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Designing and Validation of In-Service Teacher Training Courses Based on Cloud Computing

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ABSTRACT

Objective: This study aimed to propose a model for the use of cloud computing in in-service teacher training courses and to validate this model.

Methods: This study was applied in terms of purpose and adopted a mixed method with an exploratory approach. The statistical population of the qualitative study consisted of experts in the field of computer technology and curriculum planning who were selected purposefully, and finally, due to the saturation method, 14 experts were selected as a sample. The statistical population in the quantitative phase included 250 participants selected by stratified random sampling. The research data collection tool in the qualitative phase was a semi-structured interview whereas, in the quantitative section, a researcher-made questionnaire was extracted from interviews.

Results: Data in the qualitative phase were analyzed using the thematic analysis method, and in the quantitative phase, confirmatory factor analysis, divergent and convergent validity were used. The face, content, and construct validity of the instrument were confirmed. Their composite reliability and Cronbach's alpha were calculated above 0.70, which was approved. Finally, the model of cloud computing in in-service teacher training courses was presented with five factors including managerial, cultural, human resources, financial and physical and technology. The results of the confirmatory factor analysis showed that the correlations between the data are suitable for factor analysis and have the necessary and sufficient coherence.

Conclusions: The results indicate that the Ministry of Education is not optimally positioned in terms of institutional, managerial, support and technological aspects for the implementation of in-service teacher training programs on the cloud computing platform.

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Introduction

In recent decades, traditional approaches to teaching and learning have undergone fundamental changes with the emergence of new technologies such as multimedia, hypermedia and telecommunications (Mahmoudi et al., 2021). The evolution of Internet has enabled the Information and Communication Technologies (ICTs) rapid growth and broaden application. Both industry and academia have increasingly focused on the business transformation developments brought about by ICT (Timotheou et al., 2023).

Modern education is inevitably linked to the widespread use of information and communication technologies (ICT). ICTs enable the implementation of contemporary forms of education based on new pedagogical paradigms in which the learner is a central figure and actively participates in the learning process through interaction and collaboration with all participants (Wu et al., 2019). The use of ICT in education leads to training that meets the needs and characteristics of the new generation of learners, the so-called “digital natives”. They place new demands on the educational process and the learning environment. To meet changing needs and expectations, educational institutions must offer modern forms and methods of training and educational services available through a variety of devices(Mertala et al., 2024). More and more activities (learning and administration) are influenced by ICT as the new technological inventions are more flexible and can expand the educational space and make it accessible to a wider audience. Cloud computing, one of the ICTs that emerged on the basis of the revolution in the Internet and information technology (IT) industry, is considered a key strategic technology and an enabler of digital transformation in the next few years (Taleb et al., 2022).

Nowadays, cloud computing is one of the new technological trends with an important impact on teaching and learning environments. Cloud computing promotes a change in the way of learning, both inside and outside the classroom, revolutionizing the teacher’s role and his attributions, providing new resources and tools for the development of enhanced learning situations, and significantly transforming the way we communicate, collaborate, and build knowledge (Rezapour et al., 2023).

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In-service training is a professional and personal training measure for teachers to improve their performance, skills, knowledge and motivation in their professional activities (Omar, 2014). In-service training can also change the attitudes and skills of teachers and further improve student performance. In-service training has undergone considerable change in recent years. The use of innovative technologies such as cloud computing in- service training opens up new avenues for improved research and collaboration (Khan & Law, 2018). Cloud computing serves as a critical digital platform for sharing resources, including infrastructure, software and applications, which are constantly evolving. Cloud computing is a new phenomenon in which physical resources such as processing units, memory and data storage are not present in users' systems. Instead, a service provider manages and allocates these resources so that users can access them over the Internet (Kalkhoran et al., 2019). Odeh(2020) defines cloud computing as an emerging model in information systems designed to provide various computing services over network media such as the Internet (Odeh, 2020). By using cloud computing services, users can access virtual resources instead of purchasing physical infrastructure and computing resources. In essence, cloud computing can be viewed as convergence and advancement in key technology areas. Cloud computing includes two main features in the field of information technology. First, it increases the efficiency of information technology by leveraging advanced computing power through scalable hardware and software resources. Second, it enables agile business practices by leveraging information navigation as a competitive tool with rapid development capabilities, parallel batch processing, and platform-independent (Marston et al., 2011).

Research also suggests that cloud-based applications with collaborative and communicative structures can benefit certain pedagogies such as constructivism or collaborative learning. Cloud computing represents a new paradigm in the field of information and communications technology and is expected to have a significant impact on education in the future (Al Rawajbeh et al., 2019). Scholtz & Marx Gómez (2016) argued that the introduction of cloud computing in educational institutions was an important step towards improving education. The growth of data and communication services has made cloud computing a valuable tool in education, enabling access to educational content and the further development of teaching and research methods. Cloud

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computing and cloud services are used by learning service providers, higher education systems, and educational organizations to improve processing and storage capabilities (Karo & Petsangsri, 2021). González Martínez et al. (2015) highlighted various advantages of using cloud computing in education, such as cost savings, availability of useful cloud-based applications, self-organized learning, flexible learning environments, and support for mobile learning (González Martínez et al., 2015).

It is important to understand the factors that influence the use of cloud computing because it provides various types of essential hardware and software, such as applications, storage, processing, and virtual servers, over the web (Lin & Chen, 2012). The integration of cloud computing and e-learning represents a great opportunity and offers many advantages (Radenkovic et al., 2014). It helps reduce costs by eliminating the need to purchase, operate, and maintain physical data centers and servers on-site. With cloud computing, users can easily access applications and resources from anywhere with an internet connection, providing flexibility and convenience (Kaur & Chana, 2015).

(Singh & Mansotra, 2019) conducted a study to examine the factors affecting the adoption of cloud computing in the Indian school education system. The study identified various factors that significantly contribute to the adoption of cloud computing services in this particular context. These factors can be divided into technological, organizational and environmental aspects (Singh & Mansotra, 2019). Cloud computing offers numerous benefits including cost savings, accessibility, efficiency and security that make it superior to traditional methods. In addition, cloud-based technologies are compatible with the current education system and can be seamlessly integrated into existing processes. Schools are motivated to use cloud computing to maintain their competitiveness in the education sector and improve their offerings, ultimately leading to better learning experiences.

Samra et al. (2017) also emphasized the importance of cloud-based technologies in advanced learning technology. The adoption of cloud technologies in the educational environment positively impacts the learning process by providing new tools and services to improve and support the

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learning lifecycle, including interaction. This is particularly relevant in areas such as clinical skills training, where there is a growing demand for providing educational services to larger numbers of learners, leading to a need for cloud services (Samra et al., 2017).

(Arpasi, 2017) examined the potential benefits and implications of adopting cloud computing in education for knowledge management. The study suggests that adoption of cloud computing in education can improve knowledge management. The results indicate a significant correlation between perceived usefulness and expectations of knowledge creation, discovery, storage and sharing. Furthermore, there is a stronger relationship between expectations of storing and sharing knowledge and perceived usefulness. In addition, innovation and training are significantly linked to usability. These results suggest that educational institutions can expand the use of cloud computing in employee training by increasing awareness of knowledge management practices (Arpasi, 2017).

(Lashkaripour & Balouchzahi, 2020) in their research entitled "An Intelligent Cloud-Based Architecture for Evaluating E-Learning Systems" proposed an innovative architecture that leverages cloud computing for various types of e-learning courses. This architecture provides comprehensive usability and integrates intelligent and flexible evaluation mechanisms, resulting in increased user satisfaction and improved performance (Lashkaripour & Balouchzahi, 2020).

(Rouhani & Gholizadeh, 2018) discussed the impact of cloud computing on e-learning in their research study. They evaluated the service quality parameters of cloud computing, including responsiveness, throughput, scalability, and accessibility. The study compared the service quality performance indicators of cloud-based servers with those of web-based servers and concluded that cloud-based servers demonstrated superior performance (Rouhani & Gholizadeh, 2018). (Azhdari et al., 2019) presented a research study entitled "A native pattern of influential indicators in the adoption of cloud-based electronic human resource management services in knowledge-based enterprises". Their study focused on the adoption of cloud-based electronic human resource management services in knowledge-based companies. They identified influencing factors in three dimensions: technology, environment and organization. These factors included related benefits, uncertainty, complexity, adaptability, testability, competitive pressure, industry, market, external

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cloud support, physical location, organizational readiness, senior management support, previous technology-based experience, and innovation acceptance (Azhdari et al., 2019).

Research findings indicate that cloud computing is widely used in educational institutions. Its benefits go beyond cost-effectiveness and include improved performance, security, reliability, portability, storage capacity and information sharing capabilities. From teachers' perspective, the potential for improved communication and collaboration provides strong incentive for the use of cloud-based tools in learning activities. The use of cloud computing facilitates collaboration, participation and interaction between students and teachers in educational environments. In cloud-based learning environments, students demonstrate improved interpersonal relationships and therefore better learning outcomes. A focus on interpersonal relationships within a curriculum can promote higher motivation and learning achievement. In such environments, learners can collaborate seamlessly on shared projects, reducing time, cost and effort to make progress. Undoubtedly, cloud-based systems provide a conducive and collaborative environment to support long-term engagement in the wave of educational innovation. Learners can access these systems from anywhere and at any time. The ability to share and distribute student-created content while creating assignments and collaborating on various activities undoubtedly accelerates the adoption of these learning modalities in classrooms. Nevertheless, there is an urgent need for domestic scientific research to identify the optimal ways to integrate cloud computing tools into teacher training. Undoubtedly, collaborative activities within education and other educational organizations are advancing through the use of cloud-based applications and tools. Our country is poised to benefit from the ongoing changes and advancements in education and information technology in the education sector.

Therefore, this study aims to design and validate a model for the use of cloud computing tools in in-service teacher training programs. Such a model can benefit both teachers and students by improving learning experiences, promoting interpersonal and social interactions, and reducing economic costs. This study addressed to answer these questions:

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1. What is an appropriate model for the use of cloud computing in in-service teacher training courses?
2. What extent is the proposed model valid for the use of cloud computing in in-service teacher training courses?

Material and Methods

This study used a mixed methods approach that combined qualitative and quantitative methods in a sequential exploratory design. The study was conducted in two phases: Phase 1. Qualitative Content Analysis**:** In this phase, the elements and components of the use of cloud computing tools in in-service teacher training programs were identified through a qualitative content analysis of documents, literature and seminars-structured interviews with experts in Computer technology and curriculum planning. Participants included university faculty members with a doctorate in computer engineering or curriculum planning, a strong understanding of technology and educational technology, and 10 to 25 years of experience. A total of 20 experts were identified and 14 were interviewed until theoretical saturation was reached Peer review was used to ensure the validity of the instrument in the qualitative phase of the research and to confirm the accuracy of the results. Four university professors examined the coding paradigm and their feedback was incorporated into the development of the model. In addition, the members - several participants - reviewed the final report of the first phase of the categorical analysis and their suggestions were applied to the coding paradigm. In the current study, test-retest reliability and interrater reliability were used to assess the reliability of the interviews. For test-retest reliability, four interviews were selected and each was coded twice by the researcher eight days apart. Thematic analysis method was used to analyze qualitative data. Thematic analysis is a method of identifying patterns in qualitative data by dividing, categorizing, summarizing and reconstructing the data. Therefore, the researchers used the six-phase approach proposed by Braun and Clarke (2006) to explore and analyze the themes and identify patterns from the data (Braun & Clarke, 2006). The full interview texts were transcribed from audio files onto paper and the text was carefully studied to become familiar with the content of the data. Phase 2. Quantitative Phase: The population for the

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quantitative phase consisted of all computer technology and curriculum planning experts with knowledge of educational technology at the Ministry of Education. A sample size of 250 was determined using the Morgan table and selected using simple random sampling.

The data was collected using a questionnaire based on previous research on cloud computing and the model presented by Khan (2011). The reliability of the questionnaire was assessed using Cronbach's alpha, which yielded a coefficient of 0.89, indicating a high level of internal consistency. Construct validity was determined using expert assessment. To analyze the effects of the variables, structural equation modeling (SEM) was performed using AMOS software. First, the overall model fit indices were assessed. Because some indices did not meet the desired criteria, modifications were made to the model. Specifically, items with factor loadings less than 0.5 were removed and the model was reevaluated. As shown in Table 1, all fit indices were within the acceptable range.

Results

1. What is an appropriate model for the use of cloud computing in in-service teacher training courses?

In order to investigate the research question, the collected data were analyzed using the thematic analysis method through interviews. In order to familiarize the data, the interview texts were read several times and the relevant points were recorded. In the second step, 256 important and recurring points and concepts were extracted through an initial analysis of the texts. These points were then grouped into meaningful categories, resulting in the extraction of 140 initial meaningful codes.

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Table 1. A part of the collected basic themes (related to interviews with 6 people) along with the relevant codes

Interviewee	Basic themes collected from the text of the interviews	Unique code assigned to the extracted themes	Interviewee	Basic themes collected from the text of the interviews	Unique code assigned to the extracted themes
First interviewee	Creating and developing a suitable platform	1-1	Second interviewee	Drafting a constitution and educational charter based on the deployment of new communication and information technologies	2-1
	Efforts to enhance media literacy among teachers	1-2		Conducting training courses based on cloud computing infrastructure	2-2
	Expanding teaching skills based on cloud computing platform	1-3		Allocation of required facilities and equipment	2-3
	Conducting targeted training courses in electronic form	1-4		Attention to moral principles	2-4
	Design and management of training implementation based on cloud computing platform	1-5		Launching electronic platforms	2-5
	Persuasion and encouragement of teachers	1-6		the budget exclusive	2-6
	Promoting a culture of ICT adoption among teachers	1-7		Establishing platforms or systems for in-service training based on cloud computing infrastructure	2-7
	Evaluation of e-learning projects	1-8		Utilizing the educational capacity of capable private sector institutions in the field of cloud computing	2-8
	Drawing a roadmap for cloud-based education	1-9		Attention to security issues	2-9
	Revitalizing and transforming the educational planning system based on new technologies system	1-10		Attention to infrastructure development Basic requirements	2-10
	Providing the necessary facilities and tools	1-11			
Third interviewee	Precise and targeted monitoring and evaluation	3-1	Fourth interviewee	Using expert opinions	4-1
	Smartification of the education system	3-2		Building readiness within the education system to utilize new technologies	4-2
	Using the required educational infrastructure	3-3		Conducting in-service training courses based on	4-3

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				the cloud computing platform	
	Training teachers and staff in various programming languages	3-4		Programming	4-4
	Utilizing incentivization and motivational tools	3-5		supply resources	4-5
	Creating concern among senior managers in order to expand the educational space on the platform of cloud computing	3-6		Development of relative familiarity with the implementation process of online training courses	4-6
	Conducting multi-skills courses on information and communication technology communication technologies	3-7		User interface design by the Ministry of Education	4-7
	Continuous measurement of the effectiveness of the provided training	3-8		Support	4-8
	Development of capable and technological manpower in the body of the educational system	3-9		Information dissemination regarding virtual teaching courses	4-9
				Efforts to expand the management and implementation of classes in the virtual space	4-10
Fifth interviewee	Efforts to create understanding and awareness among senior managers about the importance of technology and education	5-1	Sixth interviewee	Making the necessary preparations	6-1
	Allocating a dedicated budget line for technology-related matters	5-2		Create a suitable platform	6-2
	Utilizing technical and specialized personnel	5-3		Attention to possible ethical problems	6-3
	Designing and developing a codified program to expand information and communication technology in schools	5-4		Presence of dedicated and skilled human resources	6-4
	Having a serious determination among managers	5-5		Reinforcement hard software	6-5
	Utilizing the technical capabilities of committed subsidiary companies	5-6		Creating a positive view on the optimal use of technology among managers	6-6
	Setting up a data center and establishing a dedicated inter-provincial communication network	5-7		Conducting relevant training courses	6-7
	Identifying and employing talented personnel	5-8		Having appropriate and proportional evaluation	6-8
	Having a precise roadmap	5-9			
	Changing the mindset of managers	5-10			
		5-11			

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	Continuous evaluation if an appropriate infrastructure is established				

In the third step, the initial codes were used to identify and interpret the themes. These themes formed a collection of main and sub-themes, which were then refined and reviewed in the fourth step. The criteria for assessing internal consistency and external variation were applied, as shown in the initial analysis of 19 subtopics. In the fifth step, the subtopics and main topics were named and a thematic network was created (see Table 2).

Table 2. Aggregation of theme codes and the formation of organizing and comprehensive themes

No.	Compilation of basic theme codes	Organizer themes	Overarching themes resulting from combining similar codes
1	-4،3-4،2-1،5-1،2-2،4-3،7-3،7-6،5-8،12-8،4-10،3-10،7-11،6-13	Manpower training	Human resources
2	3-5،8-5،4-6،1-7،9-8،6-9،6-11،6-12،7-،13	Employing expert staff	
3	6-1،5-3،1-8،6-8،4-11،5-12،5-13،1-14	persuasion and Encouragement	
4	3-1،9-3،4-8،2-9،1-13،6-10	Empowering staff	
5	6-2،2-5،16-8،6-10،2-12،9-14	Budget allocation	Material and Physical
6	5-4،3-2،11-1،3-3،4-7،14-8،7-10،3-11،9-13،7-14	Providing the necessary facilities and equipment	
7	5-5،6-3،1-5،10-5،6-6،8-8،1-9،1-12،3-13،10-13	Changing the attitude of managers	Management
8	4-5،4-4،2-8،5-7،10-8،1-10،2-11،5-11،8-12	Planning and targeting	
9	9-1،1-2،9-5،11-13	Roadmap design	
10	8-1،1-3،8-3،11-5،8-6،8-10،2-10،9-12	Evaluation and measurement	
11	10-1،10-4،3-9،2-4،9-4،1-6،3-8،2-7،2-13،2-14،5-14،4-14	Creating organizational readiness	
12	7-1،8-13	The culture of using information technology	Cultural
13	4-2،3-6،15-8،11-11،8-14	Moral principles and values	
14	4-9،5-9،7-12،8-2،6-5،1-4،6-7،6-14،10-14،4-12	Expanding interaction with organizations and individuals	
15	8-4،8-7،3-7،12-11،3-12	Support	Technology
16	4-1،7-8،4-13،3-14	Production and expansion of electronic content	
17	9-2،10-11	Attention to security issues in cyberspace	
18	7-4،10-12	Designing Intermediary user	
19	1-1،5-2،10-2،2-6،5-6،11-8،9-11	Infrastructure	

Given the results presented in the above table (qualitative analysis results based on the content analysis method), it is possible to identify five dimensions or overarching themes as influential

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factors in shaping the educational model for Iranian teachers using computer-assisted learning. These dimensions include the management dimension, the cultural dimension, the technological dimension, the human resources dimension and the financial resources and facilities dimension. In addition, there are 19 components (organizational themes) that contribute to the formation of this model. After extracting categories and subcategories from the model of the use of cloud computing tools in the development of part-time teacher training courses, their relationships were analyzed qualitatively and presented as a model. This connection is visualized in a conceptual model.

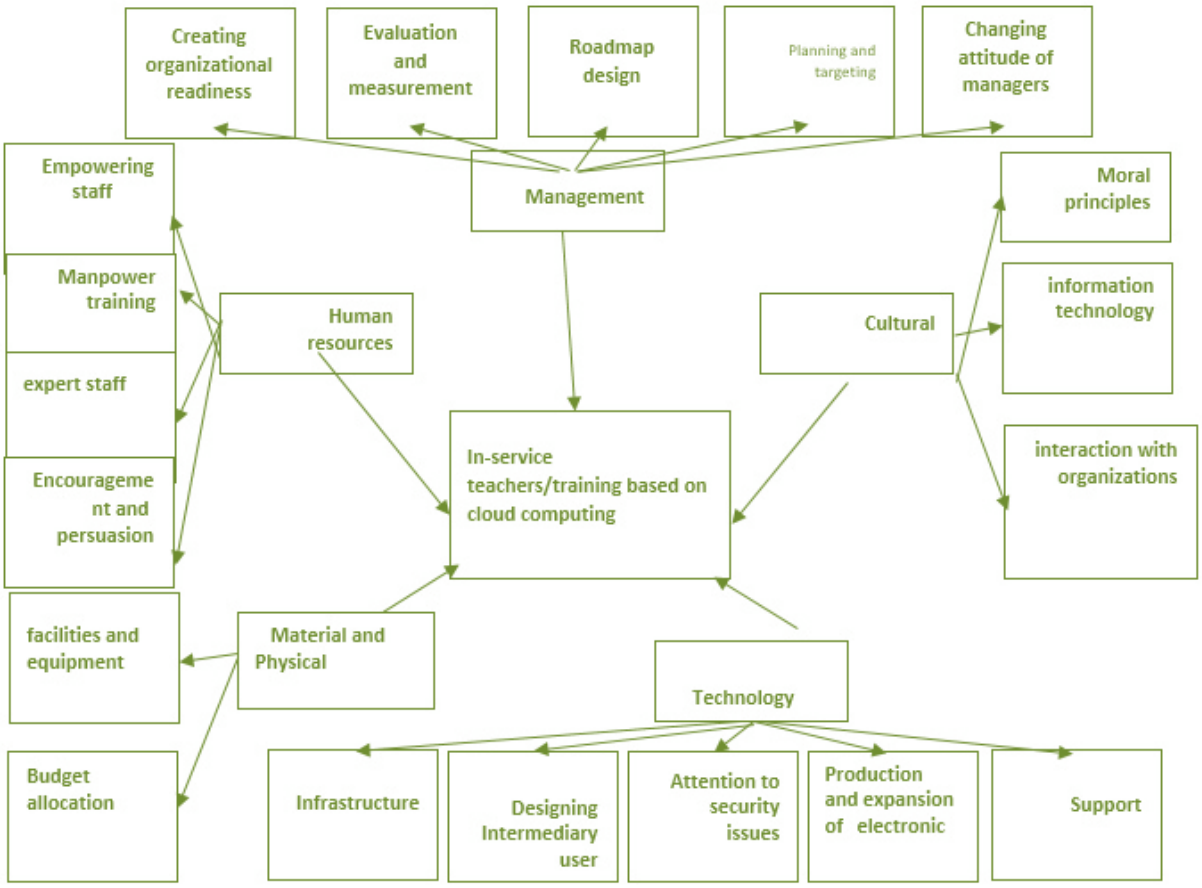


Figure 1. The Proposed Conceptual Model of the Research

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2. What extent is the proposed model valid for the use of cloud computing in in-service teacher training courses?

To answer the second research question, the validity of the proposed cloud-based in-service teacher training courses model was assessed using statistical methods including the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, Bartlett's test of sphericity, and confirmatory factor analysis.

Table 3. The results of the Bartlett and KMO test

Indices			Value
Kaiser-Mayer-Olkin value (adequacy of sample size)			0.880
	Chi-square value ($\chi 2$)		14274.8
Bartlett's sphericity test	Degrees of freedom		177
	Significance level		0.001

The KMO measure of sampling adequacy was 0.881 and Bartlett's test of sphericity was significant ($p < 0.001$), indicating that the sample size was sufficient for factor analysis. The results of Bartlett's test showed that the chi-square value for all factors exceeded the critical value at the 0.05 significance level, further supporting the suitability of the data for factor analysis. In addition, confirmatory factor analysis revealed that the factor loadings for most items exceeded 0.7, indicating that the observed variables were highly correlated with the underlying factors. Convergent validity (internal consistency between items measuring the same construct) was assessed based on standardized factor loadings, composite reliability, and average variance extracted (AVE). Items with factor loadings below 0.7 were removed and the remaining items were retained in the model. The composite reliability for all latent variables in the measurement model exceeded 0.7 and the AVE for all latent variables was greater than 0.5, indicating acceptable values. Based on these three criteria, the research instrument demonstrated sufficient convergent validity (high internal consistency between items). The discriminant validity of the model was confirmed using the correlation matrix between the latent variables. For discriminant validity, the

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squared correlation between any two latent variables should be less than the AVE of each of the two variables. Construct validity was assessed based on the correlations between the latent factors in the measurement model (Paswan, 2009). Given the significant correlations between the five latent variables in the measurement model, the research instrument was considered to have constructive validity.

Table 4. The results of the first-order confirmatory factor analysis measurement model

Latent Variable	Indicator in the Model	Standardized Factor Loading	standard Error	Critical Ratio	AVE	Composite Reliability
Managerial	M3	0.76	-	-	0.61	**0.91**
	M4	0.78	0.09	10.28		
	M5	0.87	0.09	11.42		
	M6	0.86	0.09	11.55		
	M7	0.65	0.1	۵۰/۸		
Cultural	C2	0.76	-	-	0.67	**0.79**
	C3	0.87	0.10	11.80		
	C4	0.79	0.10	10.72		
	C5	0.80	0.10	10.71		
	C7	0.74	0.10	9.78		
	C8	0.72	0.11	9.51		
Human Resources	Hr3	0.74	-	-	0.50	**0.70**
	HR5	0.73	0.11	8.34		
	HR6	0.71	0.11	8.11		
	Hr4	0.65	0.10	7.61		
Financial and Physical	Fr1	0.62			0.50	**0.73**
	FR5	0.59	0.13	6.23		
	FR6	0.77	0.15	7.61		
	FR7	0.79	0.15	72.7		
Technology	T3	0.73	--	-	0.52	**0.70**
	T4	0.76	0.1	9.72		
	T5	0.83	0.1	10.73		
	T6	0.72	0.09	9.25		
	T7	0.71	0.1	9.03		
	T9	0.64	0.1	8.10		
	T10	0.71	0.09	9.05		
	T11	0.71	0.09	9.04		

To classify and determine the factor loadings for each construct in designing the teacher training program model on the cloud computing platform, the coefficients and their significance levels were examined. As the results in Table 4, the teacher training model on the cloud computing platform is a function of five latent variables. The technology factor played the biggest role.

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Subsequently, the cultural variable was identified as the most related construct in this research. In addition, it should be recognized that the influence of all latent variables in forming the second-order construct is statistically significant.

Table 5. First-Order Confirmatory Factor Analysis Model Fit Indices

Index	Acceptable Range	Value	Interpretation
Relative chi-square $\frac{x^2}{df}$	< 2	1.36	Very good
RMSEA (Root Mean Square Error of Approximation)	≤ 0.05	0.05	Acceptable
PNFI (Normed Fit Index)	> 0.60	0.73	Optimal
PCFI (Comparative Fit Index)	> 0.60	0.79	Optimal
IFI (Incremental Fit Index)	> 0.90	0.91	Optimal
TLI (Tucker-Lewis Index)	> 0.90	0.91	Optimal
CFI (Comparative Fit Index)	> 0.90	0.90	Optimal
NFI (Normed Fit Index)	> 0.90	0.90	Optimal
RFI (Relative Fit Index)	> 0.90	0.90	Optimal

As shown in Table 5, all general model fit indices reached satisfactory levels after making the required changes. While the relative chi-square value was already in the acceptable range, it fell to 1.36 after the modifications and is therefore in the very good range. Furthermore, the RMSEA value was 0.05, which is considered acceptable. The other indices were also within the desired range.

Table 6. Ranking of the effect of first-order structures on the formation of second-order structures along with factor loadings

Factor	Unstandardized Factor Loading	Standardized Factor Loading	Standard Error	Standardized Critical Ratio	P
Technology	1.21	0.95	0.18	6.56	0.001
Cultural	15.1	0.86	0.17	6.47	0.001
Managerial	1	0.64	0.15	6.56	0.001
Human Resources	0.94	0.73	0.16	5.79	0.001
Financial and Physical	0.92	0.84	0.16	5.64	0.001

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To classify and determine the factor loadings for each construct in designing the teacher training program model on the cloud computing platform, the coefficients and their significance levels were examined. As the results in Table 6, the teacher training model on the cloud computing platform is a function of five latent variables. The technology factor played the biggest role. Subsequently, the cultural variable was identified as the most related construct in this research. In addition, it should be recognized that the influence of all latent variables in forming the second-order construct is statistically significant.

Discussion

The present study aimed to design and validate the use of cloud computing tools in in-service teacher training courses. To this end, articles on cloud computing tools and in-service teacher training courses, documents, scientific evidence, and interviews with experts were reviewed and analyzed. Confirmatory factor analysis was performed to validate the model obtained through exploratory analysis. Based on the Bartlett test statistic, it was found that the chi-square test value for all factors was greater than the critical chi-square value, and at the level of significance, it was also concluded that the factor correlation matrix is suitable for factor analysis. In addition, the results of the confirmatory factor analysis showed that the majority of the extracted factor loadings were greater than 0.7, indicating that the correlations between the data were suitable for factor analysis and had the necessary coherence to determine the factors and subscales of the factors to explain the use of cloud computing tools in in-service teacher training programs ($p<0.05$).

After extracting codes from interview texts, a total of 140 concepts were identified and extracted. The research findings of thematic analysis identified 5 dimensions (themes) and 19 components (organizing themes) as influential factors in shaping the pattern of in-service teacher training based on cloud computing. These dimensions include human resources (4 components), managerial (5 components), cultural (3 components), technological (5 components), and material resources (2 components). These components encompass the necessity for specific legal requirements and regulations for the use of cloud computing technology in education, the significance of

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incorporating international experiences in training, the emphasis on a comprehensive architecture for cloud computing technology in education, the consideration of IT governance requirements, the need to reengineer processes and educational activities for the implementation of cloud computing technology, the development of a risk model for cloud computing technology in education, the creation of various cloud-based technology platforms based on educational needs, and the involvement of the private sector in investing in cloud computing technology for education. The findings of this study are consistent with the results of the previous studies (Rezapour et al., 2023); (Taleb et al., 2022); (Odeh, 2020); (Lashkaripour & Balouchzahi, 2020); (Singh & Mansotra, 2019);and (Timotheou et al., 2023)

This model consists of five main components organized according to their technological, cultural, physical, human resources and managerial dimensions. The technological dimension underlines the importance of a robust software and telecommunications infrastructure. The implementation of such an initiative requires the procurement of necessary equipment and facilities, including high-speed Internet connections, computers and other telecommunications and electronic devices. The development of software and applications then becomes possible. In addition, the presence of specialized personnel capable of creating high-quality electronic content in the form of digital courses and computer-based training is essential. Without appropriate content, even the most advanced technology will render teacher training ineffective. Additionally, behaviors such as data destruction, infrastructure damage, and use of inappropriate software can undermine trust. Addressing security vulnerabilities in cloud-based training can increase trust between users and service providers. As the results show, cultural factors emerged as the second most important component of the model, highlighting the importance of cultural and ethical considerations in cloud-based teacher training. In addition to technological infrastructure, education systems also need to invest in cultural infrastructure. The findings of this dimension are consistent with the findings of (Taleb et al., 2022). The results of this study show that ethics and values are important factors that should be considered for the growth of information technology. Ethical issues related to cloud computing include social, political, cultural differences, biases and orientations, geographical differences, diverse learners, digital divide, behavioral norms and legal issues.

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Cultural factors are crucial for both trainees and instructors in cloud-based teacher education, and both groups should be comfortable with using new technologies and social networks in their personal lives. Adhering to relevant laws, regulations, and ethical values is critical to creating an enabling environment for the expansion of cloud-based teacher education.

Another component of the proposed model concerns management factors. The results of this pattern are consistent with the research of (Singh & Mansotra, 2019). Top managers play an influential role in the implementation of cloud computing in all organizations, especially in educational institutions, and can play an important role in this area by developing a strategic plan and creating motivational mechanisms in the work environment. In the field of education, providing the necessary resources, space, equipment and qualified human resources demonstrates the commitment and continuous support of managers in the development and implementation of cloud computing. It should be noted that the implementation and execution of cloud computing is a process that must be addressed by the top organizational managers and that the strategic decisions of the managers have a direct impact on the positive or negative implementation of cloud computing in an organization. The more the management of an organization prioritizes information technology and the implementation of in-service training on technological platforms as an integral part of the organization, the faster and more successful its application will be. In this context, leaders must not only change their mindset but also carry out the necessary planning. To realize the benefits of computerization, education management teams should embed computer-related infrastructures into their organizational structure, culture, and strategy and clearly define the role of information technology in education. Because information technology influences all organizational activities, information technology (computer) responsibilities are generally extended to all departments and units of an organization, particularly in education, under the direction and supervision of senior managers. Another component of this model relates to human resources and highlights their importance. Without skilled workers, part-time training in the IT environment would not be possible. A skilled and experienced workforce is critical to implementing computerization and leveraging its benefits within an organization. As already

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mentioned, the knowledge of decision-makers and managers in the field of computer science plays an essential role in the acceptance of computerization. Therefore, in this component, the knowledge of employees within the organization also influences this acceptance. If employees have a high level of knowledge about computers and new technologies, there will be less resistance to their adoption. In addition, management support plays a crucial role in the implementation of computerization in organizational training and can contribute significantly to this process by persuading teachers and boosting morale. The final component of the developed model relates to financial and physical resources. When building a system to train employees in an educational cloud computing environment, financial and physical resources are of particular importance. It is clear that the cost of training employees in a computer environment in the education sector is not that high compared to the high cost in other sectors. In this context, financial allocations in the education sector should be planned for expenses such as salaries of support staff, purchase of necessary hardware and software and other costs related to their implementation."

Based on the research results, it is recommended to understand the importance of in-service training for employees in today's world. The dimensions and components proposed in this research model should be considered by relevant authorities to further prepare and empower teachers. In addition, attention should be paid to the five dimensions mentioned in the research model, which can enable a comprehensive study of the training of prospective teachers using a novel and technology-based approach, especially cloud computing. Cloud computing as a new paradigm has the potential to provide low-cost, fast and highly flexible services to organizations in the education sector. However, to fully benefit from this new paradigm, a thorough study of the educational performance of organizations is required, as well as efforts to modify and reconstruct existing organizational processes to adapt them to the needs and requirements of cloud computing. This may involve modifying or even abandoning many existing processes and addressing the challenges and issues that arise when leveraging the capabilities of cloud computing.

In conclusion, the model proposed in this research is expected to be analyzed and tested by other researchers in different educational settings and at different levels. This will contribute to its expansion and generalizability and may lead to a refinement and modification of the factors and

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components that influence it, ultimately leading to a more comprehensive and complete model in the future. There are several limitations to this study that should be acknowledged. For some education officials, perceiving research as insignificant was a problem. Coordinating with experts to conduct qualitative interviews was challenging. This study was conducted within the Ministry of Education and caution should be exercised in transferring the results to other organizations.

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Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of Farhangian University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection, and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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