutional reputation (Yazdanshenasi, 2024).

One of the critical dimensions in improving education quality is pedagogical strategy. The research by Ghaedi Bardei and Keyhan (2022) on virtual education at the primary level offers evidence that pedagogical adaptation, when aligned with synthesis-based research, can significantly enhance the learner's digital and cognitive experience (Ghaedi Bardei & Keyhan, 2022). Likewise, Mokhtari et al. (2021) identify successful school practices—such as mentoring, collaborative lesson planning, and inclusive assessment techniques—as reproducible strategies to elevate education quality across broader contexts (Mokhtari et al., 2021).

Equally important are school-based management initiatives that promote participatory decision-making, resource optimization, and decentralized governance (Iswan et al., 2021). These approaches, when strategically implemented, allow for more responsive adaptation to local educational demands and the cultivation of innovation at the school level. The integration of inclusive leadership styles—where stakeholders at all levels are engaged in the visioning and operationalization of educational objectives—has been linked with improved morale, equity, and academic success (Jermsittiparsert, 2020; Romlah & Latief, 2021).

At the macro level, education policy must integrate data-driven frameworks and monitoring systems to ensure consistency between stated goals and implementation outcomes. Information systems for tracking and evaluating

the quality of educational programs have proven effective in fostering accountability and targeted intervention (Logachev et al., 2021). These tools enable real-time feedback loops that inform policy decisions and resource allocation, thereby enhancing institutional resilience and learning continuity.

Furthermore, the alignment between education and socioeconomic competencies cannot be overstated. As Farmonovna (2023) argues, cultivating students' economic competencies is essential for preparing them to engage meaningfully in society and contribute to national development agendas. This relationship between educational outcomes and employability is further supported by studies emphasizing the role of entrepreneurship education in improving both quality and relevance of learning (Muhammad & et al., 2023).

Cross-national comparisons further enrich our understanding of education quality. For example, Adriansen et al. (2025) explore how the internationalization strategies of European universities intersect with their quality assurance frameworks, revealing tensions between global competitiveness and contextual relevance (Adriansen et al., 2025). Such discourse underscores the importance of culturally situated models of quality assessment that can both accommodate global standards and reflect local values.

Notably, smart school initiatives incorporating artificial intelligence, automation, and data analytics represent the next frontier in quality assurance. The research of Nouri Hasan et al. (2021) illustrates how such innovations, when ethically deployed, can elevate both operational efficiency and learning personalization (Nouri Hasan et al., 2021). However, the success of these models requires not only technological infrastructure but also a cultural shift toward continuous professional development and data literacy among educators.

Importantly, the psychological and emotional dimensions of teaching and learning also factor into quality considerations. Leadership strategies must nurture a sense of well-being, ethical responsibility, and professional growth among educators, as these directly influence classroom dynamics and student performance (Fateh Rad et al., 2021; Fitriani & Muljono, 2019). Moreover, inclusive practices that value student diversity, promote digital equity, and emphasize learner autonomy are integral to holistic quality improvement (Crisol Moya et al., 2020).

In summary, improving education quality is a multifaceted endeavor that demands integrative thinking, evidence-based policymaking, and systemic coordination among stakeholders. Whether through curriculum reform,

technological innovation, leadership development, or fiscal restructuring, the pursuit of educational excellence requires models that are adaptable, participatory, and ethically grounded. This study contributes to this evolving discourse by offering a validated conceptual framework for assessing and enhancing the quality of e-learning systems within Iran's higher education context, particularly focusing on Payam Noor University.

2. Methods and Materials

This study was conducted using a mixed-methods approach, in which a combination of quantitative and qualitative techniques was employed within a predetermined strategic framework. The qualitative section consisted of library-based research and field investigations. The stages of conducting the qualitative research included: searching for and selecting valid and topic-relevant articles, coding the findings, validating the relevance and applicability of prior findings to the target population, conducting interviews with faculty members, transcribing and coding the interviews, aligning the findings from the library review phase with those from the field research, and ultimately presenting the proposed model.

The research population in the library review phase included Persian and English-language articles published in the last five years (from 2018 to 2022) and indexed in reputable academic databases such as www.Sid.ir, www.Civilica.com, www.Sciencedirect.com, www.Emeraldinsight.com, and www.Scopus.com.

In the interview phase, the target population was defined based on the following criteria to ensure the selection of participants with appropriate expertise and experience: (1) individuals with academic, research, or executive backgrounds in designing, implementing, or publishing scholarly articles related to quality evaluation models in the university system—especially in Payam Noor University— or with a minimum of five years of teaching experience in virtual education programs; (2) individuals holding at least a Ph.D. and an academic rank of assistant professor at a university.

Sampling from the target population was carried out through purposive sampling, and theoretical saturation was achieved after conducting 12 interviews. To assess the quality and accuracy of coding, neutral coding and the Kappa coefficient test were employed. To test the trustworthiness of the qualitative findings, techniques such as sample adequacy verification, participant review, and

peer debriefing were used. SPSS software was utilized for analysis in this phase of the study.

In the quantitative phase, aimed at validating the model, structural equation modeling (SEM) was applied using PLS3 software. The statistical population in this phase included faculty members, instructors, and students who had taught or studied for at least four academic semesters in e-learning programs at Payam Noor University and had used the university's e-learning systems. Based on Morgan's table, the sample size was determined to be 260 individuals; ultimately, 274 valid questionnaires were collected, reviewed, and analyzed.

3. Findings and Results

In the first phase, the target articles were searched across the selected databases. Abstracts and full texts were quickly reviewed, and articles that exhibited high thematic relevance, non-duplication, and alignment with the research content were selected. Other articles were excluded due to low relevance or inconsistency with the research topic. In this stage, 14 Persian articles and 32 English articles were selected. The selected articles were then subjected to in-depth review, and their research findings were coded using content analysis. The results are presented in Table 1.

Table 1

Results of Scientific Article Searches in Reputable Databases (Factors Influencing the Quality of E-Learning in Higher Education)

Subcategory (Frequency)	Concepts
Organizational Factors (10)	Mission, values, objectives, vision, investment, staff readiness, financial resources, proper organizational structure, clear e-learning policies, student-to-staff ratio
Managerial Factors (7)	Leadership, educational processes, entrepreneurship support, university–industry linkages, national and international collaborations, managerial commitment, expert human resources
Educational Factors (20)	Educational needs assessment, learning resources, assessment and evaluation, teaching style, faculty, learner support, curriculum, course design, course delivery, online teaching skills, attention to individual differences, entrepreneurship education, faculty experience, faculty-to-student ratio, program duration, study quality, student motivation, faculty satisfaction, faculty and student attitudes toward virtual learning, digital literacy of faculty and students
Infrastructural Factors (15)	Educational software, platforms, social networks, online support for faculty and students, internet speed, bandwidth, equipment and facilities, servers, software updates, security, system usability, system errors and outages, multimedia software, fraud prevention, documentation capability

At this stage, 52 frequently recurring important concepts from domestic and international articles were identified, coded, and categorized as shown in Table 1. These identified concepts were then used—prior to the interview process and during participant recruitment—to confirm their relevance to the central research phenomenon. A researcher-developed questionnaire and hypothesis testing were used to analyze the concepts and to develop the initial quality evaluation model for the e-learning system at Payam Noor University. The results of this section are presented in Tables 2.

H_0: The identified factor (component) significantly influences the quality of e-learning at Payam Noor University.

H_1: The identified factor (component) does not significantly influence the quality of e-learning at Payam Noor University.

Table 2

Results of the Binomial Test on Identified Factors from the Literature Review

Examined Factor	Test Proportion	Observed Proportion	Significance Level	Error Margin	Test Result
Organizational	0.6	1.00	0.000	0.05	H₀ Confirmed
Managerial	0.6	1.00	0.000	0.05	H₀ Confirmed
Educational	0.6	1.00	0.000	0.05	H₀ Confirmed
Infrastructural	0.6	1.00	0.000	0.05	H₀ Confirmed

It should be noted that the binomial test was also applied to each identified component individually, and the observed proportions for all components exceeded the test proportion (0.6), confirming their influence on the quality of e-learning at Payam Noor University.

In the interview phase, data analysis was performed using coding methods. The concept of "quality" was the first subject explored in the exploratory interviews. Two key questions were posed:

- How do you define the concept of quality in the e-learning system of Payam Noor University?
- From your perspective, what are the indicators that reflect this definition of quality?

From the total responses to these questions, 14 open codes were extracted. The results of this section are presented in Table 3.

Table 3

Allocation of Extracted Open Codes from Interviews to Categories in the Concept of Quality

No.	Extracted Open Code (Frequency)	Aligned with Literature Findings	Assigned Category (Quality Concept)
1	Problem-solving ability (9)	*	Academic Capability
2	Scientific expertise (10)	*	
3	Awareness of the latest scientific methods (6)	*	
4	Published scientific articles (7)	*	
5	Registered new inventions and innovations (4)	*	
6	Ideation (7)	*	Cognitive Capability
7	Critical thinking (6)	*	
8	No need for retraining for employment (5)	*	Behavioral Capability
9	Ability to apply learned knowledge (8)	*	
10	Observance of professional ethics (4)	*	
11	Number of failed or conditional students (6)	*	Virtual Learning Experience
12	Retention rate (duration of university presence) (6)		Program Duration
13	Interest in pursuing graduate studies (4)	*	
14	Perception of the usefulness of virtual learning (7)		Attitude of Faculty and Students toward Virtual Learning

The symbol * indicates newly identified concepts compared to the library research phase.

In the next phase, to identify the factors influencing the quality of e-learning at Payam Noor University, the following questions were posed, and the results are presented in Table 4.

- In your opinion, what factors play a significant role in achieving this type of quality in the e-learning system at Payam Noor University?
- In your view, what are the identifying components of each of these factors?

Table 4

Allocation of Extracted Open Codes from Interviews to Categories in the Section on Factors Influencing Quality

No.	Extracted Open Code (Frequency)	Alignment with Literature Findings	Assigned Category
1	Educational needs assessment (12)	Educational needs assessment	Pedagogical Factors
2	Curriculum planning (12)	Curriculum and course design	
3	Teaching style (10)	Teaching style	
4	Educational content (12)	Learning resources	
5	Teaching skills (8)	Online teaching skills, course delivery, faculty experience	
6	Continuous supervision (11)	Assessment and evaluation	
7	Staff commitment (6)	Staff preparedness	Institutional Factors
8	Teacher–student fit (8)	Faculty–student ratio, faculty	
9	High investment (10)	Investment and financial resources	
10	Equipment purchase support for users (3)	*	
11	University–industry linkage (5)	University–industry linkage	
12	Clear policies and programs (9)	Clear policies on e-learning	
13	Entrance exams (10)	*	
14	Active participation (12)	Active participation	Learner Factors
15	Active learning (10)	Active learning	
16	Learning enthusiasm (12)	Student motivation	
17	Desire for skill development (7)	*	
18	Cybersecurity (11)	Security	Infrastructural Factors
19	Bandwidth and capacity (11)	Bandwidth	
20	Updated technological equipment (12)	Equipment and facilities, servers, software updates	
21	Specialized platforms (8)	Platforms, educational software, multimedia software	
22	Specialized plugins (4)	*	
23	Documentation capability (11)	Documentation capability	
24	Fraud and forgery prevention (11)	Fraud prevention	
25	User-friendliness (10)	System usability	
26	System error and outage prevention (12)	System error and outage occurrence	
27	Fast online support (12)	Online support for faculty and students	
28	Attention to individual differences (8)	Attention to individual differences	Cultural Factors
29	Privacy protection (9)	Privacy protection	
30	Ethics in virtual environments (6)	*	
31	Copyright compliance (5)	Copyright compliance	
32	Access to academic databases (10)	*	Communication Factors
33	Access to digital libraries (12)	*	
34	Access to specialized software (7)	*	
35	Access to cloud storage (2)	*	
36	Access to social networks (12)	Social networks	
37	Access to high-speed internet (12)	Internet speed	
38	Access to university accounts (11)	*	
39	Digital literacy (7)	Digital literacy of faculty and students	

The asterisk (*) denotes newly identified concepts compared to the library research phase.

In this section, 44 primary concepts were identified, of which 5 were used as new categories, and the remaining 39 were classified into the main categories as follows: (1) Pedagogical (6 concepts), (2) Institutional (7 concepts), (3) Learner-related (4 concepts), (4) Communication (8 concepts), (5) Cultural (4 concepts), and (6) Infrastructural (10 concepts). Through the alignment of concepts from both the interview and literature review phases, 10 new concepts were identified.

Finally, the process of identifying the outcomes of establishing such a system was undertaken. In this phase, the following questions were posed, and the results are summarized in Table 5:

- In your opinion, if this educational system is implemented, what outcomes will be achieved?
- What are the evaluation indicators of these outcomes?

In this section, based on the total responses related to the outcomes of a high-quality e-learning system at Payam Noor University, 10 open codes were extracted. These codes were consolidated into four categories: competitiveness (4 codes), employability (2 codes), economic (1 code), and reputation

(4 codes), forming the output dimensions of quality in the university's e-learning system.

Table 5

Allocation of Extracted Open Codes from Interviews to Categories in the Section on Outcomes of a Quality E-Learning System

No.	Extracted Open Code (Frequency)	Alignment with Literature Findings	Assigned Category (Outcomes)
1	Increased student enrollment (12)	*	Competitiveness
2	Recruitment of stronger faculty (12)	Recruitment of stronger faculty	
3	Scientific growth (10)	Scientific growth	
4	Higher graduate employment rate (10)	*	Employability
5	Graduate entrepreneurship (7)	*	
6	Revenue generation (12)	Revenue generation	Economic
7	Development (8)	*	Reputation
8	University credibility (12)	*	
9	National and international academic collaboration (8)	National and international collaboration	
10	Positive perception and community support (6)	*	

The asterisk (*) denotes newly identified concepts compared to the library research phase.

At the conclusion of the analysis, 11 categories from the library study phase remained. After alignment with the field research findings and based on participant narratives describing the interactions and relationships between the identified components, the conceptual model was finalized and designed.

Table 6

Allocation of Remaining Concepts from the Library Study to the Identified Research Categories

No.	Remaining Concept from Library Study	Assigned Category	Role in the Model
1	Mission, values, goals, and vision (strategic documents)	Institutional	Factors influencing quality
2	Organizational structure	Institutional	Factors influencing quality
3	Leadership	Institutional	Factors influencing quality
4	Educational processes	Pedagogical	Factors influencing quality
5	Support for entrepreneurship	Institutional	Factors influencing quality
6	Managerial commitment	Institutional	Factors influencing quality
7	Expert human resources	Institutional	Factors influencing quality
8	Learner support	Pedagogical	Factors influencing quality
9	Entrepreneurship education	Institutional	Factors influencing quality
10	Faculty satisfaction with the program	Pedagogical	Factors influencing quality
11	Student–staff ratio	Institutional	Factors influencing quality

To examine the accuracy of the data coding, neutral coding was employed. For this purpose, the full texts of the selected articles and the transcribed interviews from each phase were provided to a Ph.D. holder in Educational Management who was not involved in the study. They were asked to independently code the materials based on their understanding. To evaluate the agreement between the two coding procedures, the Kappa coefficient was calculated using SPSS software. According to Fleiss (1981), a Kappa coefficient above 0.60 is considered good, and a coefficient above 0.75 indicates excellent agreement between coders. The results in Table 7 show that the coding quality in this study was of a highly desirable standard.

Table 7

Calculated Kappa Coefficient for Evaluating Coding Quality and Accuracy

Kappa Coefficient	Valid Cases	Standard Deviation	Significance Level
0.751	120	0.064	0.000

In the quantitative section, structural equation modeling (SEM) was used to validate the conceptual model. For this purpose, the designed model was tested in two parts: the measurement model and the structural model, and the results are presented below. In the measurement model, the factor loadings of the model relationships were examined. The findings of this analysis are shown in Table 8.

Table 8

Factor Loadings of Identified Factors in the Conceptual Model

Endogenous Variable Components	Variable Factor Loading	Measured Indicators	Indicator Factor Loading	Result
Cultural Factors	0.154	Copyright compliance	0.739	Confirmed
		Ethics in virtual environments	0.719	Confirmed
		Privacy protection	0.832	Confirmed
		Attention to individual differences	0.717	Confirmed
Learner-Related Factors	0.191	Active participation	0.952	Confirmed
		Active learning	0.951	Confirmed
		Learning enthusiasm	0.816	Confirmed
		Skill development inclination	0.947	Confirmed
Pedagogical Factors	0.193	Educational needs assessment	0.666	Confirmed
		Curriculum planning	0.685	Confirmed
		Teaching style	0.746	Confirmed
		Educational content	0.712	Confirmed
		Teaching skills	0.757	Confirmed
		Continuous supervision	0.667	Confirmed
		Educational processes	0.741	Confirmed
		Learner support	0.746	Confirmed
		Faculty satisfaction	0.645	Confirmed
Communication Factors	0.147	Access to academic databases	0.792	Confirmed
		Access to digital libraries	0.774	Confirmed
		Access to specialized software	0.729	Confirmed
		Access to cloud storage	0.873	Confirmed
		Access to social networks	0.852	Confirmed
		Access to high-speed internet	0.623	Confirmed
		Access to university accounts	0.751	Confirmed
		Digital literacy	0.671	Confirmed
Infrastructural Factors	0.329	Cybersecurity	0.668	Confirmed
		Bandwidth capacity	0.663	Confirmed
		Updated technological equipment	0.691	Confirmed
		Specialized platforms	0.602	Confirmed
		Specialized plugins	0.830	Confirmed
		Documentation capability	0.687	Confirmed
		Fraud and forgery prevention	0.621	Confirmed
		User-friendliness	0.874	Confirmed
		System error and outage prevention	0.672	Confirmed
		Fast online support	0.745	Confirmed
Institutional Factors	0.323	Staff commitment	0.656	Confirmed
		Faculty–student ratio	0.803	Confirmed
		Clear policies and programs	0.647	Confirmed
		Entrance exams	0.708	Confirmed
		Strategic documents	0.738	Confirmed
		High investment	0.540	Confirmed
		Equipment purchase support for users	0.555	Confirmed
		Organizational structure	0.701	Confirmed
		Entrepreneurship support	0.655	Confirmed
		Leadership	0.645	Confirmed
		Managerial commitment	0.624	Confirmed
		University–industry collaboration	0.586	Confirmed
		Expert human resources	0.757	Confirmed
		Entrepreneurship education	0.738	Confirmed

Academic Capability	0.926	Student–staff ratio	0.763	Confirmed
		Problem-solving ability	0.855	Confirmed
		Scientific expertise	0.856	Confirmed
		Awareness of the latest scientific methods	0.829	Confirmed
		Published scientific articles	0.784	Confirmed
		Registered inventions and innovations	0.799	Confirmed
Cognitive Capability	0.865	Ideation	0.889	Confirmed
		Critical thinking	0.882	Confirmed
Behavioral Capability	0.852	No need for retraining for employment	0.860	Confirmed
		Application of learned knowledge	0.824	Confirmed
		Professional ethics	0.826	Confirmed
Virtual Learning Experience	0.924	Number of failing or conditional students	0.811	Confirmed
		Retention rate (duration of university stay)	0.844	Confirmed
		Interest in pursuing graduate studies	0.853	Confirmed
		Perceived usefulness of the virtual course	0.799	Confirmed
Competitiveness	0.886	Increased student enrollment	0.881	Confirmed
		Recruitment of stronger faculty	0.836	Confirmed
		Scientific growth	0.802	Confirmed
Employability	0.646	Higher graduate employment rate	0.890	Confirmed
		Graduate entrepreneurship	0.886	Confirmed
Economic	0.601	Revenue generation	1.000	Confirmed
Reputation	0.513	Development	0.795	Confirmed
		University credibility	0.858	Confirmed
		National and international scientific collaboration	0.857	Confirmed
		Positive public perception and support	0.840	Confirmed

The results of Table 8 confirm the defined relationships in the research's conceptual model. After validating the measurement model, the next step is to test the relationships derived from it to address the main research questions and validate the structural model. To this end, the factor loadings of the primary latent variables in the conceptual model were evaluated for their critical values, and significance tests were conducted. The results are illustrated in Figure 1.

Figure 1

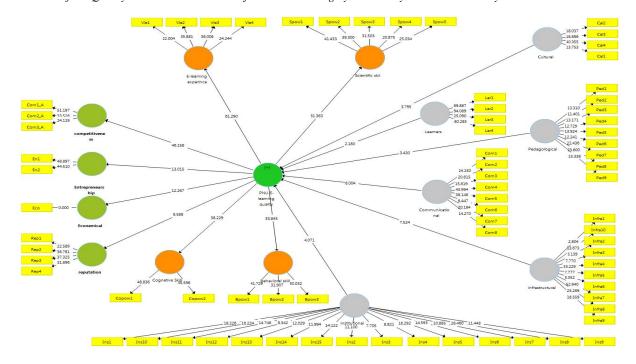*Structural Model of the Quality Evaluation Framework for the E-Learning System at Payam Noor University*

Table 9

Results of Significance Testing of Factor Loadings in the Structural Model

Examined Variable and Direction of Relationship	t-Value	Critical Value	Result
Cultural Factor → E-Learning Quality	3.795	1.96	Confirmed
Communication Factor → E-Learning Quality	8.004	1.96	Confirmed
Learner Factor → E-Learning Quality	2.180	1.96	Confirmed
Pedagogical Factor → E-Learning Quality	3.430	1.96	Confirmed
Infrastructural Factor → E-Learning Quality	7.524	1.96	Confirmed
Institutional Factor → E-Learning Quality	4.071	1.96	Confirmed
E-Learning Quality → Academic Capability	61.363	1.96	Confirmed
E-Learning Quality → Cognitive Capability	48.836	1.96	Confirmed
E-Learning Quality → Behavioral Capability	33.895	1.96	Confirmed
E-Learning Quality → Virtual Learning Experience	61.290	1.96	Confirmed
E-Learning Quality → Competitiveness	46.158	1.96	Confirmed
E-Learning Quality → Employability	13.015	1.96	Confirmed
E-Learning Quality → Economic Outcome	12.267	1.96	Confirmed
E-Learning Quality → Reputation	6.589	1.96	Confirmed

According to the results presented in Table 9, the *t-values* corresponding to the factor loadings of the examined indicators are statistically significant at the 95% confidence level. This confirms the relationships defined in the model and indicates that the identified variables are suitable descriptors for evaluating the quality of the e-learning system at Payam Noor University.

In structural equation modeling (SEM), it is essential to examine the reliability and both convergent and discriminant validity of the model. For evaluating reliability, Cronbach's alpha, rho-A, and composite reliability (CR) indices are used, while Average Variance Extracted (AVE) indicates convergent validity. The critical threshold for reliability indices is 0.70, and for AVE it is 0.50. If the calculated value of each index exceeds the critical threshold, the corresponding model construct is considered valid. The evaluation results are presented in Table 10.

Table 10

Reliability and Convergent Validity of Identified Factors in the Conceptual Model

Variable	Cronbach's Alpha	rho_A	CR	AVE	Result
Cultural Factor	0.745	0.757	0.839	0.567	Confirmed
Learner Factor	0.937	0.936	0.956	0.884	Confirmed
Pedagogical Factor	0.882	0.891	0.900	0.502	Confirmed
Communication Factor	0.895	0.903	0.916	0.581	Confirmed
Infrastructural Factor	0.845	0.885	0.878	0.540	Confirmed
Institutional Factor	0.915	0.919	0.927	0.561	Confirmed
E-Learning Quality	0.941	0.942	0.948	0.568	Confirmed
Academic Capability	0.882	0.884	0.914	0.681	Confirmed
Cognitive Capability	0.727	0.729	0.741	0.748	Confirmed
Behavioral Capability	0.786	0.789	0.805	0.700	Confirmed
Virtual Learning Experience	0.846	0.847	0.896	0.684	Confirmed
Competitiveness	0.791	0.796	0.875	0.706	Confirmed
Employability	0.732	0.732	0.882	0.788	Confirmed
Economic Outcome	1.00	1.00	1.00	1.00	Confirmed
Reputation	0.858	0.860	0.904	0.702	Confirmed

The results in Table 10 show that the values of all variables exceed their critical thresholds, confirming that the research model possesses acceptable reliability and convergent validity.

The final stage in validating the model within the SEM approach is the model fit test. In this study, the Goodness of Fit (GOF) index was used for this purpose. GOF is considered the most comprehensive index for assessing model effectiveness.

Table 11

Results of Goodness of Fit (GOF) Test for the Research Model

Average Shared Variance	Average R²	GOF	Model Fit Strength
0.589	0.860	0.712	Strong

The results from the overall model fit test indicate that the proposed model in this research demonstrates strong and acceptable fit.

4.   Discussion and Conclusion

The present study developed and validated a conceptual model for evaluating the quality of e-learning at Payam Noor University, revealing six critical components: pedagogical, infrastructural, institutional, cultural, learner-related, and communication-related factors. These components were found to significantly predict both individual outcomes—such as academic, cognitive, and behavioral capabilities, along with virtual learning experience—and institutional outcomes—namely competitiveness, employability, economic performance, and reputation.

The structural equation modeling results confirmed the statistical significance of all path coefficients, with infrastructural and communication factors exerting the most substantial influence. This emphasizes the foundational role of digital accessibility, platform stability, and technological support in any successful e-learning system. These results echo the findings of previous studies, which affirmed the importance of ICT integration and smart school infrastructure in enhancing learning environments and institutional functionality (Feili Ardalan et al., 2021; Nouri Hasanabadi et al., 2021; Sobhani et al., 2020). The reliability of such systems not only boosts the efficiency of digital education delivery but also improves students' engagement and learning outcomes (Goldhaber, 2021; Logachev et al., 2021).

Pedagogical dimensions, including teaching style, assessment, curriculum design, and faculty satisfaction, were also significantly associated with perceived e-learning quality. These results align with research emphasizing that pedagogy remains the core engine of quality—particularly in virtual education, where teacher-learner interaction and instructional planning must be more intentional and adaptive (Adabi et al., 2022; Hamdan, 2022; Mokhtari et al., 2021). Studies have also shown that dynamic and student-centered pedagogical strategies, such as continuous assessment, differentiated instruction, and collaborative learning, are directly linked with quality enhancement (Alfian et al., 2022; Raz et al., 2023). The validation of these components in our model reinforces the argument that pedagogy must evolve alongside digital delivery tools.

Institutional factors—including organizational policies, leadership, entrepreneurship support, and human resource quality—were also strongly predictive of e-learning quality. This confirms the assertion that governance and management strategies are instrumental in sustaining quality outcomes (Ismaya et al., 2023; Palar et al., 2023). Leadership commitment and policy clarity provide the scaffolding upon which pedagogical and technological innovations can thrive (Fitriani & Muljono, 2019; Romlah & Latief, 2021). Good governance is increasingly recognized as a foundational element of quality assurance in both traditional and virtual settings (Mahardhani, 2023; Noaman et al., 2017).

The cultural and learner-related variables, though slightly less impactful statistically, were also validated in the model. Cultural factors—such as respect for digital ethics, privacy, and copyright—demonstrated relevance as indicators of institutional maturity in e-learning environments (Crisol Moya et al., 2020; Yazdanshenasi, 2024). At the same time, learner-focused attributes like intrinsic motivation, participation, and skills acquisition were critical to successful virtual learning experiences. These findings are consistent with studies that highlight learner agency and personalization as central to sustainable quality (Amiri Roshkhar et al., 2021; Jafari, 2023).

The internal outcomes of e-learning—academic, cognitive, and behavioral competencies—were strongly affected by the quality dimensions. This is in line with prior research that connects the quality of educational environments with learners' intellectual growth, problem-solving abilities, and behavioral engagement (Adriansen et al., 2025; Muhammad & et al., 2023). Furthermore, the experience of virtual learning, measured through retention, perception of usefulness, and progression interest, was also validated as a critical outcome, resonating with models of smart learning environments and learner satisfaction (Ghaedi Bardei & Keyhan, 2022; Maryati et al., 2024).

Importantly, the model also confirmed that high-quality e-learning yields broader institutional benefits. The findings indicated that improvements in digital education quality significantly increased an institution's competitiveness, student employability, revenue generation, and reputation. These outcomes mirror the frameworks proposed by (Noaman et al., 2017) and (Alizadeh et al., 2022), which argue that strategic investments in quality assurance and digital infrastructure can result in tangible gains at both the micro and macro levels. In this study, competitiveness was reflected in stronger faculty recruitment and student enrollment rates, while economic outcomes included increased institutional revenues—findings also supported by (Farmonovna, 2023) and (Muhammad & et al., 2023).

The strong convergent validity and internal consistency of the model—confirmed by high values in Cronbach's alpha, rho-A, CR, and AVE—indicate that the constructs are statistically robust. The Goodness of Fit (GOF) index value of 0.712 further affirms the model's explanatory power and suitability for assessing e-learning quality. This adds to previous validation efforts that utilized analytical hierarchies or hybrid techniques to develop context-specific models of education quality (Fateh Rad et al., 2021; Ghaedi Bardei & Keyhan, 2022).

In essence, the findings of this research underscore that educational quality in the digital age is a multidimensional phenomenon, requiring synergistic management of technology, pedagogy, leadership, student support, and ethical frameworks. As (Jermsittiparsert, 2020) noted, sustainable development in education depends not only on learning outcomes but also on the well-being, equity, and empowerment of stakeholders. The present study affirms this vision by offering a validated, comprehensive model that integrates the structural, technological, and human elements of e-learning quality in higher education.

This study is not without limitations. First, the research was confined to one institution, Payam Noor University, which, while representative of Iran's distance education system, may limit generalizability across different cultural or organizational settings. Second, the reliance on self-reporting in surveys and interviews introduces the potential for response bias, particularly in items concerning satisfaction and motivation. Third, the model does not account for longitudinal variations in perceptions or outcomes over time, which could be critical in e-learning where both learners and institutions undergo dynamic adaptation. Lastly, while technological dimensions were well captured, emerging elements such as artificial intelligence, emotional analytics, and adaptive learning systems were outside the current scope.

Future research should pursue multi-institutional and cross-cultural validation of the proposed model to enhance its generalizability. Comparative studies involving different university systems—public vs. private, centralized vs. decentralized—would offer valuable insight into contextual adaptability. Longitudinal studies could track student and institutional performance across multiple semesters to assess the sustainability of quality outcomes. Moreover, expanding the model to incorporate emotional well-being, AI-enhanced pedagogy, and student equity metrics could provide a more holistic framework suited for 21st-century educational challenges.

To enhance e-learning quality, university leaders should prioritize comprehensive investments in both digital infrastructure and human resource development. This includes ongoing training for faculty in digital pedagogy, implementation of ethical and inclusive e-learning policies, and transparent leadership practices that foster trust and innovation. Institutions must also create responsive feedback mechanisms to capture learner experiences in real time. Finally, quality assurance processes should be integrated into strategic planning, enabling evidence-based decision-making that supports institutional reputation, learner success, and long-term competitiveness.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

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

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the study and participated in the research with informed consent.

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