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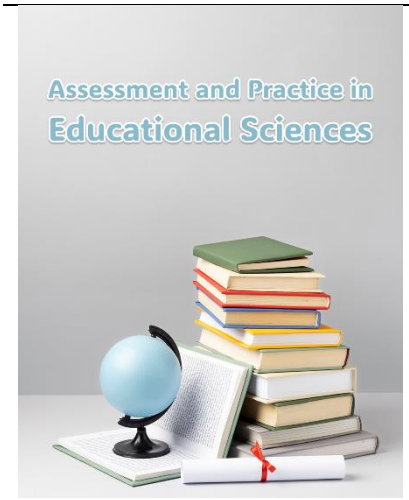

Design and Validation of an Educational Model for Allameh Tabataba'i University in the Context of the COVID-19 and Post-COVID-19 Era

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ABSTRACT

The present study aimed to design and validate an educational model for Allameh Tabataba'i University under the conditions of the COVID-19 and post-COVID-19 periods. The research employed a mixed-methods design. Using thematic analysis and grounded theory approaches, the study proposed two distinct educational models. The research population included full-time and adjunct faculty members, PhD students, and top-ranking students from the faculties of Allameh Tabataba'i University. The sample was selected through purposive sampling, and following the principle of theoretical saturation, a total of 13 interviews were conducted. The proposed models were validated using the fuzzy Delphi technique, and confirmation of the models was obtained from 10 subject-matter experts. The first model, based on the ADDIE instructional design framework, included five components: educational infrastructure and support, instructional and content design, evaluation and learning assessment, educational roles and interactions, and emerging technologies with artificial intelligence. The second model presented a sub-theory within the framework of grounded theory. In this model, the design of an effective educational model was identified as the central phenomenon influenced by causal conditions such as change-inducing factors, contextual conditions such as technological infrastructure, and intervening conditions such as university policy. Ultimately, strategies such as the development of infrastructure and flexible instructional design were proposed, leading to learner-centeredness and crisis preparedness as the resulting outcomes.

Keywords: Educational Model, COVID-19, Post-COVID-19, Allameh Tabataba'i University

Introduction

The COVID-19 pandemic triggered an unprecedented disruption in global education systems, prompting universities worldwide to transition rapidly from traditional classroom instruction to remote learning environments. This abrupt

transformation highlighted not only the opportunities inherent in digital education but also its profound structural, pedagogical, and psychological challenges (1). Higher education institutions were compelled to reimagine teaching and learning through technological platforms, reshaping academic delivery and organizational frameworks (2). In the process, new paradigms of instruction, assessment, and learner engagement emerged, laying the foundation for a redefined educational ecosystem in the post-pandemic era (3, 4).

At the onset of the pandemic, the abrupt closure of educational institutions across all levels forced more than 1.5 billion students to shift to virtual learning, which exposed the digital divide, inequalities in access, and varying levels of readiness among institutions and learners (5). The shift to online learning was not merely a logistical adjustment but a pedagogical one, demanding innovative instructional designs and rapid digital adaptation (6, 7). Research indicates that many universities struggled to maintain educational quality during this transition, primarily due to inadequate infrastructure, lack of faculty preparedness, and insufficient learner support mechanisms (8, 9). Nevertheless, this period also marked a critical turning point, driving institutions toward long-term digital transformation and hybrid models of education that blend physical and virtual modalities (10, 11).

The emergence of hybrid or blended learning models has since become a defining feature of post-pandemic higher education. Studies demonstrate that such models—combining synchronous and asynchronous instruction—enhance student engagement, flexibility, and inclusivity (12). The blended laboratory and e-learning instructional design (BLEND) model, for instance, emphasizes integrating hands-on activities with virtual simulations, enabling universities to balance experiential learning with technological scalability (12). Similarly, the conceptualization of online learning dexterity underscores the importance of adaptability, digital competence, and self-regulated learning in sustaining academic performance in hybrid environments (13).

From a sociocultural standpoint, the pandemic redefined the very notion of the academic community. The breakdown of physical proximity necessitated new digital communication paradigms to preserve social presence and academic identity (14). Social learning theories found renewed relevance as educators sought to replicate the dynamics of collaboration and peer interaction through virtual means (15). Despite such efforts, several studies reported that students experienced isolation, decreased motivation, and cognitive overload, suggesting that emotional engagement must complement technological innovation (16, 17).

Technological readiness emerged as one of the most significant determinants of successful remote learning. Universities equipped with advanced infrastructure and institutional learning management systems were better positioned to ensure continuity and quality in education (18). Conversely, institutions with limited digital capabilities faced systemic obstacles—ranging from unstable internet connectivity to insufficient technical support—that hindered equitable access to learning opportunities (19). In this context, the pandemic accelerated not only the adoption of e-learning technologies but also the recognition of digital competence as a core academic skill (20).

The transition to online and blended instruction revealed both the fragility and resilience of higher education systems. On one hand, the lack of preparedness led to learning losses, decreased student satisfaction, and compromised assessment integrity (21). On the other hand, universities that embraced flexible instructional design models, grounded in active learning and learner-centered pedagogy, reported improved engagement and academic continuity (3, 22). This duality reflects what scholars describe as the "pedagogical paradox" of COVID-19: a crisis that simultaneously exposed weaknesses and catalyzed innovation in educational practices (1).

The post-pandemic discourse in higher education has therefore focused on institutional resilience and the sustainability of hybrid models (2, 23). Research underscores that universities must now move beyond emergency remote teaching toward purposeful digital pedagogy—strategically integrating technology, pedagogy, and content (4). To achieve this, a shift from

reactive adaptation to proactive innovation is essential, encompassing curriculum redesign, faculty digital training, and data-driven quality assurance systems (5, 18). The digital transformation of education must thus be conceptualized as a long-term structural evolution rather than a temporary contingency.

The pandemic also prompted an epistemological rethinking of what constitutes "effective teaching." Traditionally, instructional quality in higher education was associated with physical presence, direct feedback, and classroom participation. However, in digital and blended environments, quality increasingly depends on interactive content, learner autonomy, and the effective use of artificial intelligence (AI) for personalized learning (24). AI-driven educational platforms have demonstrated potential in automating assessments, customizing feedback, and identifying learning gaps, thereby enhancing efficiency and inclusivity (20, 24). These developments suggest that future university models will be deeply intertwined with emerging technologies, transforming both pedagogical roles and institutional structures (12).

Nevertheless, the challenges remain substantial. The rapid digitalization of education introduced ethical, social, and psychological concerns. For instance, unequal access to technology exacerbated existing social inequities, while continuous screen exposure and cognitive fatigue affected mental well-being (16, 17). Furthermore, instructors faced significant stress in adapting to new digital teaching demands, which often required balancing technological proficiency with emotional labor and student support (15, 21). The pandemic thus foregrounded the necessity of holistic educational frameworks that integrate technological, psychological, and pedagogical dimensions (11).

In Iran and many other countries, the COVID-19 crisis exposed structural deficiencies in university governance and educational management. Studies on Iranian universities revealed gaps in managerial adaptability, digital readiness, and policy coherence during the pandemic (8, 25). While universities made significant progress in establishing virtual learning systems, they also faced limitations in infrastructure development, faculty empowerment, and quality assurance mechanisms (9, 26). The crisis, however, served as a catalyst for modernization—driving universities to invest in digital platforms, faculty training, and blended learning strategies that can sustain future disruptions (6, 7).

Empirical evidence indicates that post-pandemic higher education must emphasize flexibility, inclusivity, and learner-centeredness (3, 21). The integration of AI, data analytics, and adaptive technologies will play an essential role in designing curricula that respond to diverse learner needs (24). At the same time, educators must cultivate digital literacy, ethical awareness, and critical thinking among students to ensure responsible engagement with technology (20). Furthermore, the hybrid model must evolve beyond simple content delivery to foster active participation, reflective learning, and emotional engagement—dimensions that sustain educational quality in virtual contexts (4, 13).

Comparative studies across different educational systems suggest that universities capable of aligning digital transformation with pedagogical innovation are more likely to achieve sustainable learning outcomes (18, 23). The "mobility paradigm" in higher education, for example, emphasizes flexibility across space, time, and learning modes, enabling students to access education in diverse environments (18). Similarly, the concept of "online learning dexterity" reflects a multidimensional framework of adaptability that integrates technological, cognitive, and affective competencies (13). Together, these models reinforce the importance of institutional agility and learner empowerment in post-pandemic education.

Qualitative research in the early pandemic period also provided valuable methodological insights into how educational models can be designed and validated in crisis contexts. Grounded theory approaches, as applied in educational studies during COVID-19, offered systematic strategies for identifying the core phenomena and causal conditions underlying successful instructional models (22). The ADDIE model, in particular, has been widely adapted to address the evolving needs of digital and hybrid learning environments (12). By incorporating iterative cycles of analysis, design, development, implementation, and evaluation, the model facilitates continuous improvement and scalability of educational innovations (3, 12).

The global literature thus converges on a critical insight: higher education must not return to pre-pandemic normalcy but rather institutionalize the pedagogical and technological advancements realized during the crisis (2, 6). The post-COVID university is envisioned as a dynamic ecosystem—adaptive, technology-enhanced, and learner-centered—where resilience and innovation coalesce to sustain academic excellence (20, 24). By integrating digital infrastructure, flexible instructional design, and continuous assessment, universities can achieve not only crisis preparedness but also long-term educational transformation (3, 23).

The present study aims to design and validate an educational model for Allameh Tabataba'i University during and after the COVID-19 pandemic, providing a systematic framework to enhance instructional quality, flexibility, and resilience in higher education.

Methods and Materials

The present study employed a mixed-methods research design. Given that the study included multiple research questions, each requiring a distinct methodological approach, a multi-method strategy was adopted. The research method used for the first model was thematic analysis, whereas the second model was developed using grounded theory. The research population consisted of full-time and adjunct faculty members, PhD students, and top-performing students from various faculties of Allameh Tabataba'i University. The sample was selected through purposive sampling, and ultimately, following the principle of theoretical saturation, 13 interviews were conducted.

For data collection, multiple semi-structured interviews were conducted with participants. To ensure research ethics, all participants were informed about the main purpose of the study and the process of interview data usage. They were assured of the confidentiality of their information. Invitation and informed consent forms were also provided to all participants. Data analysis was conducted using Strauss and Corbin's (1990) coding method in three stages—open coding, axial coding, and selective coding—using MAXQDA version 2024 software. To establish the credibility (validation) of the research, two methods were employed: member checking and peer debriefing. In the member-checking process, extracted concepts from several interviews were returned to participants to ensure accurate interpretation and conceptualization of their statements. In the rare cases where discrepancies arose, necessary revisions were made. For peer debriefing, in addition to the main researchers, one external expert familiar with both the research subject and coding process served as an external auditor. This expert randomly reviewed portions of the coded data and engaged in several rounds of critical discussion with the primary researchers regarding the developed model and the emerging categories and themes.

For the second proposed model, which aimed to construct a sub-theory, the study was applied in purpose and qualitative in nature, following a grounded theory approach. Regarding data saturation, interviews continued until (a) no new or relevant data emerged for any category, (b) categories were sufficiently developed in terms of their properties and dimensions and demonstrated variability, and (c) relationships between categories were well established and validated. Data analysis followed the systematic design of grounded theory using Strauss and Corbin's (1990) three-step coding procedure—open, axial, and selective coding.

For model validation, the study employed a consensus-based fuzzy Delphi method. To validate the model, the opinions of experts in educational sciences were sought. In this phase, a questionnaire was designed according to the proposed model and sent via email to experts along with necessary explanations. Ultimately, 10 experts responded and returned their completed questionnaires via email. These individuals were independent of participants involved in other phases of the study. The selection criteria for experts included scholarly activity in the field of educational sciences and educational technology. In the distributed

questionnaire, categories and themes were rated on a 5-point Likert scale ranging from “very high” to “very low” to evaluate the degree of necessity of each category and theme within the proposed model from the experts’ perspective.

Findings and Results

In the findings section, two educational models were presented. The first model was based on the ADDIE framework, and the second model was developed through the grounded theory approach. Before presenting the educational models, the extracted categories and themes are summarized in Table 1.

Table 1. Extracted Categories and Themes from Interviews

Theme	Category
Artificial Intelligence and Emerging Technologies	Development of Digital Skills
	Integration of Artificial Intelligence into the Learning Process
Foundational Platforms and Requirements	Support and Empowerment
	Development and Strengthening of Technological Infrastructure
Instructional and Content Design	Flexibility and Personalization
	Active and Interactive Teaching Methods
	Necessity of Blended Learning
	Adherence to Design Principles
Evaluation and Assessment	Diversity in Assessment Methods
	Redefinition of Evaluation Principles
Roles and Interactions	Learner-Centered Approach
	Motivation and Sense of Belonging of the Learner
	Instructor’s Role as Facilitator and Guide

The results indicated that the suitable educational model for Allameh Tabataba'i University during the COVID-19 and post-COVID-19 periods consists of five main components.

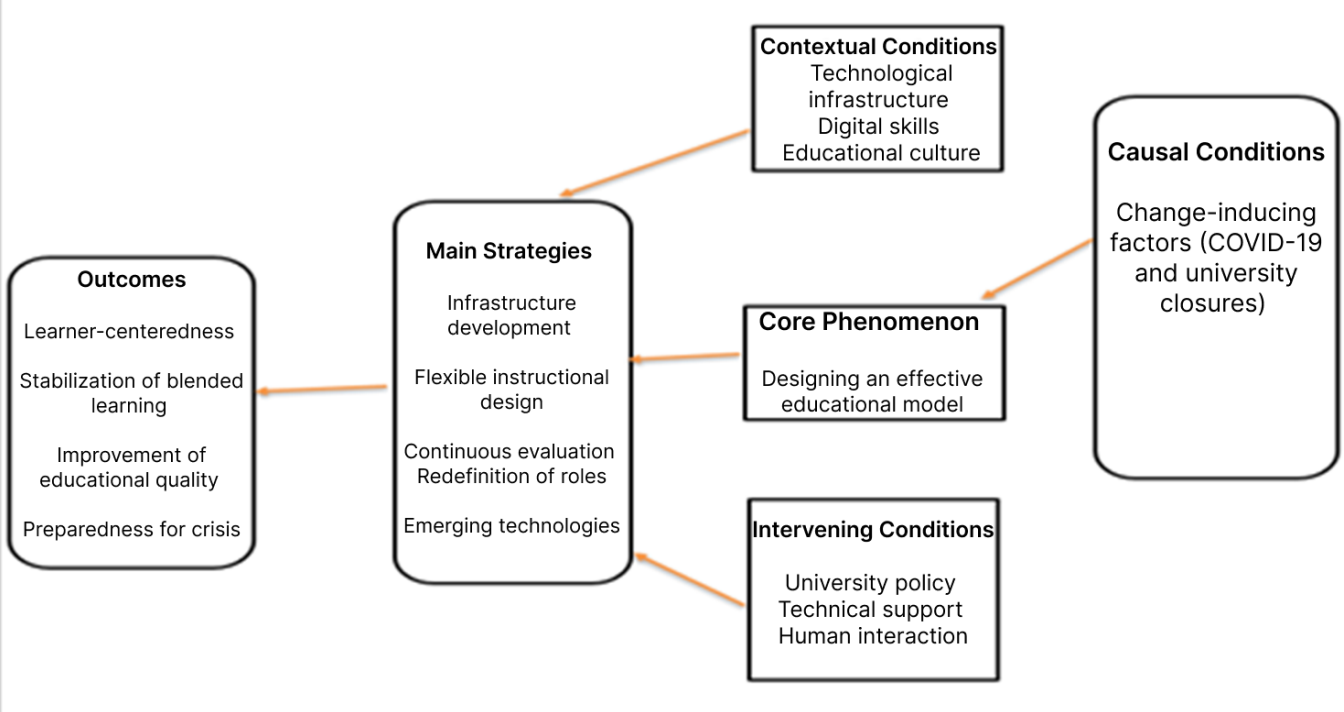

Figure 1. Components of the Educational Model for Higher Education in the Context of COVID-19 and Post-COVID-19

Data analysis revealed that technological infrastructure and educational and technical support represent the first and most fundamental prerequisites for the effective implementation of virtual and blended learning at the university. The findings

indicated that without strengthening university infrastructure, ensuring server stability, providing online support, and maintaining strong internet connectivity, the educational model would fail in practice. Therefore, infrastructure was identified as the foundational pillar of the educational model, encompassing two subthemes: *support and empowerment* and *development and strengthening of infrastructure*.

a) Support and Empowerment:

In the process of data analysis, one of the main themes extracted from participants' statements was the theme of support and empowerment. This concept refers to actions aimed at enhancing the agency and skills of students and instructors through educational, psychological, social, and even financial support, thereby creating conditions for greater growth and active participation. The related codes emerged from participants' experiences and perspectives on the role of institutional support and capacity-building in effectively addressing challenges.

Interviewee 10 stated:

"...Support for students should include technical and educational assistance: providing academic, technical, and psychological counseling to students, as well as solving infrastructural and technical challenges they face. These forms of support must be planned and implemented by the university..."

b) Development and Strengthening of Infrastructure:

Another key theme identified in the qualitative analysis was the *development and strengthening of infrastructure*. Infrastructure serves as the backbone of implementing any educational program or policy, playing a crucial role in the sustainability and success of activities. Participants emphasized the need to create or upgrade technical, educational, communicative, managerial, and logistical infrastructures that facilitate improved performance for both institutions and society. Extracted codes in this category indicated that without appropriate infrastructure, even the best educational programs would fail to achieve their intended outcomes.

Interviewee 12 noted:

"...After COVID-19, all professors and students were required to join the online platforms, and the frequent disconnections were due to the high traffic load. During that time, internet access was only available within the university network. When classes became virtual, students could no longer access the internet from home as before, so the university's server and bandwidth became critically important—but were not sufficiently available..."

The related codes also demonstrated that effective instructional design should be flexible, needs-based, learner-centered, implementable in both virtual and in-person modes, goal-oriented, contextually appropriate, aligned with adult learning principles, and supported by interactive content.

a) Flexibility and Personalization:

The theme of *flexibility and personalization* emerged from the analysis of participants' statements. According to the findings, learning becomes effective when it can be adapted to individual needs, learner conditions, and ability levels. Participants believed that space should be provided for choice, diversity, and self-directed learning. The related codes emphasized the importance of aligning instructional processes with the learners' needs and contexts.

Interviewee 7 emphasized:

"...Transformation in online learning required significant consideration; we had to ensure access to the internet and adjust programs so that we could benefit from online settings even more than in-person ones, supporting personalized and self-directed learning during this period..."

b) Necessity of Blended Learning:

One of the important points raised in the interviews was the *necessity of blended learning*. Participants believed that combining in-person and virtual instruction, synchronous and asynchronous modes, and theoretical and practical approaches can enhance learning effectiveness. This theme reflects a growing inclination toward modern learning approaches and the diversification of teaching methods. The associated codes highlighted the benefits and necessity of designing blended educational systems.

c) Adherence to Instructional Principles:

The theme of *adherence to instructional principles* also emerged from code analysis. Interviewees underscored the importance of following teaching–learning principles, promoting effective interaction, using appropriate evaluation methods, and conducting needs assessments. This finding suggested that mere content delivery is insufficient; instead, the teaching process must be designed and implemented based on scientific principles and educational standards. The related codes stressed the importance of instructional quality and proper teaching methodologies.

Interviewee 4 stated:

"...So, this adaptation rarely happens, and in my opinion, this is why learning outcomes significantly decline. The issue wasn't the online education itself—it was the fact that it wasn't implemented through appropriate methods, and that caused learning quality to decrease..."

One of the recurring themes in the qualitative data from the interviews was the *challenge of assessment in virtual education*. Participants argued that traditional evaluation methods (e.g., final written exams) are neither valid nor fair, and that assessment should be process-oriented, performance-based, and continuous. The findings revealed that assessment constitutes a key pillar of the educational model for the COVID-19 and post-COVID-19 eras, which should be grounded in continuous evaluation, performance assessment, and feedback mechanisms.

a) Diversity in Assessment Methods:

A prominent theme extracted from data analysis was *diversity in assessment methods*. Participants stressed that learning evaluation should not rely solely on traditional written exams but instead incorporate diverse and creative approaches such as performance-based assessments, project-based learning, collaborative activities, and formative evaluations. This theme highlighted that diversifying assessment methods promotes educational equity and allows for more accurate evaluation of students' real skills and learning outcomes.

Interviewee 4 noted:

"...Let me start with assessment. In our educational system, summative evaluations are often prioritized, while formative and practical assessments are given much less importance. During COVID-19, this issue became even more challenging. Although efforts were made to design analytical questions, opportunities for cheating and other forms of dishonesty were still high..."

b) Redefinition of Assessment Principles:

Another theme emerging from qualitative data analysis was the *redefinition of assessment principles*. Participants believed that the assessment system requires a fundamental revision—moving away from outcome-based and score-oriented approaches toward process-based, learner-centered, and equitable evaluation. This theme emphasized the need for philosophical and methodological shifts in assessment, focusing on deep learning, personal growth, and the development of applied skills. Related codes indicated the necessity of developing new evaluation criteria and redefining its objectives.

Interviewee 12 explained:

"...For example, on the LMS platform, students uploaded their assignments, and other students could review and comment on them—pointing out both weaknesses and strengths. Professors could also view the comments, and if students saw that their professor expected revisions, they could re-upload their assignments after making corrections..."

Thematic analysis showed that *roles in virtual education have been redefined*. In this context:

Table 2. Redefinition of Roles

Role	Change in the New Model
Instructor	Learning Coach and Facilitator
Student	Active and Responsible Learner
Instructor	Planner for Motivation and Sense of Belonging

Without human interaction, feedback, communication, and educational support, virtual education would merely be content transmission.

a) Learner-Centeredness:

One of the key themes extracted from data analysis was the *learner-centered* nature of the educational process. Participants believed that an effective educational system should emphasize activating the learner's role, fostering responsibility in the learning process, and promoting active participation in class. This approach is grounded in self-direction, critical thinking, deep learning, and interactive participation, transforming the instructor's role from a content transmitter to a facilitator of learning. The related codes highlighted the necessity of shifting from traditional teaching toward modern learning paradigms.

Interviewee 3 stated:

"...Learning should be group-based and interactive with others — for example, working together on a problem, a project, or even a simple assignment. In online learning, the responsibility for learning increasingly falls on the learner; students must take charge of their own learning..."

b) Fostering Learner Motivation and Sense of Belonging:

Another identified theme was *fostering learner motivation and sense of belonging*. Participants emphasized that motivating learners is a key determinant of educational success, and that without attention to intrinsic and extrinsic motivation, deep and sustained learning cannot occur. This theme refers to factors such as creating a supportive learning environment, employing engaging instructional methods, providing constructive feedback, and instilling a sense of value and belonging among learners. The related codes underscore the role of motivation in shaping learner engagement with instructional content.

Interviewee 4 stated:

"...Emotional presence became very weak in virtual education, and this was an important factor that needed to be preserved. When that emotional presence and engagement faded, motivation clearly declined, and consequently, the quality of learning decreased. As seen in Gagné's model, the first step is to capture attention; I believe in virtual education this attention-getting element needs to be even stronger, to ensure emotional engagement and capture students' focus..."

c) Instructor's Role as Facilitator and Guide:

The theme of *the instructor's facilitative and guiding role* also emerged from qualitative data analysis. Participants believed that the instructor's role in contemporary education extends far beyond the delivery of information; instead, instructors must act as learning guides, supporters, critical thinkers, and facilitators of the learning process. This role involves providing appropriate feedback, directing learners toward credible resources, encouraging independent learning, and creating an interactive class atmosphere. The codes emphasized a shift in the instructor's role from *controller of instruction* to *coach and mentor*.

Interviewee 5 noted:

"...We also had group discussions in our virtual classes. At Shahid Rajaee University, for example, I encouraged students to study the material beforehand, and during class, they presented their ideas while others offered input. Some even volunteered to give full presentations. They introduced preliminary concepts, and I elaborated on them — we tried to maintain this give-and-take dynamic so that I was not just a transmitter of information..."

Data analysis also showed that participants placed strong emphasis on the role of *emerging technologies such as artificial intelligence (AI)*. This component acts as an accelerator and quality enhancer in the proposed educational model and is applicable across all stages of learning—design, interaction, assessment, and support.

a) Integration of Artificial Intelligence into the Educational Process:

One of the emerging and significant themes identified was the *integration of artificial intelligence (AI) into the learning process*. Participants highlighted the necessity of utilizing advanced technologies, especially AI-based tools, to improve the quality of teaching and learning. This theme indicates that AI can play an effective role in content design, personalized feedback delivery, automated assessment, and adaptive learning development. The related codes reflect a positive attitude toward digital transformation in education and the move toward intelligent learning.

Interviewee 1 stated:

"...You can use a platform like the Metaverse to monitor whether students are actually present in class because their avatars must remain in the classroom and cannot leave their virtual space..."

b) Development of Digital Skills:

Another prominent theme identified was *the development of digital skills* among learners and instructors. Participants emphasized that in the era of technological transformation and e-learning, digital literacy and the ability to use technological tools are indispensable. This theme refers to competencies such as effective information searching, use of educational software, management of online learning, and digital security. The related codes revealed that a lack of digital literacy could be a major obstacle to effective participation in modern education.

Interviewee 3 explained:

"...Teaching and learning are interconnected processes, and artificial intelligence can assist teachers as a digital assistant—for example, helping to design lesson plans or check students' assignments. The use of AI tools can be considered a component that supports the teaching process. We can even say that students could use AI as a 'second teacher' to support their learning..."

Based on the coding framework, the appropriate educational model for Allameh Tabataba'i University in the COVID-19 and post-COVID-19 context comprises *six main components*:

Table 3. Main Components and Their Functions in the Educational Model

Main Component	Function in Educational Model	Row
Infrastructure and Support	Implementation Platform and Educational Quality	1
Instructional Design and Content	Organization of Learning	2
Educational Evaluation	Assurance of Learning and Quality	3
Roles and Interactions	Educational Dynamism and Participation	4
Smart Technology and AI	Innovation and Future Orientation of the Model	5

According to the extracted categories, *"Designing an Effective Educational Model"* was identified as the *core phenomenon*. Based on the relationship between this core category and other categories—and its observable outcomes—it was recognized as the central element of the model. The theme *"Change-Inducing Factors (COVID-19 and University Closures)"* was categorized as a *causal condition*; the themes *"Technological Infrastructure, Digital Skills, and Educational Culture"* were classified as *contextual conditions*; the themes *"University Policy, Technical Support, and Human Interaction"* were identified as

intervening conditions; and the themes *"Infrastructure Development, Flexible Instructional Design, Continuous Evaluation, Redefinition of Roles, and Emerging Technologies"* were identified as *strategies*.

Furthermore, the qualitative findings indicated that the extracted components possess a process-oriented, systematic, and goal-driven structure, allowing them to be organized into a valid scientific framework. A comparative review of the identified themes with existing educational design models in the literature revealed the closest conceptual alignment with the *ADDIE instructional design model*. This model—one of the most recognized and widely applied frameworks for educational program design and implementation—consists of five sequential stages: *Analysis*, *Design*, *Development*, *Implementation*, and *Evaluation*.

Qualitative analysis demonstrated that each of these stages corresponds with the themes identified in this study: the component *"Infrastructure and Educational Needs"* aligns with the *Analysis* stage; *"Instructional Design and Content Development"* corresponds with *Design*; the components *"Teaching–Learning Strategies"* and *"Educational Technology and Innovation"* align with *Development*; *"Educational Roles and Interactions"* correspond with *Implementation*; and finally, *"Educational Evaluation"* aligns with the *Evaluation* stage of the ADDIE model.

This conceptual correspondence indicates that the field data obtained in this research are coherent, structured, and transformable into a comprehensive educational model rather than a collection of scattered findings. Beyond alignment with the study's components, the ADDIE model is also highly applicable in higher education contexts, providing adaptability in crisis conditions such as the COVID-19 pandemic and its aftermath. The model supports dynamic and flexible redesign of the educational cycle and, with the inclusion of modern technologies and blended learning dimensions, can be localized and expanded within Allameh Tabataba'i University.

Therefore, it can be concluded that the conceptual framework derived from the qualitative data of this study can be articulated and explained through the *expanded ADDIE model*.

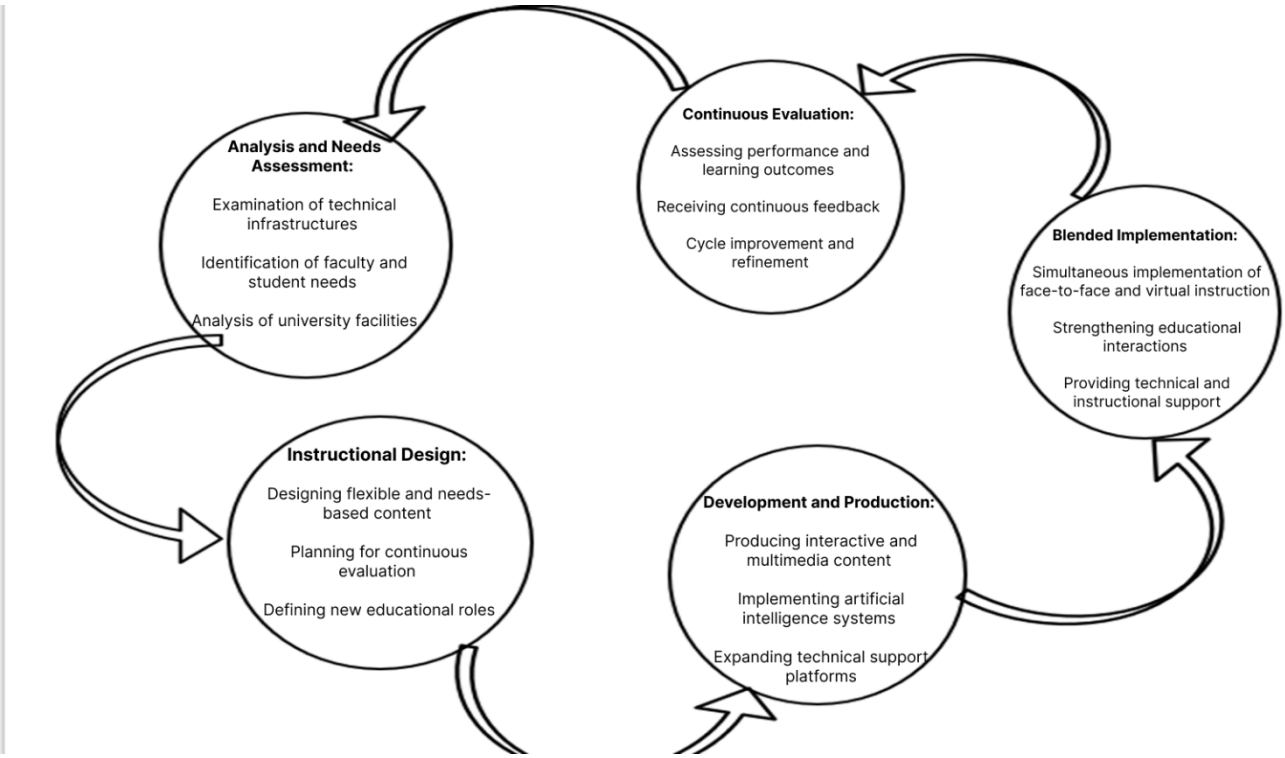

Figure 2. Educational Model for Higher Education in the Context of COVID-19 and Post-COVID-19

In this study, the *fuzzy Delphi technique* was used for model validation. Data were analyzed using Microsoft Excel. The results of this analysis are reported as follows. According to this technique, each expert received a questionnaire containing the relevant subcriteria. The selected panel of 10 experts, all familiar with the subject matter, reviewed each indicator through the Delphi method. For screening the identified indicators, assigned scores ranged between 0.1 and 1. Indicators with scores below 0.7 were eliminated. Based on the results of the fuzzy analysis, since all defuzzified values were above 0.7, all criteria and subcriteria of the model were confirmed by the experts.

Discussion and Conclusion

The findings of this study, which aimed to design and validate an educational model for Allameh Tabataba'i University during and after the COVID-19 pandemic, provide significant insights into how higher education can adapt to crisis-induced disruptions while sustaining instructional quality. The results revealed that an effective educational model in post-pandemic contexts must integrate six primary components: technological infrastructure and support, instructional design and content, educational evaluation, roles and interactions, smart technology and artificial intelligence, and blended implementation. These components collectively form a coherent and adaptable framework capable of addressing the pedagogical, technological, and managerial challenges that emerged during the COVID-19 crisis. The study identified that robust infrastructure and technical support form the foundation of sustainable virtual and blended education, while flexibility in instructional design, continuous assessment, and the redefinition of faculty and student roles serve as critical enablers of learning resilience and engagement.

The central finding—that technological infrastructure serves as the cornerstone of effective hybrid education—is consistent with global research emphasizing the indispensability of digital readiness and institutional capacity in the success of e-learning systems. Universities with stable internet connectivity, advanced learning management systems, and efficient technical support demonstrated greater continuity and quality of instruction during pandemic disruptions (18, 19). This study supports the notion that without strong infrastructure, even well-designed curricula fail to deliver meaningful educational experiences (1). Moreover, the evidence aligns with studies showing that infrastructural strength is not limited to technology but extends to organizational adaptability and the provision of psychosocial and academic support for both faculty and students (8, 25). Participants in this study repeatedly emphasized that the absence of institutional digital preparedness led to reduced participation, technical disruptions, and compromised quality of instruction—a phenomenon widely documented in comparative analyses of higher education during COVID-19 (3, 7).

The study also found that *instructional flexibility and personalization* were key dimensions of effective educational design during and after the pandemic. This result echoes previous findings suggesting that the success of hybrid and online education depends largely on adaptable instructional frameworks that can be customized to individual learners' needs (12, 13). The ADDIE-based model developed in this research incorporated iterative stages of analysis, design, development, implementation, and evaluation, allowing for responsive feedback loops and context-specific adjustments. Similar to the BLEND model proposed by (12), the present framework emphasized personalization, learner autonomy, and self-directed engagement as essential principles of post-pandemic pedagogy. This finding resonates with the global trend toward learner-centered education, which shifts the instructional focus from content delivery to active knowledge construction (4). Moreover, the results confirmed that integrating blended learning approaches—combining synchronous and asynchronous modes—enhances flexibility, inclusivity, and engagement, consistent with studies that underscore the pedagogical advantages of hybrid delivery in maintaining continuity across crises (6, 10).

Another major outcome of the study was the identification of *continuous evaluation* as a pivotal element in ensuring learning quality. The data indicated that traditional, summative assessment methods were insufficient in virtual learning environments,

echoing earlier research that advocates for formative and performance-based assessment strategies (3, 21). Participants highlighted that online examinations often suffered from issues of fairness, validity, and academic dishonesty. In contrast, continuous assessment enabled real-time feedback and fostered deeper learning engagement. This observation supports the conclusions of (4), who noted that sustained feedback mechanisms not only enhance academic integrity but also strengthen teacher presence in digital environments. The inclusion of adaptive and data-driven assessment tools, potentially supported by artificial intelligence, also aligns with findings from (24), suggesting that AI-powered analytics can improve feedback accuracy and learner performance tracking.

The findings further demonstrated the importance of *role redefinition and interaction* within virtual and hybrid learning systems. Participants noted that instructors should transition from being content transmitters to facilitators and learning coaches, while students must adopt more active and responsible roles. This shift mirrors the emerging educational paradigms emphasizing learner agency and instructor facilitation (12, 13). The evidence aligns with (15), who found that student engagement and motivation in online settings increase when teachers adopt collaborative and supportive instructional roles. Similarly, the emphasis on emotional presence and motivation found in this study corresponds to prior findings that underscore the need to preserve social and affective dimensions of learning in digital education (14, 17). This research reinforces the notion that human interaction remains irreplaceable even in technologically mediated environments and that meaningful feedback, empathy, and mentorship are essential to maintaining educational effectiveness (16).

The integration of *artificial intelligence (AI) and smart technologies* was another significant outcome of this research, highlighting the transformative role of automation and data-driven tools in higher education. Participants described AI as a "second teacher," capable of assisting in instructional design, personalized feedback, and adaptive content delivery. This aligns with (24), who found that teachers' digital skills significantly influence teaching quality in higher education. Moreover, (20) emphasized that equipping educators with digital literacy and AI-based pedagogical competencies is critical for the digital transformation of universities. The current study confirms that AI integration can streamline routine academic tasks, facilitate interactive learning experiences, and expand accessibility for diverse learners. However, it also cautions that successful AI implementation depends on institutional readiness and ethical governance frameworks—concerns echoed by (18).

The study's application of grounded theory and the ADDIE framework yielded an integrated educational model that aligns closely with the *systematic design cycle* of successful instructional innovation. The five sequential stages identified—needs analysis, instructional design, development, blended implementation, and continuous evaluation—mirror the cyclical process of the ADDIE model widely used in digital pedagogy (3, 12). Each phase complements the others, ensuring iterative improvement, feedback incorporation, and contextual adaptability. For example, the emphasis on needs analysis and infrastructure assessment corresponds with the global call for evidence-based digital planning in higher education (1, 2). Similarly, the inclusion of blended implementation aligns with the paradigm of "learning continuity" proposed by (23), which stresses the need for hybrid systems that can seamlessly transition between physical and virtual environments.

In explaining the study's outcomes, it is evident that *the human dimension of learning* remains central to educational resilience. While technology facilitates scalability and access, the emotional, psychological, and cultural dimensions of learning determine the sustainability of educational systems. This aligns with the psychological studies that documented the pandemic's impact on student well-being, motivation, and cognitive engagement (16, 17). Participants in the present study also noted that virtual fatigue and isolation often undermined academic motivation, a challenge similarly identified in the cross-national research by (21). Addressing this requires institutions to complement digital innovation with empathetic teaching practices and inclusive pedagogical approaches that nurture social connection and belonging (14).

Another key interpretation of the findings concerns *institutional policy and governance*. Participants emphasized that the success of educational transformation depends on university-level strategies and policy alignment. This resonates with (8), who argued that managerial agility and cross-departmental collaboration are decisive factors in maintaining academic operations during crises. Similarly, (25) highlighted that Iranian universities' initial lack of systemic coordination hindered the effective deployment of virtual education. By introducing structured frameworks and involving policymakers, the current model helps bridge managerial gaps and ensures a coherent institutional response to future disruptions.

The study also contributes to the global discourse on *educational quality enhancement* through blended and flexible learning. As (3) observed, universities that effectively integrate blended models report higher student satisfaction and academic achievement. The current findings reinforce that blended learning not only supports academic continuity during emergencies but also enhances pedagogical innovation and inclusivity in normal circumstances (2, 6). By embedding flexibility, personalization, and continuous evaluation into its structure, the proposed model promotes sustainable academic resilience—a finding consistent with (23) and (18).

Taken together, the results validate the conceptual alignment between the present study's model and the expanded ADDIE framework. Each component—technological infrastructure, instructional design, evaluation, interaction, and AI integration—reflects the evolution of higher education from emergency adaptation to strategic innovation. The model also offers practical relevance for universities seeking to institutionalize hybrid systems that are both pedagogically sound and technologically robust (12, 13). It underscores that educational resilience is not achieved solely through technology adoption but through the integration of pedagogy, psychology, and policy. In this respect, the study supports the argument of (20) that the digital transformation of universities must be accompanied by faculty empowerment, student engagement, and ethical innovation.

Ultimately, the validation of the proposed educational model through the fuzzy Delphi method confirmed its applicability and reliability, as experts rated all components above the acceptance threshold. This indicates strong consensus regarding the model's relevance to the Iranian higher education context and its potential scalability to similar institutional environments. The convergence between qualitative insights and expert validation demonstrates that the model is both empirically grounded and contextually adaptable—consistent with the methodological rigor advocated by (22) in grounded theory research.

Despite its strengths, this study faced several limitations that must be acknowledged. First, the qualitative phase was based on interviews with a limited sample of faculty members and students from one university, which may restrict the generalizability of the findings to other institutions or educational contexts. The reliance on self-reported experiences could also introduce subjective bias, as participants' perceptions of online learning might have been influenced by personal attitudes toward technology or prior exposure to digital platforms. Additionally, while the fuzzy Delphi validation strengthened the reliability of the model, the number of participating experts was relatively small, potentially limiting the diversity of perspectives. Moreover, the study focused on the immediate and post-pandemic phases; therefore, long-term longitudinal data are lacking to determine how sustainable the proposed model remains over time.

Future research could expand the scope of this study by applying the proposed educational model across multiple universities and comparing its performance in diverse academic settings. A mixed-methods or longitudinal design could provide deeper insights into how the model influences learning outcomes, engagement, and institutional performance over extended periods. Further studies may also explore the integration of artificial intelligence and learning analytics within the framework to measure real-time learning effectiveness. In addition, cross-cultural comparisons could reveal contextual differences in digital readiness and pedagogical adaptation, enhancing the model's applicability across global higher education systems. Finally, future research should investigate the ethical and psychological implications of AI integration in higher education, particularly concerning data privacy, academic integrity, and mental well-being.

Universities should prioritize investment in digital infrastructure and technical support systems as the foundation for sustainable blended learning. Faculty development programs must be established to enhance instructors' digital competencies, pedagogical innovation, and emotional engagement with learners. Institutions should also implement continuous evaluation systems that provide timely feedback, foster self-directed learning, and ensure assessment integrity. Moreover, university policies must encourage flexible instructional design that integrates technology with student-centered approaches, promoting inclusivity and active participation. Finally, collaboration between administrators, educators, and policymakers is essential to institutionalize resilience and innovation within higher education, ensuring that universities remain adaptive and effective in both crisis and post-crisis contexts.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors 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.

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