




Research Article

Design and Validation of a Web-Based Technology-Enriched Learning Environment Model for Skill-Oriented Universities

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Abstract

This study aimed to design and validate a model for enriching web-based technology learning environments at Fars National Skill University. An exploratory sequential mixed-methods design was employed, incorporating thematic analysis in the qualitative phase and a descriptive survey in the quantitative phase. In the qualitative segment, participants comprised university faculty members and expert specialists in educational technology, selected through purposive sampling until theoretical saturation was achieved, yielding a sample of 22 individuals. Semi-structured interviews were utilized for data collection, and the gathered data were analyzed using Attride-Stirling's thematic analysis framework. In the quantitative phase, the statistical population consisted of faculty members and information technology experts, from whom data were collected via a researcher-developed questionnaire with confirmed validity and reliability. Structural equation modeling was applied to analyze the quantitative data. The qualitative findings generated 110 basic themes, 30 organizing themes, and 7 overarching themes. The resultant model rests upon five principal pillars: Educational Strategies—comprising intelligent technology integration, educational equity, personalized learning experiences, active learning, and learning system management; Interactivity and Participation encompassing effective engagement, community building, communication tools, and collaborative activity; Standardization focusing on educational quality, continuous improvement, formative assessment, and constructive feedback; Content Management—incorporating instructional design, learning analytics, educational modeling, digital tools, and constructivist learning; and Inclusivity and Flexibility—addressing diversity, accessibility, relevance, technological authenticity, and temporal and content flexibility. Quantitative analyses confirmed the model's adequate fit ($GOF = 0.637$), and all internal components demonstrated acceptable validity and reliability. This model offers a robust scientific and practical framework for designing, developing, and evaluating web-based technology learning environments in skill-oriented universities, thereby contributing to enhanced learning quality, increased student motivation, and the fulfillment of the institution's professional objectives.

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Keywords: Enrichment; Learning Environment; Web-Based Technology; National Skill University

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1. Introduction

Technology is considered a powerful driving force for educational reforms and innovation. In 2017, the EDUCAUSE Center for Analysis and Research identified the technology-supported learning environment as a strategic investment for colleges and universities. Educational service industry institutions, including colleges and universities, can only survive in this digital revolution era through specific transformations, and smart classrooms can become a bridge to the future. Therefore, with the rapid development of smart technology, more universities are beginning to build smart classrooms to improve the learning environment (Puertas-Aguilar et al., 2025). Thus, smart classrooms can play an important role in efficient knowledge dissemination, adaptation to new learning paradigms and teaching methods, accessing improved learning resources, enhancing teaching interaction, and collecting data feedback (Dai et al., 2023).

The advent of technology has led to new learning environments taking on a more significant role with the element of interaction. Indeed, digital learning environments provide interaction through technological tools for learners and instructors, which has given new learning environments the component of being collaborative. The collaborative nature of online learning environments is among the advantages of access to modern technologies, allowing individuals from different geographical locations, with appropriate electronic devices and technologies, to see themselves in a new learning environment and engage in activities and information exchange (VanOostveen et al., 2014). Hence, it is said that technology-based learning environments are those where individuals interact with others to enrich their experiences, leading to learning (Barana et al., 2020). Enriching students' learning environments with social networks can, in addition to the effective entry of technology into the learning environment, pose the least challenge in technology integration (Toofaninejad et al., 2018).

In this context, web technology, as one of the most effective modern educational platforms, plays a significant role in shaping web-based learning environments. These environments, by providing flexible access to content, facilitating two-way interaction between learners and instructors, utilizing multimedia tools, and supporting collaborative learning, have contributed to improving the quality of the educational process (Dede, 2014; Ally, 2008). A web-based technology learning environment refers to the use of web-based tools, platforms, and technologies to facilitate the teaching and learning process; these technologies include learning management systems, interactive online tools, and enriched digital resources that enable access to content and dynamic interaction between instructor and

student (Zulaiha, 2025). Learning enrichment refers to the process that enhances the quality and depth of learning by increasing interaction, active student participation, providing timely feedback, and employing multimedia elements, transforming learners' learning experience from a passive process into an active and collaborative one (based on research on web-based learning environments) (Taib et al., 2025). A web-based technology learning environment is an organized, interactive space where learning transcends time and space constraints, and the learner plays an active role in knowledge construction (Moore & Kearsley, 2012). A web-based technology-enriched learning environment can be conceptualized as a learning environment that emphasizes flexibility, effectiveness, efficiency, interaction, adaptability, and learning efficacy where both formal and informal learning are integrated (Gros, 2016). This system is essentially an adaptive system that improves the learning experience based on learner characteristics, preferences, and progress, demonstrates higher degrees of interaction, access to knowledge, feedback, and guidance, and utilizes rich media with integrated access to relevant, real-life information and on-the-go guidance using technologies for continuous improvement of the learning environment (Dai et al., 2023).

One of the key concepts in this domain is the enrichment of the learning environment, which refers to the qualitative improvement of the learning experience through increased interaction, diversity of teaching methods, purposeful use of technology, and attention to individual learner differences (Reigeluth, 2017). Enriching web-based learning environments can lead to increased academic motivation, depth of learning, self-regulation, and development of students' cognitive and professional skills (Laurillard, 2012). Research shows that mere use of technology, without appropriate instructional design and attention to active learning components, will not have a significant impact on learning, highlighting the necessity of addressing enrichment (Mayer, 2020). In educational research literature, enriching the learning environment is a concept beyond merely providing educational tools; it refers to creating dynamic, diverse, and opportunity-based learning contexts that transform the learning process from a passive state into an active and meaningful activity. In this view, the learning environment is not limited to physical or virtual space but includes social interactions, learning tools, multimedia resources, instructional design, and learner experiences organized to place learners in authentic, collaborative, and constructive knowledge-building situations. These types of environments strive to encourage learners toward innovation, critical thinking, problem-solving, and self-regulation in learning, which are themselves key components of effective learning (Hannay & Newvine, 2006).

Research has shown that when learning is organized in environments with diverse teaching methods and active learning strategies, participation, motivation, and depth of learning increase, and learners develop more complex skills such as reasoning and critical thinking. For example, studies in enriched mathematics environments have shown that using diverse teaching methods increases student participation, consolidates learning, promotes reasoning skills, and fosters a positive attitude toward learning (Kutluca et al., 2020).

In a broader perspective, enriching the learning environment is influenced by four key factors: diversity of resources and activities, capacity for interaction and participation, effective feedback, and flexibility in learning pathways. These factors enable the learning environment not only to transmit information but also to provide a context in which learners can learn in different, active, and experience-based ways. In other words, enrichment means creating authentic and learner-need-aligned opportunities for active participation in knowledge construction, which is achieved in technology-based environments through digital and internet capabilities (Durnali & Limon, 2020). Consequently, the concept of learning environment enrichment in new educational research emphasizes the scientific integration of technology, human-centered instructional design, and social interaction, transforming learning into an active, interactive, and meaning-oriented experience and reinforcing the learner's role in the learning journey (González Pérez, 2018).

Enriching the learning environment in educational organizations is of greater importance due to its significant role in the development and progress of society in multiple dimensions. Educational organizations can continue to grow and enhance their quality when their members are also developed and of high quality (Jameh Bozorg et al., 2023). Paying attention to individuals' positive aspects and enriching them in educational organizations is profitable and leads to organizational progress. Enhancing the level of learning environment enrichment is one of the key missions of policymakers, decision-makers, and planners, through which they can realize their organization's goals and missions (Moradi Mukhlis et al., 2025).

In the age of digital transformation, skill-oriented universities increasingly require innovative, web-based technology learning environments. Web technologies, by providing blended learning, virtual simulations, online workshops, multimedia content, and self-directed learning, can make skill-based learning richer and more effective (Dede, 2014; Ally, 2008). Especially in technical and vocational fields, the use of digital learning environments provides opportunities for continuous practice, ongoing feedback, and skill repetition, reducing the time and space constraints of face-to-face education

(Mayer, 2020). In skill-oriented universities, including National Skill University, the importance of this issue is more prominent; because the main mission of these universities is to train skilled and capable human resources for entering the job market. In such a context, web-based technology learning environments can play an effective role in achieving educational goals by simulating real situations, enhancing practical learning, and providing self-directed learning opportunities (Herrington et al., 2014). However, research evidence indicates that in many higher education institutions, especially at regional levels, the utilization of web technology is often limited to providing electronic content, with less attention paid to real enrichment of the learning environment.

Skill-oriented universities, as one of the modern and strategic approaches in higher education, have been established with the main goal of training capable, entrepreneurial human resources ready to enter the job market (UNESCO, 2015; OECD, 2019). The focus of these universities is on developing practical, professional skills and job competencies, and unlike traditional universities that often emphasize theoretical and knowledge-based education, in skill-oriented universities, "being able to do" is as fundamentally important as "knowing" (Billett, 2011). These types of universities strive to reduce the gap between the higher education system and the real needs of industry, services, and the job market, directing education toward solving real societal problems (Wheelahan & Moodie, 2016). In skill-oriented universities, curricula are designed based on competencies; meaning that educational content, teaching methods, and assessment methods are all aligned with acquiring specific, practical, and measurable skills. Learning in these universities is primarily based on experience, implementation of practical projects, internships, simulation of real job situations, and problem-based learning (Kolb, 2015; Herrington et al., 2014). In this space, instructors, more than acting as knowledge transmitters, serve as guides, facilitators, and skill coaches, and students, as active learners, participate in the process of knowledge and skill construction (Prince, 2004).

One of the distinctive features of skill-oriented universities is their close and systematic connection with industry and the job market. This connection is established through collaboration with organizations and companies, use of expert industrial instructors, design of applied courses, and implementation of internship programs (UNESCO, 2016). Such an approach ensures that educational content is always up-to-date, practical, and aligned with real societal needs. Research shows that this effective interaction plays a significant role in increasing graduates' job readiness and employability (OECD, 2019). In this context, enriching the learning environment in skill-oriented universities gains double

importance; because skill-based learning requires high interaction, practical experience, immediate feedback, and encountering real problems (Reigeluth et al., 2017). If web-based learning environments are designed and enriched purposefully, they can play an effective role in strengthening professional skills, increasing student motivation, and enhancing learning quality (Laurillard, 2012). Therefore, attention to the nature of skill-oriented universities and their specific needs is a fundamental condition for designing and developing efficient and effective learning environments in contemporary higher education (OECD, 2019).

The necessity of this research can be explained from several aspects. First, in the present era, web technologies are recognized as one of the axes of transformation in higher education; these technologies are not just tools for content delivery but are also platforms for enhancing self-regulation skills, interaction, and knowledge sharing, which can increase the efficiency of educational systems (Tshuma & Chasokela, 2025). Given the increasing expansion of e-learning and the need for flexibility in teaching-learning processes, universities are compelled to adopt and utilize modern technologies to meet the expectations of students and the job market (Adelia, 2025).

In skill-oriented universities such as Fars National Skill University, strengthening web-based technology learning environments can contribute to the development of specialized skills, student motivation, and increased educational effectiveness, which in turn strengthens the university's position in the country's higher education system. The research problem also stems from the fact that despite the potential of web technology for improving learning processes, in many universities, especially in skill-oriented and regional contexts, a precise understanding of how to enrich web-based learning environments is still insufficient. The lack of scientific structures for analyzing and evaluating these environments creates challenges in their effective design and implementation. Investigating this issue helps identify key components affecting learning enrichment and design evidence-based practical solutions for improving learning quality. In total, this research is a scientific effort to define, model, and analyze components of a web-based technology learning environment and how to enrich it in an academic context. Such a study can contribute to improving educational performance and developing students' skills and provide guidance for policymakers and educational administrators in developing new learning strategies. Therefore, the main problem of the present research is: How is the design of a web-based technology-enriched learning environment model at Fars National Skill University? And does this model have the necessary validity?

2. Method

The design of this research was an exploratory mixed-methods design. In the qualitative part, thematic analysis in the style of Attride-Stirling (2001) was used. This method systematically examines research data and, through extraction and analysis of themes at three levels—basic, organizing, and overarching themes—seeks to discover conceptual patterns and hidden meanings in the data. The goal of this process is to gain a deep and comprehensive insight into the studied phenomenon so that a more coherent theoretical framework can be presented based on the findings. The data collection tool in the qualitative phase was a semi-structured interview. Referring to the research literature and considering exploratory interview content, data were collected step by step, interview questions were designed, and they were analyzed using thematic analysis.

To ensure the validity of the interviews, trust-building was established during the interviews. In this research, during the interview, participants were asked questions related to enriching the web-based technology learning environment at the university for an approximate duration of 45 to 60 minutes. The interview questions were as follows: Faculty were asked: What is your view on enriching the web-based technology learning environment at your university? How does enriching the web-based technology learning environment at the university take place from your perspective? What features does an enriched web-based technology learning environment at the university require? What is your practical and operational strategy at the University for creating an enriched web-based learning environment? Additionally, questions were asked from educational technology experts, which were: What are the indicators and standards of web technology in the higher education sector? In your opinion, how can the learning environment in educational organizations be enriched using web technology? And based on their answers, subsequent questions were asked. Finally, the interview results were reviewed again with the interviewees. Research participants included faculty members of Fars National Skill University and specialists and experts in the field of educational technology.

Participants in this research were university faculty and experts in educational technology who were selected using purposive criterion-based sampling and the principle of theoretical saturation, totaling 22 individuals, and were interviewed. Therefore, the data collection tool in the qualitative part was the semi-structured interview. Selection criteria for faculty participants were having at least 10 years of teaching experience in educational management fields and having articles or publications in the fields of learning, learning environment, and

educational technologies. Additionally, experts in the field of information and communication technology included specialists with at least 10 years of work experience in ICT in Fars province and holding relevant degrees in information and communication technology, especially in higher education. The sampling continued until reaching theoretical saturation, and in total, the interview process was conducted with 22 individuals. For validation in this research and ensuring data quality and interpretations, Lincoln and Guba's criteria with four dimensions—credibility, conformability, dependability, and transferability—were utilized. To ensure the validity or accuracy of findings obtained through interviews, attempts were made to adhere to this important principle by allocating sufficient time for data collection, integrating methods, and participant review, by providing interview transcripts to interviewees so they could add explanations where necessary or remove or modify any phrases they felt did not match their statements. To adhere to the principle of conformability, efforts were made to avoid any bias in the interview process and result extraction, and to increase reliability, which refers to the sufficiency of the analysis and decision-making process, guidance and supervision from expert faculty were used.

The research method in the quantitative part was descriptive-survey type. The statistical population in this phase included all faculty members of Fars National Skill University and specialists and experts in educational technology, totaling 140 individuals, from which 103 individuals were selected using the Morgan-Krejcie table

and stratified random sampling. Collected data from the environment were examined and described using a researcher-developed questionnaire. In the present research, to determine questionnaire validity, two main methods were used: content validity and construct validity. To examine content validity, questionnaires were given to a group of faculty, specialists, and experts in educational technology, including 30 faculty members, higher education specialists, and experts. Each faculty member and specialist was asked to express their opinion about each item in the questionnaire using a predetermined judgment scale. This scale was as follows:

- A: Essential
- B: Useful but not essential
- C: Not essential

After collecting members' opinions, responses were coded, and the average approval percentage for each item was calculated. Considering 30 participants, the average approval percentage for each item was reported as calculated. Based on the CVR standard table, if the CVR percentage is above 33%, the item was deemed appropriate. This method was used to ensure the content validity of the questionnaires in the research, and results are reported separately in Table 2, indicating the suitability of items for continuing the research. Additionally, confirmatory factor analysis was used to confirm construct validity, item analysis to assess the validity of each item separately, and examination of correlations between items using confirmatory factor analysis to confirm structural validity.

Table 1. Demographic Information of Research Participants

Interview Code	Experience	Position	Gender	Field of Study	Degree
IN-FA-01	12	Faculty Member	Male	Accounting	PhD
IN-FA-02	15	Faculty Member	Female	Statistics and Mathematics	PhD
IN-FA-03	10	Faculty Member	Female	Electrical and Electronics	Master's
IN-FA-04	11	Faculty Member	Male	Electrical Power	PhD
IN-FA-05	10	Faculty Member	Female	Visual Arts	Master's
IN-FA-06	12	Faculty Member	Female	Architecture	Master's
IN-FA-07	14	Faculty Member	Male	Civil Engineering	PhD
IN-FA-08	10	Faculty Member	Male	Electronics	PhD
IN-FA-09	15	Faculty Member	Male	Chemical Engineering	PhD
IN-FA-10	17	Faculty Member	Male	Architecture	PhD
IN-FA-11	20	Faculty Member	Female	Accounting	PhD
IN-FA-12	14	Faculty Member	Female	Electro technics	PhD
IN-IT-13	13	IT Specialist	Male	Data and Network Security	PhD
IN-IT-14	20	IT Specialist	Male	ICT Management	PhD
IN-IT-15	14	IT Specialist	Male	Computer Networks	PhD
IN-IT-16	18	IT Specialist	Female	Manufacturing and Production	Master's
IN-IT-17	18	IT Specialist	Female	Network-based Systems	PhD
IN-IT-18	12	IT Specialist	Female	Switching and Transmission	Master's
IN-IT-19	10	IT Specialist	Male	ICT Applications	Master's
IN-IT-20	10	IT Specialist	Male	Computer Networks	Bachelor's
IN-IT-21	12	IT Specialist	Male	Data and Network Security	Bachelor's
IN-IT-22	14	IT Specialist	Female	Switching and Transmission	Bachelor's

Table 2. Demographic Information of Quantitative Sample

Characteristic	Variable	Frequency	Percentage
Gender	Male	78	72.75%
	Female	25	28.24%
Total	-	103	100%
Degree	Bachelor's	34	33%
	Master's	45	43.69%
	PhD	24	23.31%
Total	-	103	100%
Position	Faculty Member	45	43.68%
	IT Specialist	58	56.32%
Total	-	103	100%

Table 3. Results of Questionnaire Items' Validity Examination

Question	Essential	Useful but not essential	Not essential	Content Validity
1	28	2	0	86.66%
2	29	1	0	93.33%
3	28	2	0	86.66%
4	28	2	0	86.66%
5	30	0	0	100%
6	30	0	0	100%
7	28	2	0	86.66%
8	27	3	0	80%
9	29	1	0	93.33%
10	28	2	0	86.66%
11	28	2	0	86.66%
12	28	2	0	86.66%
13	30	0	0	100%
14	29	1	0	93.33%
15	28	2	0	86.66%
16	30	0	0	100%
17	30	0	0	100%
18	30	0	0	100%
19	29	1	0	93.33%
20	29	1	0	93.33%
21	29	1	0	93.33%
22	28	2	0	86.66%
23	28	2	0	86.66%
24	28	2	0	86.66%
25	30	0	0	100%
26	30	0	0	100%
27	28	2	0	86.66%
28	28	2	0	86.66%
29	29	1	0	93.33%
30	28	2	0	86.66%
31	29	1	0	93.33%
32	28	2	0	86.66%

These results show that the structure and components in the questionnaire are well-confirmed, and through factor analysis, the internal structure of the questionnaire is confirmable. At the level of descriptive findings, demographic variables and main variables were described using statistical indicators of frequency and percentage frequency, mean, standard deviation, and bar charts. Normality of variables was examined using skewness and kurtosis indices and the Kolmogorov-Smirnov test. At the level of inferential findings, confirmatory factor analysis and structural equation modeling were used.

3. Results

Question 1: How is the design and validation of the web-based technology-enriched learning environment model at Fars National Skill University?

To answer this question in the research, using thematic analysis and employing the *Attride-Stirling (2001)* thematic network, qualitative data from semi-structured interviews and related documents were analyzed line-by-line and paragraph-by-paragraph. In this process, initial codes were manually extracted, then through removal,

merging, modification, and alignment with theoretical foundations, they were transformed into basic themes. Finally, the hierarchical structure of themes included 110 basic themes, 30 organizing themes, and 7 overarching themes. These overarching themes reveal the key principles governing the enrichment of the web-based technology learning environment at Fars National Skill University. The findings report was accompanied by descriptions of overarching themes and direct quotations from the data to provide a better understanding of the proposed model for readers. The overall process of data collection, analysis, and validation is also summarized in Chart 1.

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In this stage, attempts were made to reach more abstract themes by reorganizing initial themes, guiding us toward more principal and overarching themes. In this stage of thematic analysis, 30 organizing themes and 7 overarching themes were extracted. [Table 2](#) shows the total basic, organizing, and overarching themes.

Table 4. Construct Validity and Reliability of Questionnaire Components

Row	Component	Composite Reliability	Cronbach's Alpha
1	Content Organization	0.87	0.82
2	Communication Tools	0.89	0.90
3	Active Collaboration	0.85	0.88
4	Personalizing Learning Experience	0.90	0.91
5	Flexibility	0.92	0.73
6	Support	0.91	0.87
7	Active Learning	0.85	0.77
8	Educational Quality	0.88	0.77
9	Constructive Learning	0.89	0.80
10	Educational Modeling	0.88	0.85
11	Community Building	0.90	0.92
12	Relevance and Technological Authenticity	0.87	0.85
13	Role of the Instructor	0.75	0.73
14	Continuous Improvement	0.88	0.82
15	Digital Tools	0.94	0.91
16	Content Delivery	0.86	0.79
17	Effective Participation	0.89	0.89
18	Environmental Characteristics	0.92	0.82
19	Learning System Management	0.91	0.79
20	Problem Solving	0.93	0.88
21	Assessment and Feedback	0.85	0.80
22	Security and Privacy	0.87	0.92
23	Accessibility	0.85	0.79
24	Educational Equity	0.91	0.90
25	Media Literacy	0.87	0.72
26	Diversity	0.85	0.74
27	Flexibility	0.79	0.78
28	Instructional Design	0.87	0.88
29	Technology Application	0.81	0.85
30	Financial Management	0.79	0.85
31	Online Learning Resources	0.93	0.82
32	Learner Needs	0.92	0.90

Table 5. Interview and Extracted Initial Themes

Interview Code	Interview Text	Extracted Theme
IN-FA-01	<p>Web-based e-learning is one of the most important educational developments in the present era. With advances in information and communication technology, distance learning has become a popular and effective option for individuals who, for various reasons, cannot attend face-to-face classes. This type of education, due to many advantages such as easy access, lower costs, and flexibility in time and place, is gaining increasing attention. However, one of the major challenges in this type of education is the issue of student participation in the learning process. Reduced participation can lead to failure in achieving educational and learning objectives. The web environment can break down any knowledge and skill and contain learning steps. With web technology, one can also estimate the individual's effective mental algorithm and learning style based on standardized tests. Then, with initial tests, the individual's knowledge and skill level can be identified, and finally, steps to increase skills and knowledge can be suggested to individuals. Also, let me mention that this method I described is attractive. In an enriched learning environment, interactivity exists. It should enable active interaction between students and teachers. There is diversity of resources and use of diverse resources such as video, text, audio, and images that aid learning. There is the possibility of adaptation to students' diverse needs and learning styles. Support for self-directed learning exists, and students should be able to learn independently and at their own pace. A safe and supportive environment creates a space where students feel comfortable and secure. Continuous assessment opportunities for evaluating student progress are provided.</p>	<p>Easy access, lower costs, flexibility in time and place, issue of student participation in the learning process, standardized tests aligned with mental algorithm and effective learning style, attractiveness, interactivity, slow, diversity of resources and use of diverse resources such as video text, audio, and images, possibility of adaptation to needs and different learning styles, support for self-directed learning, independent learning at one's own pace, a safe and supportive environment creating a space where students feel comfortable and secure, opportunities for continuous assessment for evaluating student progress.</p>
IN-IT-14	<p>It should be an interactive flexible environment, meaning it engages the audience with multiple tools in education, moving the educational environment away from being traditional and purely one-way, to instill a sense of vitality, effectiveness, and a type of cooperation, and so the audience doesn't get tired of the web space. By having multiple media such as images, sound, animation, and video in producing education, it should be used to create a colorful, attractive environment for the audience receiving the material, attracting them to the educational environment. Placing appropriate feedback during teaching times using web technology for flexibility in education in line with completion of the first point: placing appropriate media for audience questions without disrupting teaching-learning, including what is needed from knowledge and skills for the audience's present and future. An enriched learning environment... from my perspective means that knowledge and skills are presented based on each individual's scientific and skill background... meaning that each individual can benefit according to their own ability and their mental group learning algorithm because individuals are different, and consequently, their learning styles are different.</p>	<p>Interactive flexible environment, sense of vitality and effectiveness and a type of cooperation, having multiple media like images, sound, animation, and video in producing education, colorful attractive environment, placing appropriate feedback during teaching times, placing appropriate media for audience questions without disrupting teaching-learning, knowledge and skills presented based on each individual's scientific and skill background.</p>

Table 6. Basic, Organizing, and Overarching Themes

Overarching Themes	Organizing Themes	Basic Themes
Inclusivity and Flexibility	Accessibility	Easy and quick access, Adherence to accessibility standards e.g., WCAG, Maintaining consistent access to new documents and files, Access to static pages like printed course materials, Unprecedented access to educational resources.
	Flexibility	Content flexibility, Facilitating education, Flexibility in time and place, Open learning experiences, Flexible and distributed space, Updated content, Updated teaching methods.
	Diversity	Diversity of resources and use of diverse resources such as video, text, audio, and images, More diversity in teaching, Presenting content in different languages or considering diverse cultural contexts, Avoiding cultural biases in educational content.
	Relevance and Technological Authenticity	Selecting appropriate technologies, Scalability for diverse educational needs, Proper sequencing of technology application, Giving direct input to potential items, Related management and server programs and applications.
Educational Strategies	Personalizing Learning Experience	Student profiles and dashboards, Adaptive technologies that adjust content with individual progress and preferences, Independent learning at one's own pace, Personalization based on the semantic web network, Independent self-paced study, Self-directed learning.
	Application of Updated Technology	Internet technologies, especially the web, Use of visual technology, Application of technology for deep processing of ideas, Application of technology to increase student engagement with course topics, Application of technology to enhance instructor and student motivation for learning, Application of technology to increase student-student participation, Use of technology as a high-quality supplement in the educational process, Application of technology for learning that goes beyond information retrieval.
	Financial Management	Lower costs, Cost-effectiveness, Behavioral changes in learners with minimal cost in the shortest time, Reducing education costs, Sufficient investment, Use of open-source or free software.
	Attention to Learner Needs	Alignment with learner needs, Creating a positive attitude in the learner, Goal of behavioral changes in learners, Control in the learner's hands, Online self-tutorials, Success of a curriculum, Active engagement of student in learning, Enhancing the relationship between content and access method, Collaborative learning, Increasing student-instructor interaction, Continuous interaction.
	Constructive Learning	Web-based enriched learning in three forms: problem-solving, Creating open learning, distributed learning, Distributed learning in different and decentralized locations, Making teaching and effective learning more effective, Integrating authentic tasks and constructive learning, Factor of blended learning, Teaching with the help of data analysis, More motivation and commitment, More interesting and challenging courses and training enriched for students.
	Establishing Educational Equity	Development of interactive content, Easy access, Non-discrimination and respect for learners' rights, Student participation and competence in decision-making, Fair and diverse assessment, Providing opportunities for re-learning or content repetition, Capability of content accessibility for individuals with disabilities such as video captions, text reading by software for the visually impaired, Providing free or accessible educational resources (such as handouts, instructional videos, digital library), Ensuring access to appropriate internet bandwidth for all students.
	Content Management	Content Delivery Method

Table 6. Basic, Organizing, and Overarching Themes(Continued)

Overarching Themes	Organizing Themes	Basic Themes
Standardization	Content Organization	Modifying, adjusting, and enriching content, Content adaptable according to learning domain components, Categorizing educational content into groups and classes of larger domains, Easy method for organizing needed content in a web-compatible tool, Enriching electronic educational content based on open corpora relying on linked data, Presenting content including multimedia resources, Focusing on content.
	Media Literacy in Content Delivery	Organizing online resources in an adaptive tool, Media and information technology skills, Instructor's multiple expertise, Instructor's teaching skill, Having technological and media literacy.
	Existence of Online Learning Resources	Online self-tutorials, Textbooks, Digital libraries, Hyperlink structures (multimedia titles that take the user to another page) and HTML web pages, Electronic version of the desired textbook, Preparing educational content and course materials on the web platform, Related course PowerPoint, Online question and exam system and examples and code samples.
	System of Assessment and Feedback	Opportunities for continuous assessment for evaluating student progress, Placing appropriate feedback during teaching times, Follow-up and evaluation, Achieving required results, Feedback and guidance through synchronous and asynchronous communications, Feedback through student projects.
	Educational Quality	Optimizing teaching methods, Proper combination of content, Good scenario for designing teaching methods, Teaching effectiveness, Enhancing individual knowledge, Creating uniformity in quality.
	Continuous Improvement	Increasing quality and accelerating dissemination in education discussion, Causing change in teaching and learning methods, Leading to conceptualization and guiding the learning process, Continuous feedback and evaluation, Needs analysis and goal-setting, Capability to improve the educational process, Deepening education considering learner needs, Rapid updating.
Interactivity and Participation	Learning System Management	Individual's effective learning style, Possibility of adaptation to diverse needs and learning styles, Presenting knowledge and skills based on each individual's scientific and skill background, Creating meaningful and lasting learning experiences in the mind, Classroom-centered educational approach, Knowledge construction, Developing independent learning, Possibility of managing and distributing content, Shortening teaching time, Integrating technology with the teaching-learning process.
	Community Building	Use of interactive and participatory tools, Access to open educational resources, Expanding information sharing and reflection, Presence of capable programmers, Method of interaction and user interface design, Formation of cohesive workgroups, Mutual participation of learners in the training course, Meaningful interaction of students with others and performing useful tasks, Social communications, Facilitating collaborative learning communities.
	Effective Participation	Student participation in the learning process, Interactivity, Educational interaction, Research, exploration, and collaborative learning, Engaging, participatory, and efficient education, Interactive capabilities, Participation of educational policymakers and e-learning creators, Collaboration with subject matter experts and collaboration with learners, Learner-instructor interaction, Interaction as a characteristic of e-learning using the internet, hyperlinks, browsers, servers, authoring programs.
	Active Collaboration	Active interaction, Online collaboration tools, Active participation of social media, Tracking learner interaction and performance.

Table 6. Basic, Organizing, and Overarching Themes(Continued)

Overarching Themes	Organizing Themes	Basic Themes
	Communication Tools	Synchronous communication: video conferencing, virtual chats, and virtual whiteboard, Asynchronous communication: discussion forums, blogs, email, and messaging applications, Interactive games or scenario-based learning activities.
Data Analysis and Learning Intelligence	Problem Solving	Teaching and learning for problem-solving, Innovation with usability, Utilizing problem-based learning, Teaching soft psychological and motor skills, Significant achievements and increased innovation, Problem-solving and aiding teaching strategy, Scaffolding problem-solving, Increasing problem-solving skill.
	Digital Tools	Having multiple media such as images, sound, animation, and video in producing education, Placing appropriate media for audience questions without disrupting teaching-learning, Discussion forums via email, video conferencing, and live video lectures, video streaming via web, Virtual applications, Mobile tools like laptops, tablets, computers, and smartphones, Employing various technologies to create a more engaging experience, Learning platforms like Sky room and Adobe Connect.
	Instructional Design	Standardized tests aligned with mental algorithm, Technical design and materials, Design for flexibility and accessibility, Integration of instructional, social, and technological design, User-friendly interface design, Designing and preparing learning assignments and activities for curriculum improvement, Multimedia instructional design.
	Educational Modeling	Appropriate and efficient modeling of adaptable content, Creating a model for content and learners, Creating a model for content and linked data techniques, Creating an educational hypermedia, Modeling distributed learning, Multi-agent-based models, Adaptive learning models.
Supportive and Technical Infrastructure	Support	Supporting future learner interactions, Supporting self-directed learning, Supporting learners, Supporting social learning, Technical and educational support, Support for various devices, Supporting students in searching and combining their ideas, Support for multiple languages, screen readers, and alternative formats.
	Security and Privacy	Creating a space where students feel comfortable and secure, Security and privacy protection, Using internal or controlled servers, Supporting user privacy, Clear privacy policies and regulations, Access management, Data encryption, Using reputable and secure Learning Management Systems (LMS).
	Role of the Instructor	Awakening interest in education, Adaptive guidance on the learner, Assessing learner ability, Role of instructors in ICT in structuring students' learning experiences, Facilitation and guidance, Role of instructor in engaging students in web-based enriched activities.
	Environmental Characteristics	Attractiveness, Safe and supportive environment, Interactive flexible environment, Sense of vitality and effectiveness, Providing an optimal environment for learning, Creating multiple learning contexts for learners and teachers, A supportive, facilitative, and complementary space, Type of space and activities, Creating an intermediary and mediating environment.

Table 7. Descriptive Statistics of Investigated Variables

Main Factor	Mean	Variance	Skewness	Kurtosis	Range	Minimum	Maximum
Inclusivity and Flexibility	3.87	0.62	0.95	1.10	4	1	5
Educational Strategies	4.12	0.55	1.01	1.05	4	1	5
Content Management	3.95	0.70	0.89	1.02	4	1	5
Standardization	4.08	0.50	1.10	0.98	4	1	5
Interactivity and Participation	4.20	0.48	1.05	1.00	4	1	5
Data Analysis and Learning Analytics	3.78	0.66	0.93	1.07	4	1	5
Technical and Support Infrastructure	4.03	0.60	1.00	1.03			

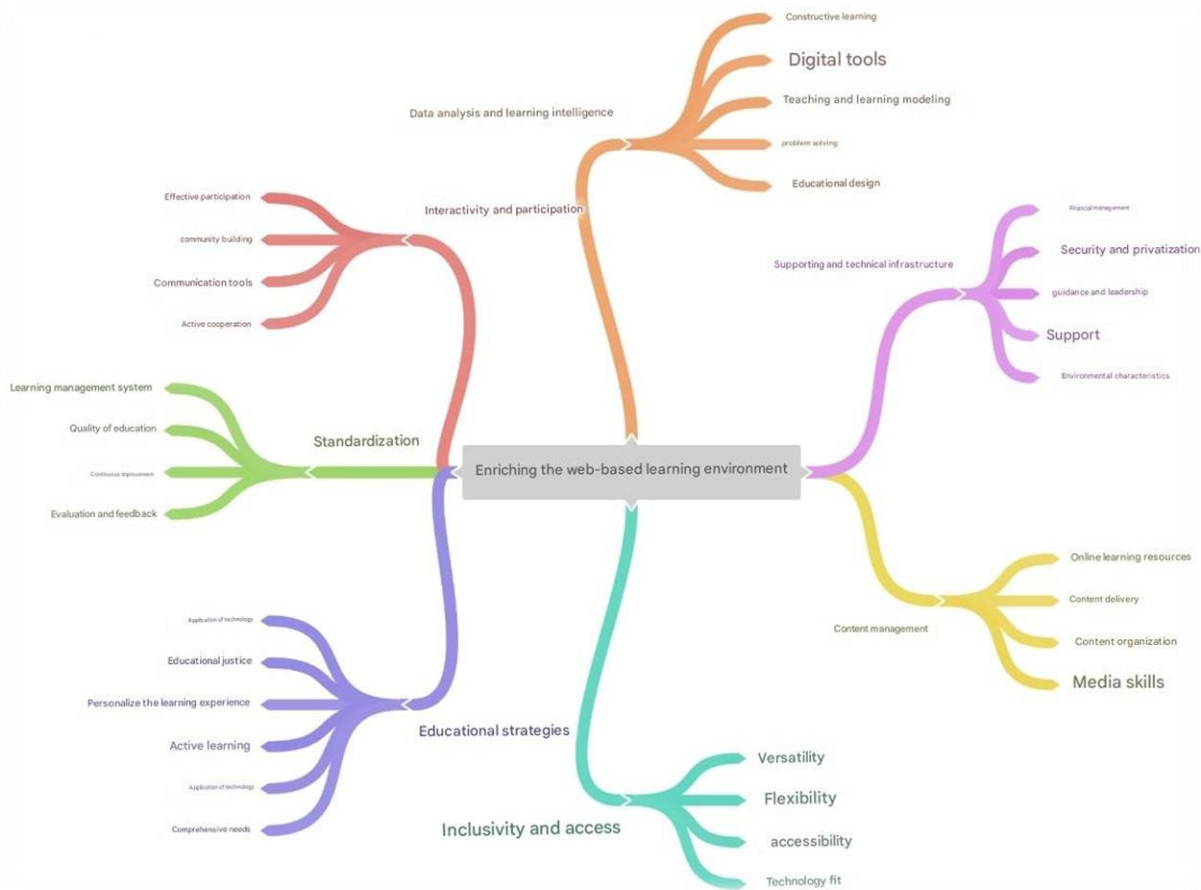


Figure 1. Thematic Network for Enriching the Web-Based Technology Learning Environment

Discovery and Description of Thematic Network:

By examining and analyzing related themes, 7 overarching themes were extracted, including: Content Management, Educational Strategies, Standardization, Data Analysis and Learning Intelligence, Interactivity and Participation, Inclusivity and Access, and Supportive and Technical Infrastructure.

Finally, overarching themes were mapped as a thematic network. Using the thematic network, a comprehensive and deep view of the data can be obtained, and research questions can be answered. This method helps identify key concepts, discover patterns, and understand relationships between them. Below, the thematic network along with its description is provided. Fig. 1 represents the thematic network of components for enriching the web-based technology learning environment.

The figure below presents the research conceptual model. This model indicates that in a web-based learning environment, five key elements—Learner, Instructor, Physical Environment, Electronic Tools, and Learning Process—interact with components such as Data Analysis and Learning Intelligence, Interactivity and Participation, Educational Strategies, Content Management, Inclusivity

and Flexibility, and Standardization to shape learning quality. As follows: The learner is the central axis, and their behavioral and progress data lead to personalized learning. The instructor plays a facilitating role, using data to provide appropriate feedback and employs diverse strategies such as adaptive learning or flipped classroom. The physical environment should be multi-platform, accessible (based on standards like WCAG), and compatible with diverse learner needs. Electronic tools (such as LMSs) collect data, manage content, and facilitate interaction, and their compatibility with technical standards (such as LTI and xAPI) is crucial. The learning process is dynamic, personalized, and flexible, strengthened through active participation, self-directed learning, and modern methods. Consequently, the success of a web-based learning environment requires simultaneous coordination and attention to all these elements and components.

Does the web-based technology-enriched learning environment model at Fars National Skill University possess the necessary validity?

To describe the main variables of the research, indicators such as mean, standard deviation, and others were used. These indicators are presented in the Table 7.

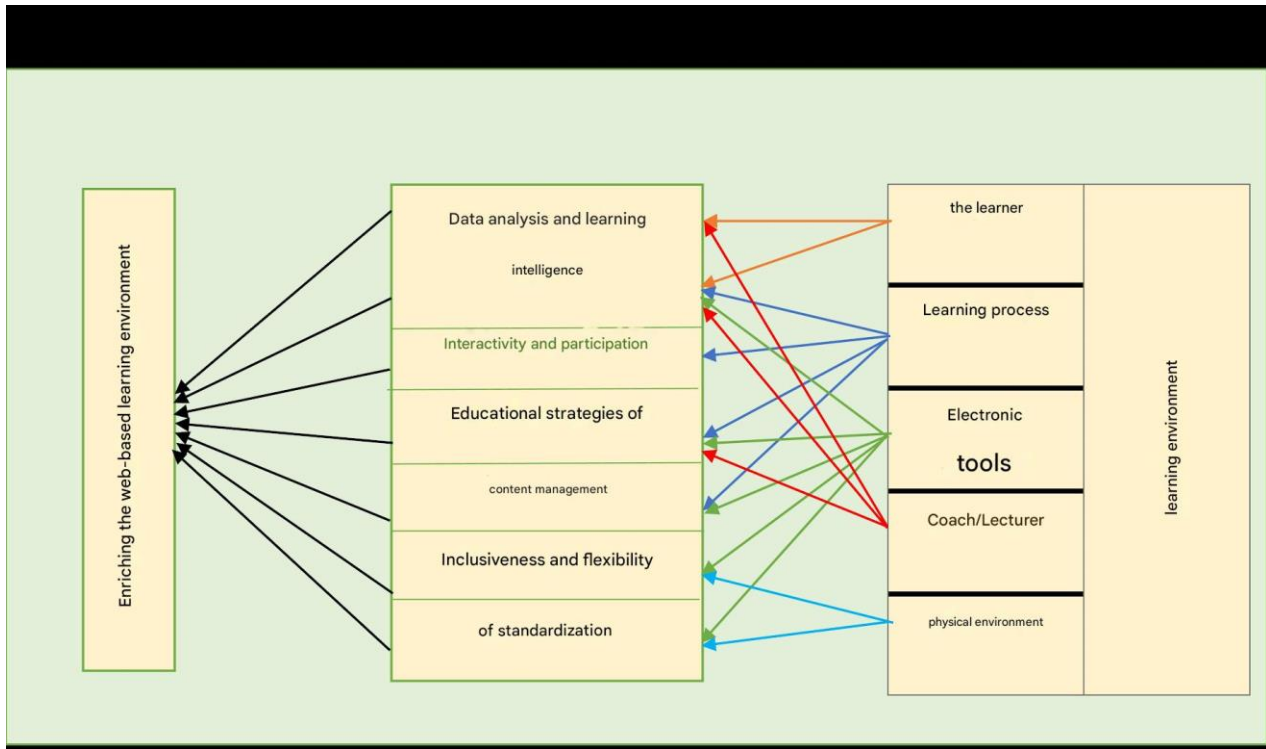


Figure 2. the web-based technology-enriched learning environment model

Calculation of Sample Adequacy Index

To examine sample adequacy and the suitability of data for factor analysis, the KMO and Bartlett's tests were performed for each main variable. According to the Table 8, all KMO values are above 0.7, indicating adequate data suitability for factor analysis. Also, the chi-square value of Bartlett's test was significant in all cases (Sig < 0.05), and the null hypothesis is rejected. Therefore, the correlation matrix between items is suitable for factor analysis.

Partial Least Squares Technique and Testing Research Hypotheses

In the present research, structural equation modeling methods, namely the Partial Least Squares (PLS) method, were used to test the measurement model and research hypotheses. To evaluate and examine the validity and

reliability of measurement model constructs in partial least squares structural equation modeling, Cronbach's alpha, composite reliability (CR), convergent validity (AVE), and divergent validity (Fornell-Larcker) were calculated and presented. The following Table 9 presents data related to each.

Construct Validity

To examine the discriminant validity of the research model constructs, the Fornell-Larcker criterion was used. Based on this, the square root of AVE for each construct should be greater than its correlation coefficients with other constructs. The Table 11 results show that this condition is met for all constructs, and thus it can be said: Discriminant validity between measurement models constructs is confirmed. This finding indicates that each construct measures a concept distinct from other constructs, and there is no conceptual overlap.

Table 8. SPSS Output for KMO for All Investigated Variables

Main Factor	Number of Items	KMO Coefficient	Bartlett's Statistic (Chi-Square)	Degrees of Freedom (df)	Significance Level (Sig)	Result
Inclusivity and Flexibility	4	0.723	123.181	6	0.000	Significant
Educational Strategies	6	0.765	198.447	15	0.000	Significant
Content Management	4	0.701	115.520	6	0.000	Significant
Standardization	4	0.754	130.933	6	0.000	Significant
Interactivity and Participation	4	0.770	139.180	6	0.000	Significant
Data Analysis and Learning Intelligence	4	0.736	127.663	6	0.000	Significant
Supportive and Technical Infrastructure	4	0.747	132.340	6	0.000	Significant

Table 9. Partial Least Squares External Model (Measurement Model)

Main Variable	Outer Loading	t-Statistic (t-value)	Significance Level (p-value)
Inclusivity and Flexibility	0.78	10.35	0.000
Educational Strategies	0.84	15.62	0.000
Content Management	0.76	9.41	0.000
Standardization	0.81	13.27	0.000
Interactivity and Participation	0.79	11.48	0.000
Supportive Infrastructure	0.82	14.03	0.000
Data Analysis and Learning Intelligence	0.86	16.87	0.000

Table 10. Convergent Validity and Reliability of Research Variables

Variable	Cronbach's Alpha	AVE	CR	Rho
Inclusivity and Flexibility	0.78	0.85	0.58	0.78
Educational Strategies	0.91	0.93	0.66	0.91
Content Management	0.87	0.90	0.60	0.87
Standardization	0.83	0.88	0.55	0.83
Interactivity and Participation	0.85	0.89	0.57	0.85
Supportive Infrastructure	0.88	0.91	0.63	0.88
Data Analysis and Learning Intelligence	0.89	0.92	0.64	0.89

Table 11. Fornell-Larcker Method Table

Variables	Inclusivity and Flexibility	Educational Strategies	Content Management	Standardization	Interactivity and Participation	Supportive Infrastructure	Data Analysis and Learning Intelligence
Inclusivity and Flexibility	0.76	0.52	0.48	0.50	0.45	0.47	0.43
Educational Strategies	0.52	0.81	0.60	0.55	0.58	0.54	0.57
Content Management	0.48	0.60	0.77	0.51	0.49	0.50	0.53
Standardization	0.50	0.55	0.51	0.74	0.44	0.47	0.45
Interactivity and Participation	0.45	0.58	0.49	0.44	0.75	0.52	0.50
Supportive Infrastructure	0.47	0.54	0.50	0.47	0.52	0.79	0.55
Data Analysis and Learning Intelligence	0.43	0.57	0.53	0.45	0.50	0.55	0.80

For a more precise examination of divergent validity, the Heterotrait-Monotrait Ratio (HTMT) was used. If the HTMT value between any two constructs is less than 0.90, it can be concluded that divergent validity is established. Based on the HTMT table, all values are reported below 0.90; therefore, divergent validity among research constructs is confirmed, and each construct has been able to measure a concept distinct from other constructs. After ensuring measurement models through reliability, convergent validity, and divergent validity tests, results from the structural model can be presented. In the structural part of the model, unlike measurement models, questions and manifest variables of the model are not considered, and only latent variables and relationships between them are examined.

To examine model fit, structural model fit indices including the R² criterion, effect size measure F², and the Q² criterion are used. Obtained values for R² are as follows:

Based on Chin's (1998) suggested categorization, these values fall between moderate to relatively strong levels; therefore, it can be concluded that the research structural model has an acceptable fit, and independent variables have been able to appropriately explain changes in dependent variables. Specifically, the value of 0.723 for Educational Strategies indicates that about 72.3% of the changes in this construct are explained by the model's independent variables, showing a desirable level of fit. Overall Model Fit (GOF Criterion).

This criterion pertains to the overall part of structural

equation models. Meaning that through this criterion, the researcher can, after examining the fit of the measurement part and the structural part, also control the fit of the overall part of their research.

$$GOF=0.621*0.655=0.637 \quad GOF=0.621*0.655=0.637$$

In this model, the GOF value ≈ 0.637 indicates a very good fit of the overall model.

As observed, all endogenous variables of the model have R^2 values above 0.59, indicating appropriate predictive power and acceptable validity of the structural model.

Table 12. HTMT Method Results for Examining Divergent Validity

Variables	Inclusivity and Flexibility	Educational Strategies	Content Management	Standardization	Interactivity and Participation	Supportive Infrastructure	Data Analysis and Learning Intelligence
Inclusivity and Flexibility	--	0.67	0.59	0.62	0.60	0.58	0.55
Educational Strategies	0.67	--	0.74	0.70	0.69	0.72	0.71
Content Management	0.59	0.74	--	0.65	0.61	0.63	0.68
Standardization	0.62	0.70	0.65	--	0.60	0.62	0.59
Interactivity and Participation	0.60	0.69	0.61	0.60	--	0.66	0.64
Supportive Infrastructure	0.58	0.72	0.63	0.62	0.66	--	0.67
Data Analysis and Learning Intelligence	0.55	0.71	0.68	0.59	0.64	0.67	--

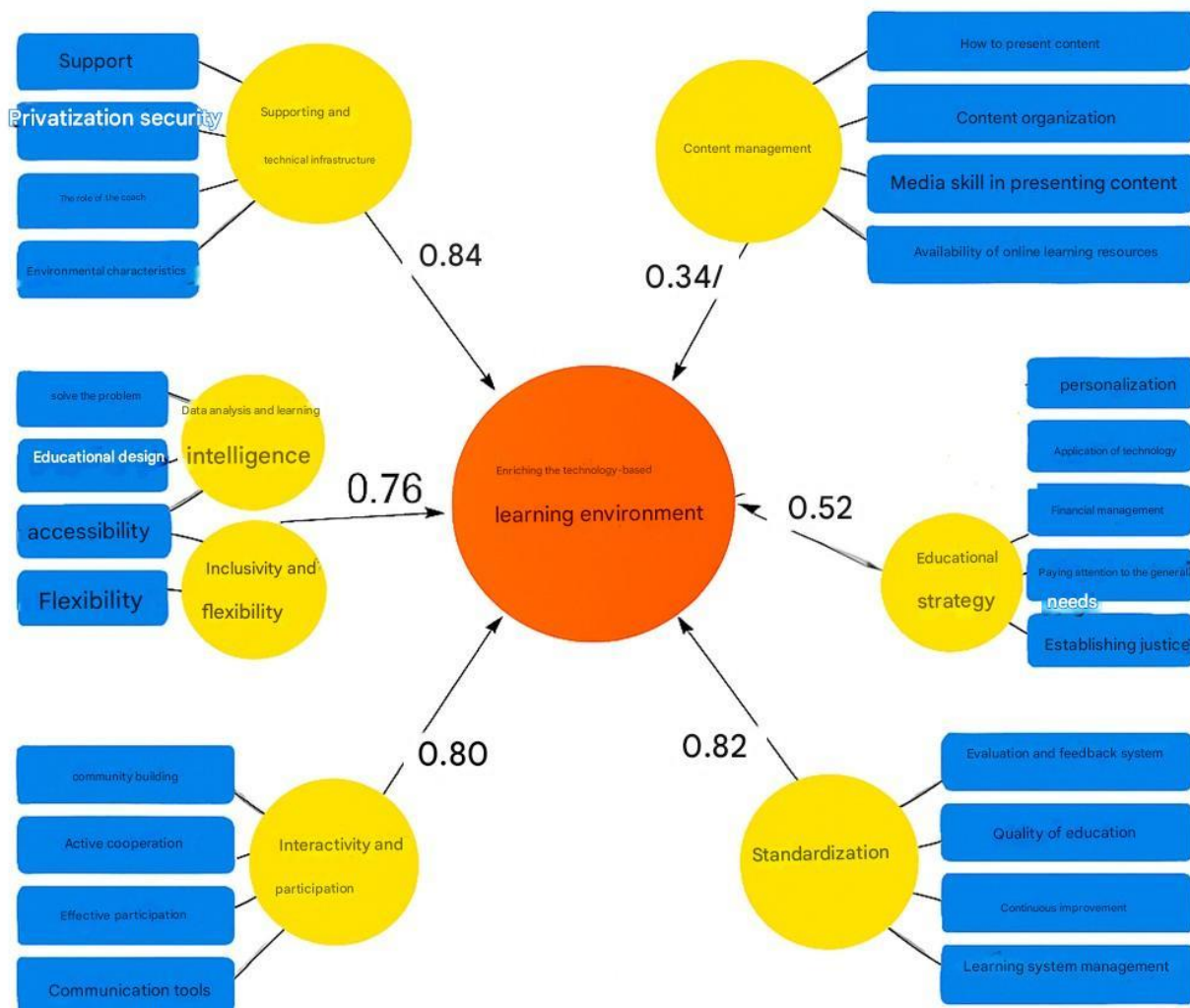


Figure 3. measurement model constructs in partial least squares structural equation modeling

Table 13. Results of HTMT Method for Examining Divergent Validity

Interpretation of Explanatory Power	R ²	Endogenous (Dependent) Variable
Strong	0.723	Educational Strategies
Strong	0.681	Content Management
Moderate to Strong	0.625	Standardization
Moderate	0.591	Interactivity and Participation
Strong	0.643	Supportive Infrastructure
Strong	0.667	Data Analysis and Learning Intelligence

Table 14. Effect Size Measure (Cohen's Index)

Effect Size Interpretation	R ²	F ²	Endogenous (Dependent) Variable
Very Large	0.723	2.61	Educational Strategies
Very Large	0.681	2.14	Content Management
Large	0.625	1.67	Standardization
Large	0.591	1.45	Interactivity and Participation
Large	0.643	1.80	Supportive Infrastructure
Very Large	0.667	1.99	Data Analysis and Learning Intelligence

5. Discussion

This research employed a mixed-methods (qualitative-quantitative) approach to design and validate a web-based technology-enriched learning environment model at Fars National Skill University. In the qualitative part, through semi-structured interviews with 22 experts and faculty members and using thematic analysis, key components for enriching the learning environment were identified and the conceptual model was formed. In the quantitative part, data from 103 faculty members and experts (stratified random sampling) were analyzed using structural equation modeling to evaluate relationships between variables and model fit.

Effective content management in web-based learning environments is a key factor in the success of e-learning. Online learning resources, by providing 24/7 access, easy updating, and flexibility, form the foundational pillars of these environments. Internationally, Open Educational Resources (OER) have contributed to equitable access to knowledge, and in Iran, initiatives such as the "Virtual University" have taken steps in this direction. However, the vast volume of information in cyberspace has made media literacy essential; because learners must be able to evaluate resources for credibility and accuracy. Studies show that Iranian students' media literacy is still at an average level and requires structured training. Also, the method of content delivery directly impacts motivation and learning quality; the use of multimedia methods (such as interactive videos and animations) and information visualization makes learning more effective. Additionally, logical organization of content (based on models such as Gagné and Merrill) using tools like concept maps contributes to more meaningful and deeper learning. Consequently, content management should be carried out with a comprehensive, interactive, and standard-oriented approach that considers both local needs and aligns with international criteria.

With the expansion of web-based learning environments, learning analytics and learning intelligence have become key tools for optimizing education. This approach, by extracting and analyzing data from learner interactions in digital space, helps identify learning patterns, predict performance, and make intelligent educational decisions. Systematic instructional design frameworks (such as Gagné's model) provide a basis for collecting meaningful data; without it, data would be disorganized and aimless. Activities such as problem-solving also produce rich data about reasoning, learning styles, and common errors, enabling personalized learning. Also, educational modeling using simulations and mathematical methods predicts learner behavior under different conditions and optimizes educational programs. This process is made possible through digital tools such as Learning Management Systems (LMS), artificial intelligence, and data analysis platforms. Alongside this, constructive learning—which emphasizes activity, collaboration, and reflection—produces valuable conceptual and interactive data. The integration of these components (instructional design, data analysis, modeling, technological tools, and active learning) provides the infrastructure for an intelligent, dynamic, and responsive learning system. Therefore, enriching web-based learning environments requires the integrated incorporation of these elements within a framework that ensures learning quality, user satisfaction, and achievement of educational goals. This research aligns, at the domestic level, with studies of [Moradi Margani \(2025\)](#).

Supportive and technical infrastructure is one of the fundamental pillars for enriching web-based learning environments and includes five key components: a) Security and Privacy: Protecting learners' personal and academic data through encryption and access control is essential. Studies show that LMSs in Iran often lack necessary security standards, and users feel insecure.

b) **Role of the Instructor:** In virtual space, the instructor is more than a knowledge transmitter; they are a facilitator, advisor, and manager of interactions. Their active presence increases motivation and learning quality, but many Iranian instructors, due to insufficient training, have not been able to perform this role well.

c) **Multidimensional Support:** Technical, educational, and managerial support systems reduce learning barriers and increase user satisfaction. In Iran, most universities lack integrated support systems, leading to increased student anxiety.

d) **Environmental Characteristics (User Experience):** User-friendly interface, accessibility, attractive design, and logical content structure contribute to motivation and learning quality. However, many Iranian educational systems still use outdated and non-user-friendly designs.

e) **Financial Management:** Financial planning, cost control, and use of sustainable models such as Open Educational Resources are essential for the long-term survival of learning environments. In Iran, unsustainable financial models are one of the main challenges in developing these environments. In summary, although attention to these components is growing in Iran, there is a significant gap with international standards in the areas of security, user interface design, instructor training, and financial sustainability. Therefore, it is necessary to consider these components comprehensively in the design and evaluation of web-based learning environments and apply global standards to them.

Inclusivity and accessibility are fundamental pillars in designing web-based learning environments, ensuring that all learners, regardless of cultural, linguistic, physical or mental ability, or socio-economic background, can effectively benefit from these environments. Five key components in this domain are: Diversity, which refers to the environment's ability to respond to individual and group differences including learning styles, language, and culture. Neglecting this diversity in Iran has led to reduced participation of regional and cultural groups. Flexibility, meaning the possibility of adapting time, content, methods, and assessment to diverse learner needs, which facilitates personalized and continuous learning. Accessibility, meaning full access for individuals with disabilities to the learning environment, in accordance with international standards such as WCAG. Studies show that only about 17% of online courses in Iran adhere to these standards. Relevance, meaning alignment of content with real life, career goals, and the learner's cultural context. Lack of content relevance to real needs reduces student motivation and engagement. Technological Authenticity, which refers to the use of applicable, up-to-date technologies aligned with learning goals, not merely as display tools. Many Iranian educational systems still use outdated and inefficient technologies. While attention to these principles is

growing in Iran, there is a significant gap with global standards in the areas of comprehensive design, accessibility, and content adaptation. Therefore, it is necessary to systematically consider these components in the design, development, and evaluation of web-based learning environments and utilize international frameworks such as Universal Design for Learning (UDL) and WCAG standards to make learning possible and effective for all without exception. This research aligns, at the domestic level, with studies by studies by [Toofaninejad et al. \(2018\)](#).

Web-based learning in the digital age requires an interactive and participatory environment that goes beyond content access, providing opportunities for effective collaboration and communication between learners and instructors. Four key components in this area are: a) **Effective Participation:** Active engagement of learners in discussions, activities, and educational decision-making, leading to increased motivation, deeper learning, and enhanced problem-solving skills. In Iran, this participation is often limited to answering test questions, and real opportunities for participation are not provided. b) **Community Building:** Creating meaningful connections and a sense of belonging in the virtual learning environment. Research indicates that in Iranian environments, feelings of loneliness and lack of meaningful connections are prevalent. c) **Communication Tools:** Use of diverse tools (text, audio, visual, social) to facilitate interaction and reduce feelings of isolation. In Iranian educational systems, the diversity of these tools is low, leading to reduced interaction and increased student anxiety. d) **Active Collaboration:** Group participation in learning activities that enhance social and academic skills. In Iran, these activities are very limited, and learning is mostly individual. International studies consider these four components as quality criteria in designing virtual learning environments, but in Iran, there are still significant gaps in standardization, technology development, and instructor training. Therefore, it is necessary to apply international standards in the design and evaluation of web-based learning environments in Iran.

In the digital age, standardizing web-based learning environments is essential to ensure educational quality, continuous improvement, effective assessment, and provision of appropriate feedback. This standardization relies on four main components. First: **Educational Quality**, which includes accurate, interactive, accessible content aligned with learning objectives. International standards such as ISO/IEC 23894 and [UNESCO's perspective \(2016\)](#) emphasize inclusion and equality in access. Second: **Continuous Improvement**, a cyclical process based on models like PDCA (Plan-Do-Check-Act) that requires regular evaluation and data-based modifications.

In the digital age, educational strategies in web-based learning environments must be intelligently, dynamically, and appropriately designed to meet diverse learner needs. Five key components—Application of Technology, Educational Equity, Personalizing Learning Experience, Active Learning, and Learning System Management—have been identified as the main pillars of these strategies. Application of Technology means the intelligent utilization of digital tools such as Learning Management Systems (LMS), artificial intelligence, learning data, and educational social networks, which can increase quality, flexibility, and interaction. However, domestic studies show that many Iranian universities still use outdated technologies, and instructors are unfamiliar with modern tools. Educational Equity also requires providing equal learning opportunities for all individuals, regardless of gender, age, geographical location, or physical abilities—an achievement that in Iran, due to lack of appropriate accessibility for vulnerable groups, has not yet been fully realized. Personalizing Learning Experience, which includes adjusting content and activities based on individual learning styles, knowledge levels, and interests, can significantly increase motivation and educational satisfaction, but in most Iranian educational systems, this approach is implemented at a very low level. Active Learning, based on learner participation in activities such as projects, group discussions, and problem-solving, plays a key role in developing deep learning and social skills, but in Iranian virtual environments, passive and one-sided approaches predominantly prevail. Finally, Learning System Management—including planning, monitoring, evaluating, and continuous improvement of educational systems—is essential to ensure the quality and sustainability of online courses, but many Iranian universities lack specialized management structures for this purpose. Comparative analysis shows that while developed countries employ these components as quality standards in their educational strategies, in Iran there are still significant gaps in the areas of standardization, technology development, and instructor training. Hence, applying international standards in the design, implementation, and evaluation of web-based learning environments in Iran's educational system is an unavoidable necessity.

Given the significant role of technology in educational transformation, the success of web-based learning requires simultaneous and coordinated attention to a comprehensive set of key elements that, together, create an effective, sustainable, interactive, and inclusive experience. These elements are summarized in five main domains: First, Educational Strategies, which are based on five components: intelligent application of technology, educational equity, personalizing learning experience, active learning, and learning system management, providing the groundwork for deep learning tailored to

individual needs and based on participation. Second, Interactivity and Participation, which, relying on effective participation, community building, appropriate communication tools, and active collaboration, strengthen learners' sense of belonging, motivation, and responsibility. Third, Standardization, which, through ensuring educational quality, continuous improvement based on systematic cycles (such as PDCA), formative assessment, and effective feedback, establishes the qualitative foundations of learning. Fourth, Content Management, which, by utilizing purposeful instructional design, learning analytics, modeling educational processes, using digital tools, and promoting constructive learning, provides the groundwork for forming intelligent and flexible learning systems. And fifth, Learning Environment Design Principles, including diversity, flexibility, accessibility, relevance, and technological authenticity, ensuring that the educational environment is not merely a space for content transmission but transforms into a human-centered, technological, and ethical ecosystem that engages all individuals in the learning process and supports their right to equitable access to education. Despite recent advancements in Iran's educational system, including the expansion of virtual universities and increased access to technology, significant gaps remain in the areas of standardization, instructor training, media literacy, learning analytics, and development of high-quality educational resources. To address these challenges, it is essential to adopt a coherent approach based on international standards and simultaneously aligned with local conditions in the design, development, and evaluation of web-based learning environments—an approach that not only enhances learning quality but also ensures equitable access, learner satisfaction, and the long-term sustainability of the digital educational system.

Practical Recommendations

1. Develop and utilize Open Educational Resources (OER) at the national level through creating and distributing high-quality, free, and accessible educational content to the public. This not only reduces educational costs but also enables equitable access to learning for deprived groups, individuals with disabilities, and residents of underprivileged areas. This requires governmental support, university collaboration, and standardization of resources based on international principles.

2. Use advanced Learning Management Systems equipped with Learning Analytics and Artificial Intelligence. Implementing LMSs that can track learner behavior, provide immediate and personalized feedback, and use data to optimize content and educational activities can significantly enhance learning quality. These systems also enable more accurate assessment and evidence-based decision-making.

3. Provide intensive and continuous training for instructors and instructional designers in the areas of interactive content design, accessibility standards (WCAG), data analysis, and active learning principles. Without empowering instructors and designers, technological advancement alone cannot have the desired impact. Holding practical, need-based, and continuous in-service courses can bridge the gap between technology and teaching methods and establish a culture of effective digital education in universities.

4. Increase interaction and participation through interactive tools, learning communities, and gamification methods. Using tools such as Kahoot, Padlet, discussion forums, live sessions, and motivational systems based on points, badges, and challenges not only reduces feelings of isolation but also increases motivation, interaction, and deep learning. Creating sustainable "virtual learning communities" can also help form a collective identity and social support among learners.

Authors' Contribution

All the authors have participated sufficiently in the intellectual content, conception and design of this work or the analysis and interpretation of the data (when applicable), as well as the writing of the manuscript.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Conflict of interests

The author states that there is no conflict of interest.

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