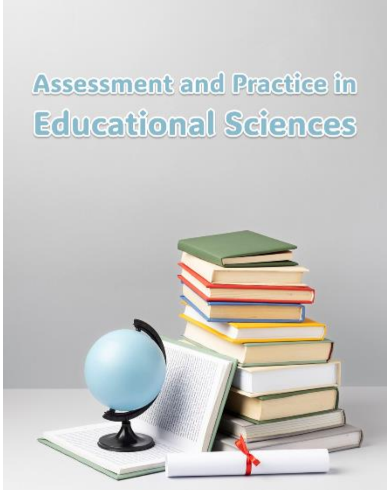
Assessment and Practice in Educational Sciences



Designing a Model of Blended Learning at Alborz University of Medical Sciences Based on a Mixed Approach

ABSTRACT

The present study was conducted with the aim of providing a model of blended learning for Alborz University of Medical Sciences. The research method, in terms of objectives, is applied; in terms of data collection, it is exploratory mixed-method (qualitative–quantitative); and in terms of nature and type of study, it is grounded theory of the emergent type in the qualitative dimension and cross-sectional survey in the quantitative dimension. The statistical population in the qualitative section included experts in "medical education" and "educational technology." In the quantitative section, it included 340 faculty members of Alborz University of Medical Sciences (160 men and 180 women). The sampling method in the qualitative phase was purposive sampling of the snowball type, which reached theoretical saturation with 15 experts. In the quantitative phase, the sample size was determined using the Morgan sampling formula, resulting in 181 participants (96 women and 85 men). In the present study, after open and axial coding, the measurement tool was developed in the form of a structured form and sent to experts for selective coding and validation. Based on this process, a researcher-made questionnaire was designed and distributed among the selected statistical sample. Finally, the collected data were analyzed using descriptive and inferential statistics. The results showed that the blended learning model for Alborz University of Medical Sciences consists of six dimensions in order of priority: educational agents, structure, management, implementation method, information and communication technology, and frameworks. These dimensions are composed of 15 components and 111 indicators. The identified dimensions, within a coherent structure, support the constructs of the model under the concept of the blended learning model of Alborz University of Medical Sciences.

Keywords: blended learning, educational agents, structure, management, implementation method, information and communication technology, frameworks

1. Marzieh. Seyedabadi: PhD Student, Department of Educational Management, Kish Branch, Islamic Azad University, Kish, Iran.
2. Parinaz. Benisi*: Associate Professor, Department of Educational Management, West Tehran Branch, Islamic Azad University, Tehran, Iran. (Email: Parenazbanisi2017@gmail.com)
3. Abbas. Khorshidi: Full Professor, Department of Educational Management, Islamshahr Branch, Islamic Azad University, Tehran, Iran.

Article type:
Original Research

Article history:
Received 06 January 2025
Revised 10 March 2025
Accepted 16 March 2025
Published online 20 March 2025

How to cite this article:
Seyedabadi, M., Benisi, P., & Khorshidi, A. (2025). Designing a Model of Blended Learning at Alborz University of Medical Sciences Based on a Mixed Approach. *Assessment and Practice in Educational Sciences*, *3*(1), 1-17. https://doi.org/10.61838/japes.3.1.6

Introduction

In the last two decades, the growing intersection of digital technologies and pedagogical innovations has transformed the landscape of higher education, leading to the rapid emergence and institutionalization of blended learning models. Blended learning, broadly understood as the strategic integration of face-to-face instruction with online learning modalities, is increasingly recognized as a sustainable and adaptive solution for addressing the evolving needs of learners, educators, and institutions alike (1, 2). This paradigm represents more than a simple combination of teaching modalities; rather, it embodies a deliberate effort to create synergistic learning environments that maximize the strengths of both traditional and digital methods (3, 4).

The global discourse on blended learning has been shaped by theoretical, empirical, and applied contributions across diverse contexts. Systematic reviews have identified blended learning as a cornerstone of modern education, with evidence suggesting its capacity to enhance student engagement, learning outcomes, and retention when properly designed and implemented (1, 4). More specifically, blended models are understood as frameworks that foster constructivist learning opportunities, where learners are empowered to co-construct knowledge through both guided instruction and autonomous exploration (5). This emphasis on learner-centeredness reflects a broader transformation in higher education, whereby technological advances are no longer supplementary but integral to educational strategies (6, 7).

From an institutional perspective, the implementation of blended learning requires multidimensional preparedness, including technological infrastructure, organizational culture, and faculty competencies. Scholars emphasize that the successful adoption of blended models is contingent upon teacher readiness, pedagogical innovation, and the availability of supportive learning analytics (5, 8, 9). Indeed, teacher attributes such as adaptability, digital literacy, and reflective practice have been cited as critical enablers of effective blended instruction (8). Equally important is the institutional commitment to leadership, policy frameworks, and strategic vision that align blended learning with broader educational objectives (10, 11).

In the Iranian context, the movement toward blended learning reflects both global educational trends and specific national imperatives. The necessity of integrating digital tools into higher education has been reinforced by challenges such as resource constraints, increased student enrollment, and the demand for flexible and equitable access to education (12, 13). Iranian scholars and practitioners have explored the conceptualization and operationalization of blended learning within universities, identifying opportunities for innovation as well as structural barriers that require policy-level interventions (14, 15).

Recent studies have highlighted the pedagogical benefits of blended learning in Iran. For example, research on nursing education demonstrated its effectiveness in improving learning processes, student satisfaction, and professional competencies (16). Similarly, investigations into associate degree programs in medical sciences reported positive impacts on student performance and learning outcomes (17). At a systemic level, however, the transition has been hindered by issues such as insufficient technological infrastructure, lack of faculty training, and the absence of standardized frameworks (10, 18). These findings underscore the need for context-specific models that can guide universities in effectively implementing blended learning strategies while addressing localized challenges (19).

Beyond Iran, the global literature has increasingly converged on the idea that blended learning is not a temporary adaptation but a durable feature of contemporary education systems. International initiatives, such as UNESCO's framework for capacity-building in blended learning, provide higher education institutions with tools for self-assessment and strategic planning (7). These global frameworks highlight the importance of institutional readiness, technological investment, and faculty development as prerequisites for sustainable blended learning ecosystems (6, 20).

Furthermore, comparative research across diverse cultural and disciplinary contexts illustrates how blended learning can be tailored to meet different needs. For instance, the integration of MOOCs into blended courses has been shown to expand accessibility while enriching pedagogical strategies (6). Similarly, frameworks for mathematics education have demonstrated how blended approaches can enhance teacher competence and subject-specific learning outcomes (9). Meanwhile, studies on personalized learning emphasize the role of learner profiling and adaptive technologies in optimizing instructional design (21). Such findings reinforce the idea that blended learning is a highly adaptable model, capable of being contextualized in alignment with local needs and global trends.

The pedagogical foundations of blended learning are grounded in constructivism, social learning theories, and cognitive approaches to knowledge acquisition. Blended environments promote active learning by encouraging learners to engage in both synchronous and asynchronous interactions, thereby supporting deeper understanding and critical thinking (1, 11). Theories of self-regulation and self-directed learning further suggest that blended models can cultivate learner autonomy, responsibility, and lifelong learning skills (18, 22). Importantly, the blended model is not a "one-size-fits-all" solution but rather a flexible approach that must be adapted to pedagogical objectives, learner characteristics, and disciplinary requirements (3, 4).

Scholars also emphasize the cognitive and motivational dimensions of blended learning. By leveraging digital platforms, students are afforded greater control over the pace and style of their learning, which has been linked to increased motivation and satisfaction (20, 21). Simultaneously, the integration of face-to-face interaction fosters social presence, collaboration, and community building—critical aspects for sustaining learner engagement (2, 19). Thus, the strength of blended learning lies in its ability to balance flexibility with structure, autonomy with guidance, and technology with human interaction (8, 14).

Despite its promise, blended learning presents multiple challenges. These include issues of equity, as unequal access to digital infrastructure can exacerbate educational disparities (10, 18). Moreover, faculty resistance to technological integration, stemming from inadequate training or perceived increases in workload, has been identified as a barrier to successful implementation (12, 13). Institutional challenges such as limited budgets, policy misalignment, and the absence of robust evaluation frameworks also complicate adoption (7, 15).

At the same time, opportunities for advancing blended learning are abundant. Emerging research points to the potential of learning analytics and personalized teaching strategies to enhance educational effectiveness (5, 21). Moreover, experiences from the COVID-19 pandemic have accelerated both the demand for and the normalization of blended approaches, reinforcing the argument that higher education must embrace flexibility and innovation as core principles (2, 20). When effectively implemented, blended learning can not only improve academic outcomes but also equip students with critical digital skills required in the knowledge economy (6, 9).

Given the significant theoretical and practical contributions in the literature, there remains a pressing need to design context-sensitive models of blended learning that account for cultural, institutional, and disciplinary specificities. For Iranian higher education in particular, the gap lies in translating global insights into locally relevant frameworks that can address systemic constraints while capitalizing on the benefits of blended instruction (15, 19). This study aims to contribute to this ongoing discourse by designing and validating a comprehensive blended learning model for Alborz University of Medical Sciences, informed by both international best practices and local needs.

By synthesizing evidence from global research (1, 4, 6, 7, 9) with findings from the Iranian educational system (14-17, 19), this study addresses the dual challenge of theoretical innovation and practical application. In doing so, it advances a framework that highlights the roles of educational agents, structural mechanisms, managerial commitments, implementation methods, technological capacities, and institutional frameworks as critical dimensions for the success of blended learning models.

Methods and Materials

The present research method, in terms of purpose, is applied; in terms of data, it is exploratory mixed-method (qualitative and quantitative); and in terms of nature and type of study, it is grounded theory of the emergent type in the qualitative dimension and cross-sectional survey in the quantitative dimension.

The statistical population of the present research consisted of two sections.

A- Qualitative section: experts in the field of educational management.

B- Quantitative section: all faculty members of Alborz University of Medical Sciences, totaling 340 individuals (180 women and 160 men).

In the qualitative section, 15 individuals were selected as the sample using purposive sampling, and theoretical saturation was reached with these 15 experts. In the quantitative section, the sample size was determined using the Morgan sample size determination table, resulting in 181 participants (85 men and 96 women).

Measurement Tools

In the qualitative section: the measurement tool was a semi-structured interview form, obtained through open, axial, and selective coding.

In the quantitative section: after achieving theoretical saturation with experts regarding the qualitative interview form, the mentioned form was transformed into a questionnaire by attaching the identified indicators and was administered to the sample group that had been selected randomly.

The validity and reliability of the measurement tool were conducted in two parts:

A- Qualitative section: the validity and reliability of the tool in this section were achieved through triple consensus (data consensus, researcher consensus, and consensus of theories and methodologies).

B- Quantitative section: in this section, reliability was calculated using Cronbach's alpha, and its overall value was 0.98.

Data Collection Methods

Qualitative section: included the following steps:

1- The researcher initially studied several theories, patterns, models, and research findings, both national and international.

2- The indicators obtained in step 1 were extracted through open coding.

3- The extracted indicators were then categorized using axial coding into dimensions, components, and indicators.

4- At this stage, the categorized indicators were organized into a semi-structured interview form, presented to experts, and followed by brainstorming. This process continued until theoretical saturation was achieved.

5- The final dimensions, components, and indicators were prioritized, illustrated in the form of a model, and validated by experts.

Quantitative section: included the following steps:

1- The saturated interview form regarding the experts was developed by weighting the indicators.

2- The questionnaire was administered to the sample group selected randomly.

3- The participants' responses were manually calculated and then analyzed using LISREL software with confirmatory factor analysis.

4- In this way, first the components and indicators were measured.

5- Then, the qualitative and quantitative phases were compared.

Data Analysis Methods

A- Qualitative section: the data were analyzed through open, axial, and selective coding (interviews and brainstorming with experts).

B- Quantitative section: included the following three methods:

1- Data description: in this part, conventional descriptive statistical methods such as drawing descriptive tables, calculating statistical characteristics, and preparing charts were used.

2- Data analysis: in this part, confirmatory factor analysis tests were employed.

Findings and Results

In the qualitative phase of the study, a total of 181 participants were included. Regarding gender distribution, 85 participants (47.22%) were male and 96 participants (52.78%) were female. In terms of work experience, 75 participants (41.67%) had between 1 to 10 years of experience, 89 participants (49.17%) had between 11 to 20 years, and 20 participants (11.05%) had more than 21 years of professional experience. Concerning academic rank, 73 participants (40.55%) were assistant professors, 103 participants (56.67%) were associate professors, and 5 participants (2.78%) were full professors.

In this study, descriptive statistical methods (mean, skewness, and kurtosis) were used.

Table 1. Descriptive indices of research factors

Factors	Mean	Skewness	Kurtosis
Empowerment of instructors	5.19	-1.541	3.039
Empowerment of learners	5.14	-1.473	2.541
Resource provision	5.12	-0.814	2.014
Rules and regulations	4.08	-1.341	2.307
Support	5.40	-0.142	3.135
Management commitment	5.36	-1.150	2.29
Leadership	5.35	-1.512	1.089
Planning	5.35	-1.35	1.770
Implementation	5.03	-1.150	1.019
Evaluation	4.99	-1.344	2.22
Standardization	4.90	-1.232	2.20
Technological infrastructure	5.33	-1.132	1.99
Technological environment	5.21	-1.232	2.22
Development	5.04	-1.233	3.330
Excellence	5.11	-1.30	3.03

According to Table 1, the highest mean value among the dimensions belongs to the factor of support (M = 5.40), while the lowest mean belongs to the factor of rules and regulations (M = 4.08). Furthermore, the distribution of scores for all factors shows negative skewness. In other words, the sum of squared deviations of the scores from the mean is negative, meaning that most individuals' scores in these scales are above the mean. The skewness of the factor empowerment of instructors (-1.45) is the highest, while the skewness of the factor support (-0.14) is the lowest. The distribution of scores for all dimensions and factors also shows positive kurtosis, indicating that most individuals' scores in these scales are close to the mean. Therefore, based on the results, the distribution of the studied sample is normal, and it can be stated that the sample is fully representative of the target population.

Table 2. Results of Kolmogorov-Smirnov test

Significance level	Degree of freedom	K-S
0.907	179	6.40

The results of Table 2 show that the significance level obtained for the blended learning variable (0.907) is greater than 0.05, and the value of K-S is 6.40. Therefore, the distribution of data for the blended learning variable is normal. Hence, the conditions for using parametric tests for data analysis are satisfied.

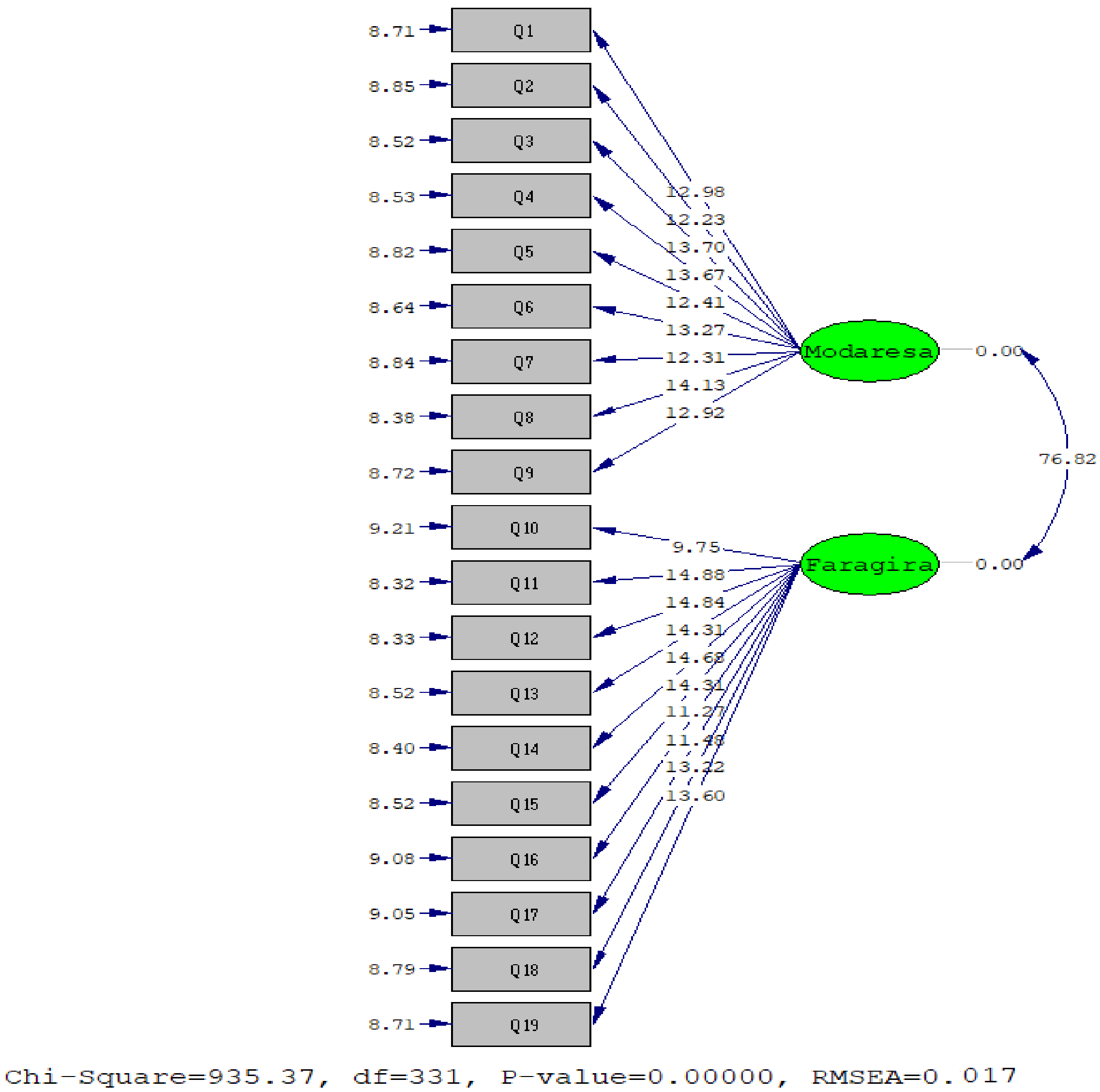


Figure 1. Significant values (t-values) of the educational agents dimension

Figure (1) illustrates the significance of the coefficients between the observed and latent variables. Since significance is tested at the 0.05 level, if the obtained t-values fall outside the ±1.96 range, the relationship is significant. The results indicate that the t-values for all relationships are significant. In summary:

- The factor loading and significance coefficient of the path from empowerment of instructors to the educational agents dimension are ($\lambda = 0.91$, $t = 9.28$).
- The factor loading and significance coefficient of the path from empowerment of learners to the educational agents dimension are ($\lambda = 0.90$, $t = 9.53$).

Regarding the model fit indices, the following results were obtained. After removing covariance errors, the model fit indices confirmed that the model had a good fit. The chi-square to degrees of freedom ratio was 2.83, which is less than 3. The root mean square error of approximation (RMSEA) was 0.017, which is less than 0.08. Other fit indices, such as the Goodness of Fit Index (GFI = 0.91) and the Adjusted Goodness of Fit Index (AGFI = 0.90), confirmed the educational agents dimension. Other fit indices were also greater than 0.90.

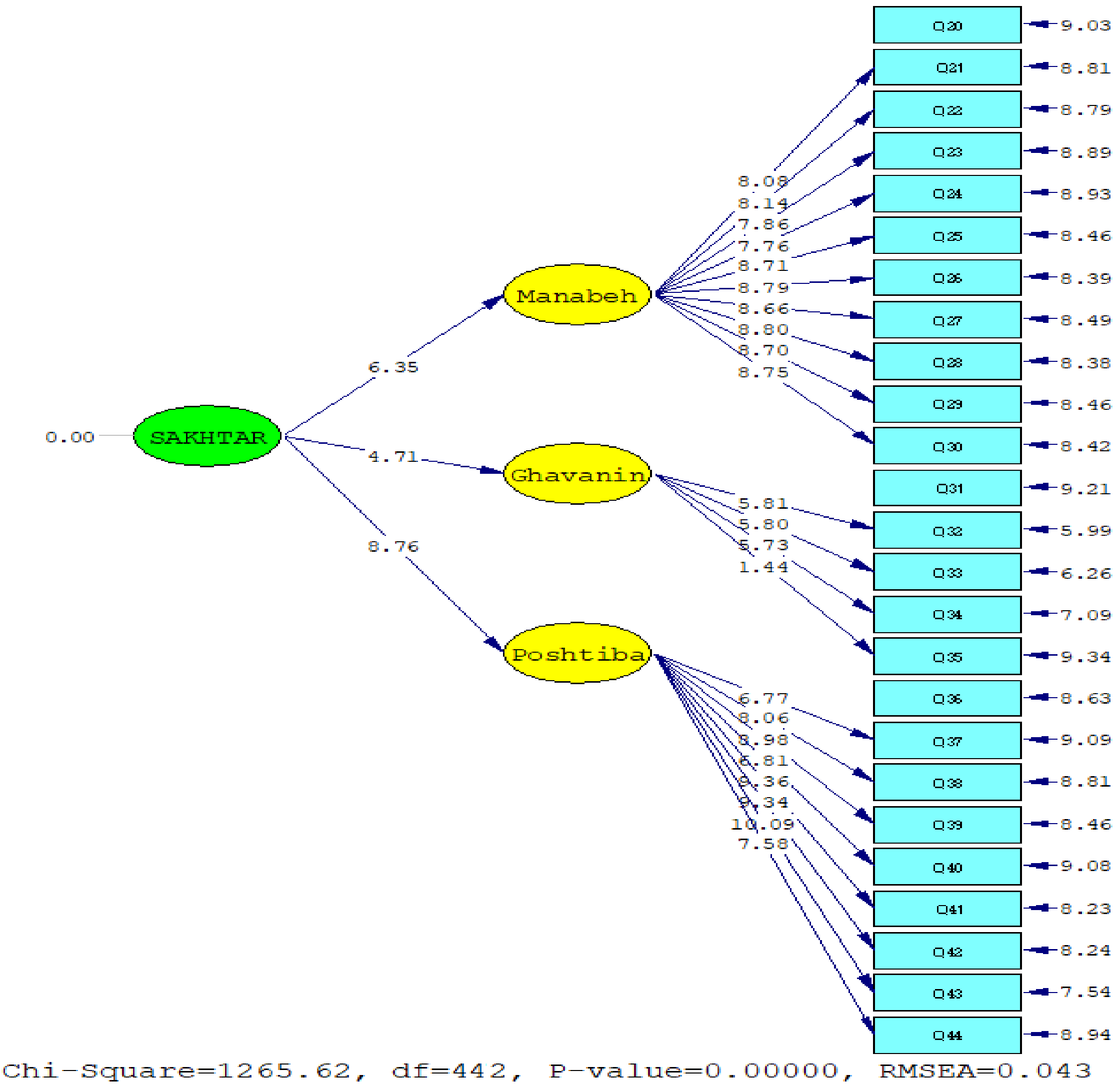


Figure 2. Significant values (t-values) of the structure dimension

Figure (2) illustrates the significance of the coefficients between the observed and latent variables. Since significance is tested at the 0.05 level, if the obtained t-values fall outside the ±1.96 range, the relationship is significant. The results show that t-values for all relationships are significant, except for indicator number 35, which yielded 1.44. In summary:

- The factor loading and significance coefficient of the path from resource provision to the structure dimension are ($\lambda = 0.74$, $t = 6.35$).
- The factor loading and significance coefficient of the path from rules and regulations to the structure dimension are ($\lambda = 0.71$, $t = 4.71$).
- The factor loading and significance coefficient of the path from support to the structure dimension are ($\lambda = 0.87$, $t = 8.76$).

Regarding the model fit indices, the following results were obtained. After removing covariance errors, the model fit indices confirmed that the model had a good fit. The chi-square to degrees of freedom ratio was 2.86, which is less than 3. The RMSEA was 0.043, which is less than 0.08. Other fit indices, such as the GFI (0.91) and the AGFI (0.90), confirmed the structure dimension. Other fit indices were also greater than 0.90.

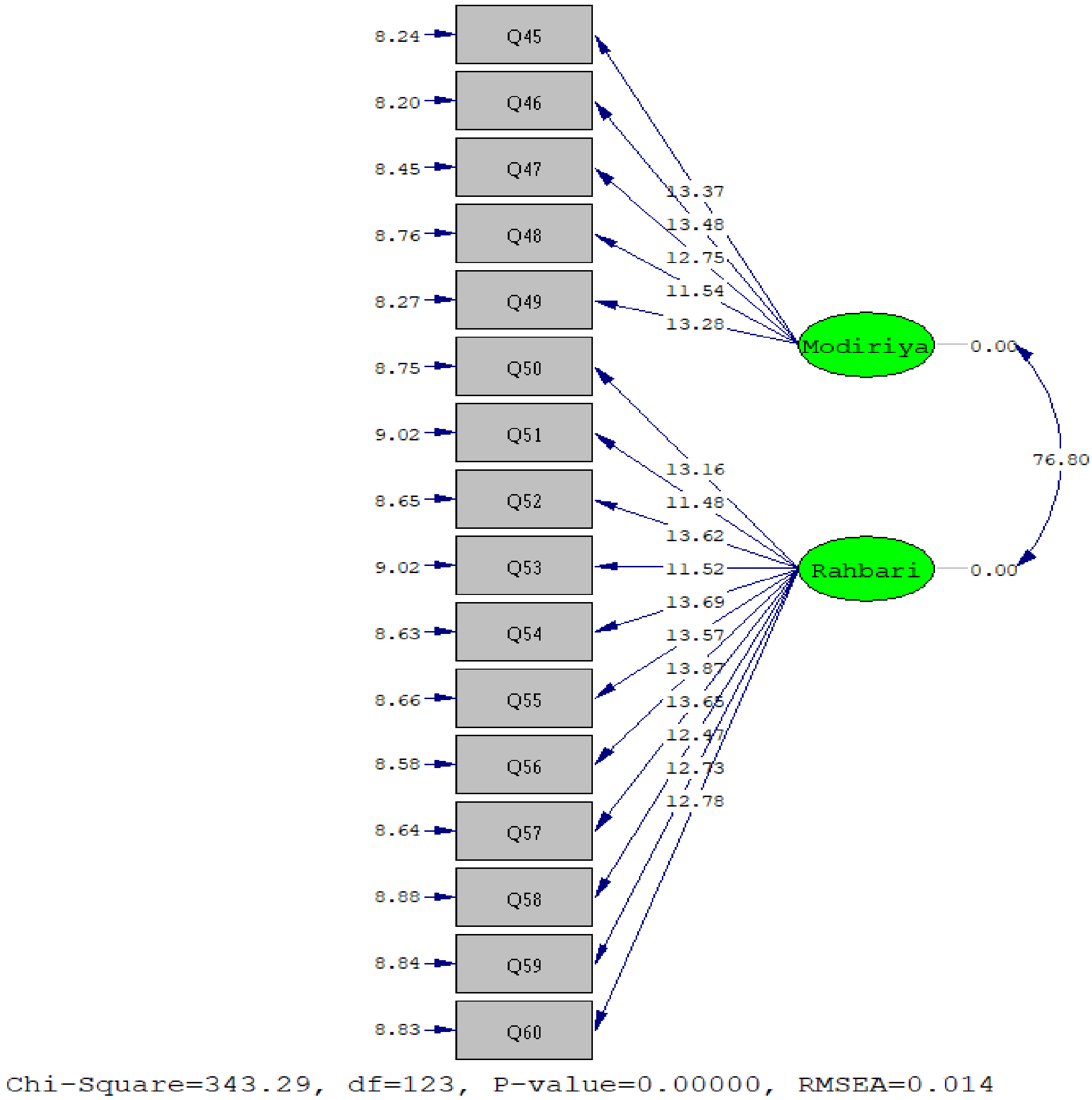


Figure 3. Significant values (t-values) of the management dimension

Figure (3) shows the significance of the coefficients between the observed and latent variables. Since significance was tested at the 0.05 level, if the obtained t-values fall outside the ±1.96 range, the relationship is significant. In summary, it can be stated:

- The factor loading and significance coefficient of the path from management commitment to the management dimension are ($\lambda = 0.90$, $t = 9.15$).
- The factor loading and significance coefficient of the path from leadership to the management dimension are ($\lambda = 0.90$, $t = 9.12$).

Regarding the model fit indices, the following results were obtained. After removing covariance errors, the evaluation of fit indices indicated that the model had a good fit. The chi-square to degrees of freedom ratio was 2.86, which is less than 3. The root mean square error of approximation (RMSEA) was 0.043, which is less than 0.08. Other fit indices, such as the Goodness of Fit Index (GFI = 0.92) and the Adjusted Goodness of Fit Index (AGFI = 0.90), confirmed the management dimension. Other fit indices were also greater than 0.90.

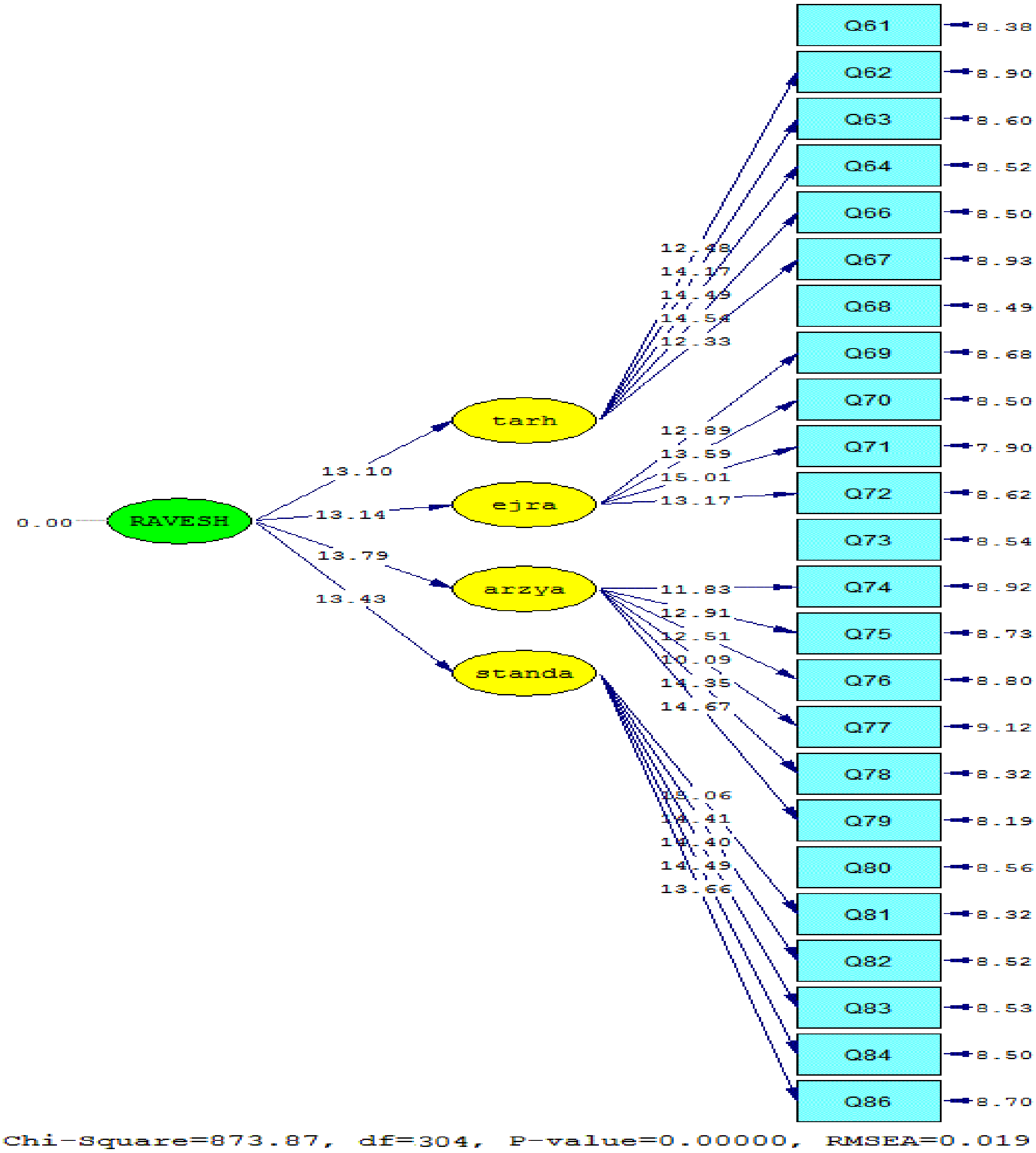


Figure 4. Significant values (t-values) of the implementation method dimension

Figure (4) shows the significance of the coefficients between the observed and latent variables. Since significance was tested at the 0.05 level, if the obtained t-values fall outside the ±1.96 range, the relationship is significant. The results show that the t-values for all relationships (except for indicators number 65 and 85, which had significance coefficients outside the ±1.96 range) are significant. In summary, it can be stated:

- The factor loading and significance coefficient of the path from planning to the implementation method dimension are (λ = 0.89, t = 13.10).

- The factor loading and significance coefficient of the path from execution to the implementation method dimension are (λ = 0.90, t = 13.14).
- The factor loading and significance coefficient of the path from evaluation to the implementation method dimension are (λ = 0.94, t = 13.79).
- The factor loading and significance coefficient of the path from standardization to the implementation method dimension are (λ = 0.91, t = 13.43).

Regarding the model fit indices, the following results were obtained. After removing covariance errors, the evaluation of fit indices indicated that the model had a good fit. The chi-square to degrees of freedom ratio was 2.87, which is less than 3. The RMSEA was 0.019, which is less than 0.08. Other fit indices, such as GFI (0.92) and AGFI (0.91), confirmed the implementation method dimension. Other fit indices were also greater than 0.90.

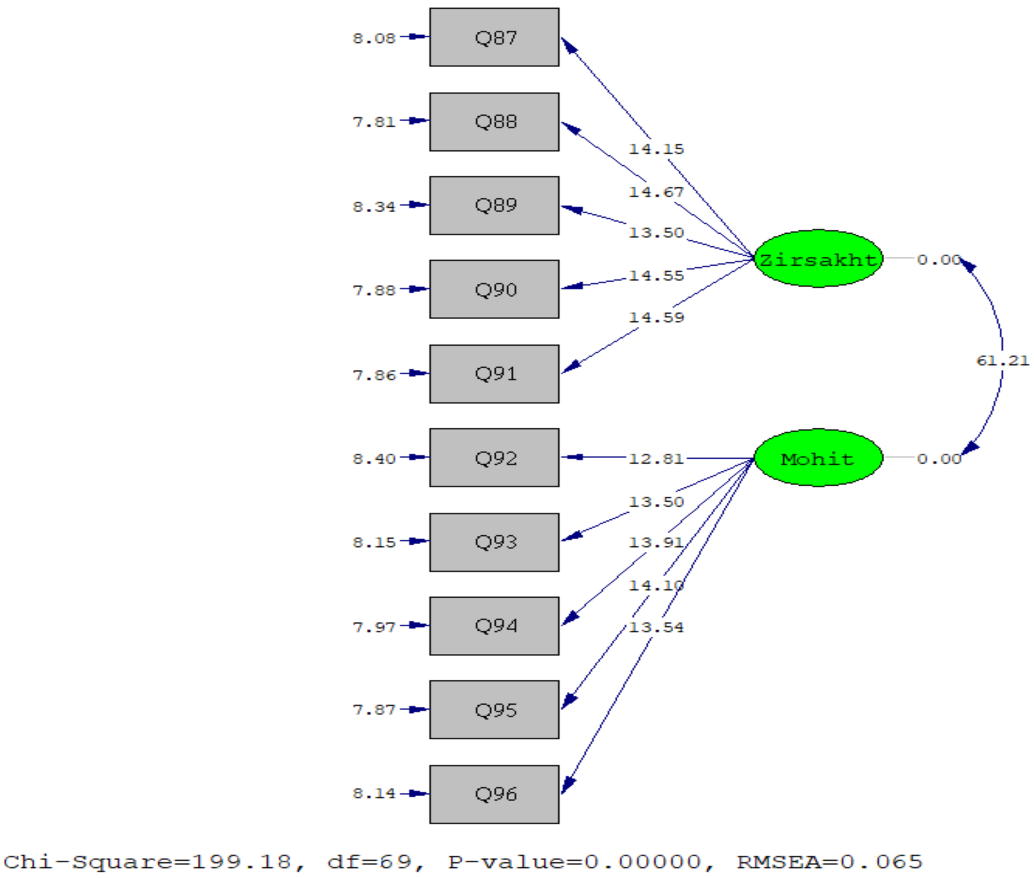


Figure 5. Significant values (t-values) of the ICT dimension

Figure (5) shows the significance of the coefficients between the observed and latent variables. Since significance was tested at the 0.05 level, if the obtained t-values fall outside the ±1.96 range, the relationship is significant. The results show that the t-values for all relationships are significant. In summary, it can be stated:

- The factor loading and significance coefficient of the path from technological infrastructure to the ICT dimension are (λ = 0.92, t = 9.24).
- The factor loading and significance coefficient of the path from technological environment to the ICT dimension are (λ = 0.90, t = 8.93).

Regarding the model fit indices, the following results were obtained. After removing covariance errors, the evaluation of fit indices indicated that the model had a good fit. The chi-square to degrees of freedom ratio was 2.89, which is less than 3. The RMSEA was 0.065, which is less than 0.08. Other fit indices, such as GFI (0.93) and AGFI (0.91), confirmed the ICT dimension. Other fit indices were also greater than 0.90.

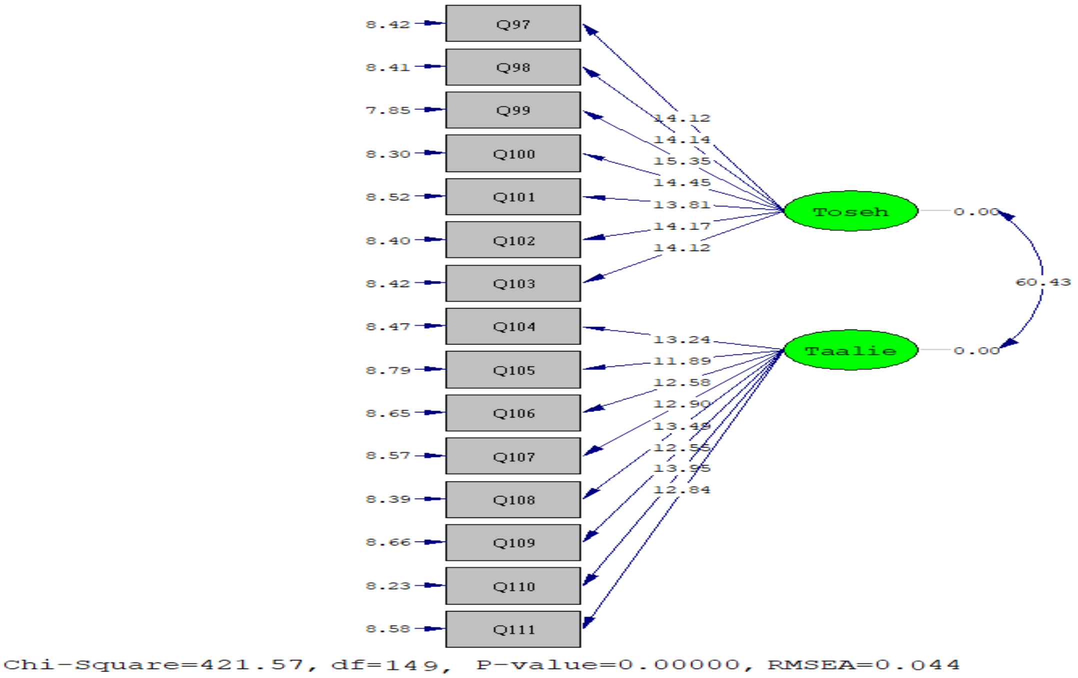


Figure 6. Significant values (t-values) of the frameworks dimension

Figure (6) shows the significance of the coefficients between the observed and latent variables. Since significance was tested at the 0.05 level, if the obtained t-values fall outside the ±1.96 range, the relationship is significant. The results show that the t-values for all relationships are significant. In summary, it can be stated:

- The factor loading and significance coefficient of the path from development to the frameworks dimension are (λ = 0.93, t = 11.88).
- The factor loading and significance coefficient of the path from excellence to the frameworks dimension are (λ = 0.92, t = 11.69).

Regarding the model fit indices, the following results were obtained. After removing covariance errors, the evaluation of fit indices indicated that the model had a good fit. The chi-square to degrees of freedom ratio was 2.83, which is less than 3. The RMSEA was 0.044, which is less than 0.08. Other fit indices, such as GFI (0.92) and AGFI (0.91), confirmed the frameworks dimension. Other fit indices were also greater than 0.90.

The generated indices of the structural equation modeling (SEM) are not limited only to the overall model fit indices. Rather, the standardized beta and gamma parameters (path coefficients) and their corresponding *t*-values for each of the causal paths from the exogenous variable (blended learning) to the endogenous variables of the dimensions of educational agents, structure, management, implementation method, information and communication technology, and frameworks (gamma coefficients) also exist and must be interpreted. The structural model shows how the latent variables are interrelated.

These coefficients and indices indicate the relative strength of each path. Below, the standardized coefficients and *t*-test values for path analysis are presented.

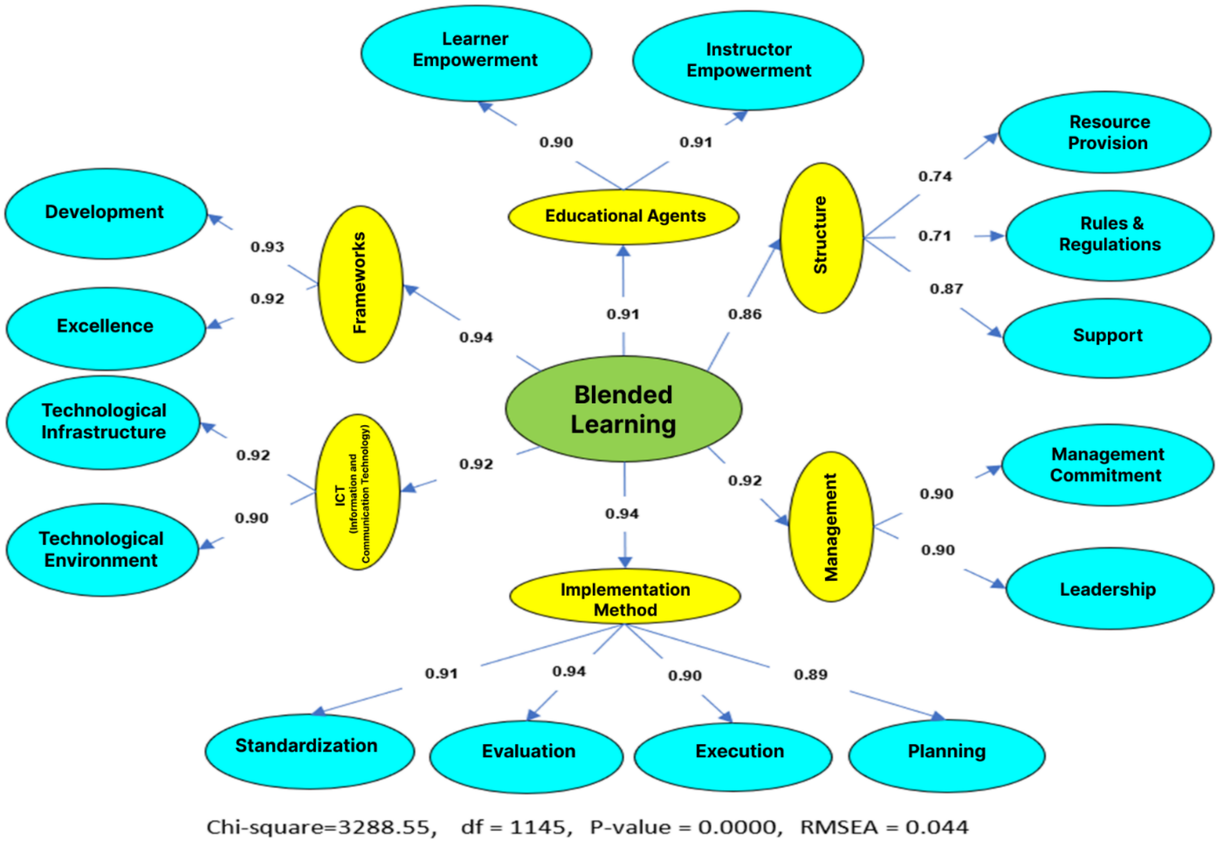


Figure 7. General model of the research (path analysis) in the state of standardized coefficients

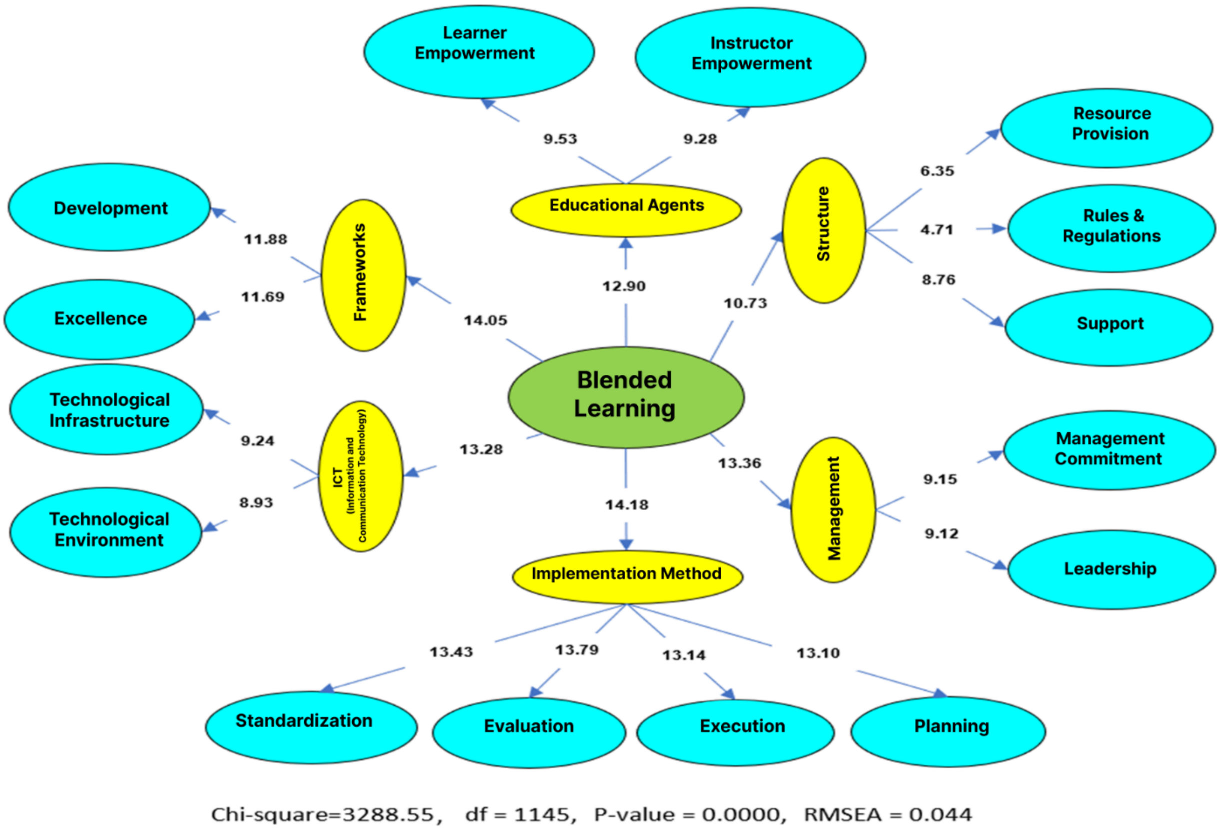


Figure 8. General model of the research (path analysis) in the state of significance coefficients (*t*-values)

To determine the level of model fit for the general research model, fit indices provided in LISREL software were used. These indices are presented in Table 3.

Table 3. Fit indices of the general research model

Index	Acceptable Range	Obtained Value
X^2	–	3278.55
Df	–	1145
X^2/df	Less than 3	2.86
RMSEA	Less than 0.08	0.044
CFI	Greater than 0.90	0.95
IFI	Greater than 0.90	0.94
RFI	Greater than 0.90	0.94
GFI	Greater than 0.90	0.93
AGFI	Greater than 0.90	0.91

Based on the results in Table 3, the chi-square to degrees of freedom ratio is 2.86. The root mean square error of approximation (RMSEA) is 0.044, which is considered an acceptable value for model fit. Other fit indices, such as the Goodness of Fit Index (GFI) and Adjusted Goodness of Fit Index (AGFI), along with other indices, also have values above 0.90, which are regarded as desirable indicators of model fit. As observed in Figures (7) and (8), based on the results of the modeling, it can be concluded that the model has a relatively good fit with the data.

Discussion and Conclusion

The findings of this study revealed that the blended learning model developed for Alborz University of Medical Sciences is structured around six major dimensions: educational agents, structure, management, implementation methods, information and communication technology (ICT), and frameworks. Each of these dimensions was supported by multiple components and indicators that collectively contribute to the successful implementation of blended learning. Confirmatory factor analysis demonstrated that the model had an acceptable fit, with indices such as RMSEA, CFI, and GFI exceeding the threshold for good fit. These results highlight that blended learning, when carefully designed and institutionally supported, can function as a comprehensive strategy for advancing higher education quality and student outcomes.

The dimension of educational agents, encompassing both instructors and learners, showed strong factor loadings, underscoring the critical role of human factors in blended learning success. Instructor empowerment was identified as a determinant factor, consistent with international research emphasizing that faculty readiness, adaptability, and digital pedagogy skills are foundational for blended environments (1, 8). Similarly, learner empowerment was found to be vital, aligning with findings that students who are given autonomy, flexibility, and access to digital resources report higher levels of engagement and motivation (20, 21). These findings confirm earlier work in the Iranian context, where research demonstrated that blended learning improved students' critical thinking, problem-solving abilities, and professional competencies, particularly in nursing and medical education (16, 17).

The results also confirmed that structural elements, including resource provision, rules and regulations, and support mechanisms, significantly influence blended learning implementation. This resonates with the study by (15), who identified structural readiness as a prerequisite for universities aiming to institutionalize blended learning models. Inadequate resources and the absence of coherent policy frameworks have repeatedly been highlighted as barriers to adoption (10, 12). Globally, similar concerns have been raised, as institutions without robust infrastructure and clearly defined policies struggle to sustain blended learning initiatives (4, 7). Thus, the structural dimension of this model provides essential guidance for universities seeking to build capacity in blended education.

The management dimension, reflected through leadership and management commitment, demonstrated a strong effect on model fitness. The importance of management commitment aligns with (6), who argued that institutional leadership is indispensable for integrating blended learning into strategic planning. The path coefficient for leadership was also significant, echoing (11) who stressed the role of cognitive and organizational leadership in sustaining blended learning environments. Local research in Iran similarly points to the necessity of managerial support, with (19) emphasizing that without visionary leadership, universities cannot effectively harness digital tools to transform pedagogy.

Another key outcome relates to the implementation method, which included planning, execution, evaluation, and standardization. Among these, evaluation and standardization showed the highest loadings, indicating their centrality in sustaining blended learning. This is consistent with (5), who demonstrated that learning analytics and evaluation mechanisms are critical for monitoring and improving blended learning outcomes. Standardization further ensures consistency across programs, supporting scalability and quality assurance (13). These results resonate with international experiences where continuous assessment and standardized frameworks were highlighted as prerequisites for institutionalizing blended learning (1, 3).

The dimension of information and communication technology (ICT) was strongly validated in this study, confirming that both technological infrastructure and technological environment are indispensable enablers of blended learning. Similar findings have been consistently reported across the literature. (7) emphasized that ICT readiness is a foundational requirement for blended education, while (9) showed that ICT-supported frameworks significantly enhanced mathematics teachers' competence. In Iran, insufficient ICT infrastructure has been reported as one of the main challenges to blended learning (10, 18). Thus, the validation of ICT as a central dimension of the present model highlights the urgency of strengthening digital infrastructure in Iranian higher education.

Finally, the frameworks dimension, which included development and excellence, confirmed the necessity of long-term institutional frameworks for sustaining blended learning. These results align with (20), who argued that effective blended education requires not only short-term strategies but also frameworks aimed at continuous improvement and excellence. The emphasis on development and excellence also resonates with (2), who suggested that blended learning must be conceptualized as part of broader institutional development rather than as isolated initiatives. In Iranian research, similar concerns have been raised, with scholars pointing out that without long-term frameworks, blended learning risks remaining fragmented and unsustainable (13, 14).

Overall, the findings confirm that blended learning is a multidimensional construct that requires simultaneous attention to human, structural, managerial, technological, and institutional factors. The strong fit of the proposed model suggests that it provides a comprehensive framework for guiding universities in adopting blended learning. These results are not only consistent with prior studies but also extend the literature by contextualizing blended learning within Iranian higher education, thereby addressing the unique cultural and infrastructural challenges of this context.

Despite its contributions, this study is subject to several limitations. First, the research was conducted in a single institution, namely Alborz University of Medical Sciences, which may limit the generalizability of the findings to other universities with different organizational cultures, resources, or disciplinary orientations. Second, while the mixed-methods approach allowed for a more comprehensive understanding of blended learning, the cross-sectional design of the quantitative phase restricts the ability to infer long-term causal relationships. Third, the reliance on self-reported measures may introduce biases such as social desirability or subjective interpretation of blended learning constructs. Additionally, the rapidly evolving nature of educational technologies means that models developed today may require frequent updates to remain relevant in light of technological advances. Finally, the qualitative phase relied on expert opinion, which, although valuable, may not fully capture the perspectives of students as the ultimate beneficiaries of blended learning.

Future research should address these limitations by conducting longitudinal studies to examine how blended learning models evolve over time and influence learning outcomes in the long run. Comparative studies across multiple institutions, disciplines, and cultural contexts could enhance the generalizability of the findings. Including student perspectives in future qualitative phases would provide a more holistic understanding of blended learning effectiveness, capturing both faculty and learner experiences. Future studies should also explore the integration of emerging technologies such as artificial intelligence, adaptive learning systems, and virtual reality into blended models. Moreover, future research could test the proposed model in non-medical universities and across different educational levels to assess its applicability and adaptability. Finally, further exploration of policy-level enablers and barriers could provide critical insights for aligning blended learning with national educational strategies.

The results of this study provide several implications for practice. University administrators should prioritize investments in ICT infrastructure and provide comprehensive training programs for faculty to enhance digital pedagogy competencies. Policymakers should design supportive frameworks and regulations that facilitate the sustainable adoption of blended learning across higher education institutions. Curriculum developers are encouraged to integrate continuous evaluation and standardization mechanisms to ensure consistency and scalability. Furthermore, institutional leaders should emphasize managerial commitment and visionary leadership to align blended learning initiatives with strategic educational goals. Lastly, a culture of innovation and excellence should be cultivated to ensure that blended learning not only addresses immediate instructional needs but also contributes to the long-term transformation of higher education.

Acknowledgments

We would like to express our appreciation and gratitude to all those who helped us carrying out this study.

Authors’ Contributions

Not applicable.

Declaration of Interest

The author of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

References

1. Anthony B, Kamaludin A, Romli A, Raffei AF, Phon DN, Abdullah A, et al. Blended learning adoption and implementation in higher education: A theoretical and systematic review. Technology, Knowledge and Learning. 2020. doi: 10.1007/s10758-020-09477-z.

2. Garrison R, Vaughan N. Blended Learning in Higher Education: Tehran: Avaye Noor Publications; 2022.

3. Sharpe R, Benfield G, Roberts G, Francis R. The undergraduate experience of blended e-learning: A review of UK literature and practice: The Higher Education Academy, U.S. Government Printing Office; 2022.

4. Bernard RM, Borokhovski E, Tamim RM. The state of research on distance, online, and blended learning: Meta-analyses and qualitative systematic reviews In - M. G. Moore & W. C. Diehl (Eds.), Handbook of Distance Education (4th ed., pp. 92-104). Routledge; 2019.

5. Bani Hashem SK, Badli M, Ali Abadi K, Pourrostaei Ardakani S. Developing an Integrated Model of Learning Design and Learning Analytics: A Constructivist Approach. Educational and School Studies. 2022;11(2):97-120.

6. Williams RT. An overview of MOOCs and blended learning: integrating MOOC technologies into traditional classes. IETE Journal of Education. 2024;65(2):84-91. doi: 10.1080/09747338.2024.2303040.

7. Lim CP, Wang T. A Framework and Self-assessment Tool for Building the Capacity of Higher Education Institutions for Blended Learning: UNESCO ISBN - 9789292235659; 2022.

8. Bruggeman B, Tondeur J, Struyven K, Pynoo B, Garone A, Vanslambrouck S. Experts speaking: Crucial teacher attributes for implementing blended learning in higher education. The Internet and Higher Education. 2021;48:100772. doi: 10.1016/j.iheduc.2020.100772.

9. Winarso W, Udin T. Implementing Blended Learning Within the TPMK Framework to Enhance Mathematics Teachers' Competence. Edelweiss Applied Science and Technology. 2024;8(4):2292-305. doi: 10.55214/25768484.v8i4.1599.

10. Khosravi Pour E, Khosravi Pour B, Musapour SK. The Necessity and Challenges of Implementing Blended Learning in Academic Environments. Civilica. 2022.

11. Talkhabi M. A Cognitive Approach to Blended Learning: Tehran: Mirat Publishing Institute for Learner Schools; 2020.

12. Enayati Novinfar A, Gholamali M, Seraji F. Presenting a Model for Implementing a Virtual Curriculum Based on Collaborative Learning in Higher Education. Educational Measurement and Evaluation Studies. 2018;8(23):117-52.

13. Sharafi S, Hassanzadeh T, Zohoor V. Designing and Developing a Curriculum Model with a Blended Learning Approach for Secondary Education. Dynamics in Educational Sciences and Counseling. 2020;6(13):91-118.

14. Mirzaei K, Esmaili A. Blended Learning: Hamedan: Sepehr Danesh Publications; 2021.

15. Ghafrani A, Naranji Sani F, Shahhosseini MA, Abili K, Pourkarimi J. Designing a Blended Teaching-Learning System Model for Universities: Explaining Dimensions and Components. Civilica. 2023.

16. Karimi H, Kalati SH, Amini S, Jamalzadeh N. The Impact of Blended Learning on Nursing Process Learning: An Educational Evaluation Study. Iranian Journal of Medical Education. 2021;21(84):533-6.

17. Nouri Khanqah Z, Sadati L, Faryab Asl M, Karami S, Fathollahi S, Haj Firoozabadi M. The Impact of Blended Learning on Educational Outcomes of Associate Degree Students in Operating Room Technology. Research in Medical Education. 2022;14(1):24-31. doi: 10.52547/rme.14.1.24.

18. Rahmanian M, Soleimani H. Revisiting Technology in Learning: Self-Control and Self-Regulation in a Blended Course. Linguistic Research in Foreign Languages. 2020;9(4):1085-104.

19. Ghorbani S, Pishinian Pordanjani M, Oloumi F, Piri F, editors. Investigating the Impact of Blended Learning in Iran's Education System. First International Conference on Education with an Approach to Smart Schools, Creative Teachers, and Thoughtful Students in the Horizon of 2025; 2024: Bushehr.

20. Rahmani EF, Riyanti D, Misieng J, Sayok AK. A Review on Synchronous, Asynchronous, and Blended Learning on ELT in Indonesian Context. Jeels (Journal of English Education and Linguistics Studies). 2024;11(1):223-60. doi: 10.30762/jeels.v11i1.2326.

21. Liu B. Research on Personalized Teaching Strategies Based on Learner Profiles in a Blended Learning Environment. International Journal of Information and Communication Technology Education. 2024;20(1):1-25. doi: 10.4018/ijicte.346823.

22. Mahmoudi M, Mohammadi R. The Role of Blended Learning in Learning Effectiveness. Journal of Psychology and Educational Sciences (Negareh Higher Education Institute). 2019;39:141-8.