Original Article

Identifying and validating the dimensions and components of improving the medical education system in the implementation of online curricula

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Abstract

Background: The current research was conducted with the aim of identifying and validating the dimensions and components of online curriculum implementation.

Methods: The research was conducted with a mixed approach. In order to collect information in the qualitative part after studying the sources, 25 faculty members in the fields of educational management and curriculum planning of medical science groups were purposefully selected and semi-structured interviews were conducted. In the quantitative part, based on the results of qualitative part, an online curriculum implementation questionnaire was compiled with the aim of determining the components of the improvement of the medical education system. The validity of the questionnaire was obtained from factor analysis and reliability from the index of Cronbach's alpha coefficient and composite reliability. The questionnaire was distributed among 380 professors of different disciplines. The results were analyzed using the univariate t test.

Results: The results of the qualitative part showed that the implementation of the online curriculum included 11 dimensions, 36 components and 123 concepts. The results of the quantitative part also showed the validity of the identified dimensions and components, and the validity and reliability of the variables were confirmed. The results of the univariate t-test showed that the status of online curriculum implementation dimensions was moderate to high.

Conclusion: The online implementation of the curriculum requires the combination of synchronous and asynchronous education for better participation and access of students to the subjects at any time without restrictions and establishing communication and interaction between students and professors.

Keywords: Curriculum; Education, Medical; Universities.

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Introduction

The COVID-19 outbreak has become a vital challenge in many sectors, including education. An emerging body of knowledge on the effects of the COVID-19 pandemic on education was developed (1). The COVID-19 outbreak significantly affected the world's education system and led to the closure of many schools and universities. Educational systems faced challenges during this period and made them use e-learning while they were not prepared for it (2). Curriculum and

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learning design for online learning is different from learning design for a face-to-face course. The needs of students in an online learning course are different from the needs of students who choose other methods of study. The learner and his needs should be at the forefront of the design process in the design of any learning program (3).

Additionally, an understanding of the medium through which the teaching or learning experience occurs is required. Content, learner, teaching strategies, and learning experience evaluation tools are among the crucial elements that should be considered when designing learning for distance education (4). Curriculum design that requires deeper reflection and participation from students depends on sociocultural learning theories such as constructivist learning approaches. It creates higher levels of student responsibility for learning, helps them be better prepared, and displays a stronger student organization (5). The models presented in the area of curriculum design did not have sufficient compatibility in the field of online education environment. Thus, new learning environments need to adopt new approaches concerning curriculum design to solve the problems related to traditional and inflexible learning (6).

In other words, curriculum design and development are necessary for the successful implementation of e-learning since improving the quality of learning in the context of online education requires the design of a systematic curriculum in which the relationship between curriculum elements and the way of integrating it with technological capabilities is displayed (7). Accordingly, it is necessary to design and implement an online curriculum, especially in the pandemic of diseases such as COVID-19 and the possibility of such conditions reoccurring in the future, from the viewpoints of various stakeholders, including teachers, school principals, and students. This study identifies and validates the dimensions and components of improving the medical education system in the implementation of online curricula.

Methods

Research environment and population

This study was conducted using a mixed approach (qualitative-quantitative) and sequential technique. In the qualitative section, the dimensions and components of the implementation of the online curriculum were identified through interviews with experts in the field of educational management of medical sciences and content analysis of studies and articles related to the curriculum. A purposeful sampling method was used in the qualitative section among the experts in the field of educational management and curriculum planning of medical groups who were also faculty members of the university.

Data collection method

The required data in this section were collected through interviews with 21 experts in the field of the research subject. To conduct the interviews, a semi-structured interview was conducted after identifying and determining the samples, referring to the participants in the research, explaining the objectives of the research, and attracting their participation. Content analysis of the interviews is performed through the systematic classification of codes and categories directly and inductively from the raw data. To analyze the data, some steps were used including reading significant results and empathy with the participants to understand people and extract important sentences related to the studied phenomenon, giving specific concepts to the extracted sentences, categorizing concepts and the obtained clusters, referring to the primary content and compare the data, describing the studied phenomenon, and finally returning the description of the phenomena to the participants to check the reliability of the obtained results, and then, coding and

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extracting the dimensions. To determine the credibility, a strategy such as reviewing the participants was used. Additionally, the full text of the codes and classes was provided to three experts and their opinions were used in the correction or confirmation.

Statistical analysis

According to the results of data classification, primary dimensions and components were formed. According to the results of interviews and past studies, an online curriculum implementation questionnaire was developed in the form of 11 dimensions and 123 items. In the quantitative section, to examine the factor validity of the dimensions and components of the implementation of the online curriculum, the method of factor analysis and the indicators related to the validity of the auditor (Fronell-Larcker criterion, factor loads, and convergent AVE index) were used. Cronbach's reliability index and composite reliability were used to examine reliability. The software was used to calculate the validity and reliability indices. Then, by removing some questionnaire items that had a lower Smart PLS factor load, the final questionnaire was developed with 123 items on a 5-point Likert scale. Then, it was distributed among 380 male and female professors working in different groups of medical sciences using the cluster sampling method.

Results

Qualitative section

The main results of the study are presented in this section. The interviews conducted in the first stage were coded and by identifying verbal items, 123 concepts were identified. In the axial coding stage, by reviewing the concepts, sub-categories were identified and categorized. In this stage, 36 components were extracted from 123 open codes. In the third stage of selective coding, the subcategories identified in the axial coding stage were analyzed and categorized into 11 primary dimensions. Table 1 presents the three stages of coding.

Quantitative section

In the quantitative section of the study, the reliable Kolmogorov-Smirnov test was first used to check the data distribution. The results of this test revealed that the significance level of the test for all variables was less than 0.05, so the H0 hypothesis of the variables is rejected and the H1 hypothesis is confirmed. Thus, the distribution of the variables does not follow the normal distribution. Therefore, non-parametric methods were used to investigate the relationships between research variables.

Spearman correlation test

Due to the non-parametric nature of the data distribution, Spearman's correlation test was used to investigate the relationship between the primary variables.

Table 2 presents the results of Spearman's correlation between the primary research variables. As shown in the Table 2 (all numbers are between zero and one), the significance level of the correlation coefficients is less than 5%. Thus, the null hypothesis is rejected and the opposite hypothesis is confirmed. Thus, there is a significant correlation between all research variables. As a result, the hypotheses can be tested using the structural equation method.

Sampling adequacy test

Before performing the factor analysis, it is necessary to ensure whether the number of available data is suitable for factor analysis or not. For this purpose, we use KMO indices and Bartlett's test. Based on the significance level, we concluded that the desired data are suitable for sampling.

The KMO test shows whether the number of sample data is suitable for factor analysis or not. This index value is variable in the range of zero to one. If the index value is close to one (at least 0.6), the desired data are suitable for factor analysis, otherwise (usually less than 0.6), the results of factor analysis are not suitable for the desired data. Based on the obtained index (KMO=0.929), the number of data is suitable for factor analysis.

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Table 1. Results of coding and identification of dimensions(D) and components of online curriculum implementation

D	components	Concepts
Goals of online curriculum	Development of multiple communications	Improving cooperation among students in the classroom
		Capabilities to develop communication skills among students
		Creating exchange and the possibility of free discussion in the online classroom space
		Capabilities to develop communication skills between students and teachers
	Adaptability to online education	Flexible goals and fostering creativity among students
		A fit between course goals and educational content
		Fit between curriculum goals and characteristics of the online learning environment
	Improving independent learning	Improving students' independent learning
		Developing students' intrinsic learning motivations
		Development of active learning in students
		Giving independence to students in the online classroom
		Development of self-regulated learning
	Development of online learning skills	Developing students' technological skills and digital literacy
		Problem-solving skills of students
		Creative and critical thinking among students
		Implementation of education using hardware and online platforms
Teachers	Media literacy	Teachers with digital capability and technological skills
		Production and design of electronic content for the classroom
		Teachers capable of using diverse learning resources and media
	Creativity	Communication skills of teachers
		Creative teachers in online classroom time management
		Creative teachers in using educational media in the online classroom
		Facilitating the teacher in the process of online learning, especially for high school students
	Capability in establishes communications and relationship	Providing feedback to students by teachers
		The continuous communication between the teacher and the students and the feeling of his presence in the class by the students
		The teacher's role in students' participation and social activities in the online classroom
	Online education skills	Teachers' sensitivity to differences between students in the online classroom
		Facilitating learning conditions for online classroom students by teachers
		Mastery in presentation methods, group discussion, and brainstorming
		Considering individual differences between students (learning style, learning speed, etc.)
		The active role of the teacher in facilitating the online learning process
Educational content	Persuasive content	Optimal presentation of educational materials in the online classroom
		Persuasive and attractive content for high school students
		Content based on attractive ideas for high school students
		Educational content tailored to the interests and expectations of high school students
		Content based on key competencies for high school students
		Educational content that fosters the cognitive development of students
	Optimal and up-to-date content	Up-to-date and accessible educational content
		Optimizing online educational materials based on academic categories at the high school level
		Using multimedia such as sound and image appropriately
Online education	Support from students	Support of school counselors for high school students
		technology support team in the school to provide online curriculum requirements and infrastructure
	Support from teachers	Technical support for teachers from effective and optimal online teaching
Applying efficient technology	Accessible technology	Accessibility of technology from the viewpoint of students and teachers (suitable educational hardware and software)
		Low-cost technology
		Ease of using technology in the classroom
	Learning facilitating technology	Up-to-date and modern educational technology
		Attractiveness for students
		Technology facilitator learning
		The possibility of producing assignments virtually
		The possibility of multimedia in educational technology
		Speed of used network
		The usefulness of technology in the classroom context
		Various possibilities of educational technologies used in the classroom
	Primacy technology	Students' and parents' trust in the educational platform
		Ensuring the impossibility of cheating on the online learning platform
		Respecting the privacy of students
Evaluation	evaluation strategies	Self-evaluation
		Group evaluation
		Synchronous and asynchronous evaluation
		Peer evaluation
	Evaluation appropriate to online environment	Fit between strategies and e-learning

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D	components	Concepts
Learners	Motivation	Active and independent students without the need for traditional learning scaffolding such as teachers and parents
		Curiosity of learners
		Knowledge-creating learners
	Individual differences	Talent level of students
		Students' position regarding access to online educational facilities
		Compensatory education for some students
	Self-centeredness and independence	Autonomous learners
		Self-paced learners
	Learning skills	Critical thinking learners
		Learners with social skills
		Learners with problem-solving skills
	Self-evaluation	Learners evaluating their learning and that of other students in the online classroom
		Self-progress monitoring
	Digital literacy	Digitally literate learners
		Desire for online learning
Presence in the online learning process	Emotional presence	Emotional presence of teachers by establishing interaction between learners in the online classroom
		Monitoring and analyzing emotions to adapt students to a new role
	Cognitive presence	The teacher's effort to develop thinking skills among students
		Cognitive presence of teachers through the provision of educational content persuading problem-solving and critical thinking
	Educational presence	The educational presence of teachers through the design and organization of students' learning experiences
		Educational presence of teachers through dialogue environment
		Educational presence of teachers through the implementation of learning activities
		Educational presence of teachers through the creation of dialogue and direct education environment
	Social presence	Clarifying the expectations from students by teachers in the classroom due to the lack of physical presence of teachers and students
		Social presence of the teacher by providing quick and timely feedback to students in the online classroom
		Lack of psychological distance between teacher and students and intimacy in the classroom
		Creating a sense of belonging among students by the teacher in the classroom
Grouping learners	Non-homogeneous grouping and flexible group learning	Grouping students based on the subject and purpose of education
		Developing relationships and interactions among students
		Determining expectations for each group member
		Knowing the capabilities of each member and supporting them
		Group learning precedes individual learning
		Emphasis on experiential and active learning in the classroom
		Teaching group-oriented skills among students
		Development of online activities
		Class activities in the form of working groups
		Formation of flexible groups
		Providing group work instructions in the online classroom
synchroneity	Education flexibility	Combining synchronous and asynchronous learning in the online curriculum
		Flexibility in response time in the classroom along with defining the necessary rules in the classroom
		Providing teacher control over group interaction by setting a specific time limit, not merely classroom hours
		The opportunity to review students for better participation in the classroom
	Access to materials without time limits	Access of high school students to subjects at any time without restrictions
		Communicating and interacting between students and teachers regardless of classroom time
Parents	Knowledge about online education	Positive attitude toward online education
		Knowing your child's online learning processes
		Parents aware of online and virtual learning
	Parent support from students	Providing the necessary tools and infrastructure for online education of children
		Giving self-confidence to students by parents and reducing their anxiety
		Emotional and social support of parents to their children during online education
	Desire for participation in the child's education process	Cooperation with teachers and schools in online education
		Providing criticism and suggestions to improve children's online education
		Active participation of parents in the education process
	Sufficient time to allocate to the child's education	Time management for online education of children and other responsibilities
		Planning for children's education
		Learning the necessary skills for better participation in the online education process
Evaluation	Constructive evaluation	Fit between tools and curriculum goals
		Continuous and two-way feedback to improve the online learning process
		Evaluation of problem-solving and critical thinking skills among students
		Evaluation of communication skills and student's participation level
		Paying attention to individual differences

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Table 2. Correlation between variables of the research model

Row	Goals of online curriculum	Learners	Teachers	Educational content	Grouping learners	Presence in the e-learning	applying efficient technology	Synchronicity	Parents	Evaluation	Online curriculum
Goals of online curriculum	1										
Learners	0.694**	1									
teachers	0.567**	0.729**	1								
Educational content	0.476**	0.532**	0.626**	1							
Grouping learners	0.417**	0.560**	0.576**	0.775**	1						
participation in the e-learning process	0.359**	0.548**	0.434**	0.280**	0.497**	1					
applying efficient technology	0.485**	0.632**	0.552**	0.378**	0.492**	0.712**	1				
synchronicity	0.418**	0.518**	0.470**	0.306**	0.362**	0.434**	0.619**	1			
Parents	0.492**	0.600**	0.532**	0.395**	0.433**	0.551**	0.707**	0.669**			
Evaluation	0.387**	0.493**	0.440**	0.261**	0.341**	0.434**	0.554**	0.528**	0.654**	1	
Online curriculum	0.731**	.870**	.823**	.702**	.723**	.669**	.790**	.677**	.790**	.660**	1

In the above table, * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Bartlett's test

It tests the assumption "correlation matrix of observed variables is unit". This test confirms that the variables are not related to each other. It is obtained through the significance of the chi-square test. If the significance level in Bartlett's test is less than 5%, the correlation matrix will not be the same, meaning that there is a relationship between the variables, and the statistical null hypothesis is rejected. Based on the table, the significance level of the test is 0.000, meaning that the null hypothesis is rejected and there is a significant relationship between the variables.

Model fit

The fit of the research model was examined in two stages. The first is the evaluation of the fit of the measurement part of the model and the second is the evaluation of the fit of the structural part of the model, which are discussed in detail below.

Measurement model

The t-statistic value is used to examine the significance of relationships in SmartPLS software. This value is 1.96 for a 5% error. To examine the significance, comparing the t-statistic value of relationships with the value of 1.96 is used. If the t-value is higher than the mentioned value, the relationship will be significant. According to the above figure, all the t-values are higher than 1.96,

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so all the model relationships are significant.

Structural model

A) Since all Cronbach's alpha, composite reliability (internal consistency), and AVE values are all in the relevant range, it is possible to confirm the suitability of the reliability and convergent validity of the research model.

B) The factor load of each of the research measures to examine the reliability and construct validity is presented in Table 3. As seen in the table, the factor loads of the variables are all above 0.4. Thus, the reliability and construct validity of the research model measures can be confirmed.

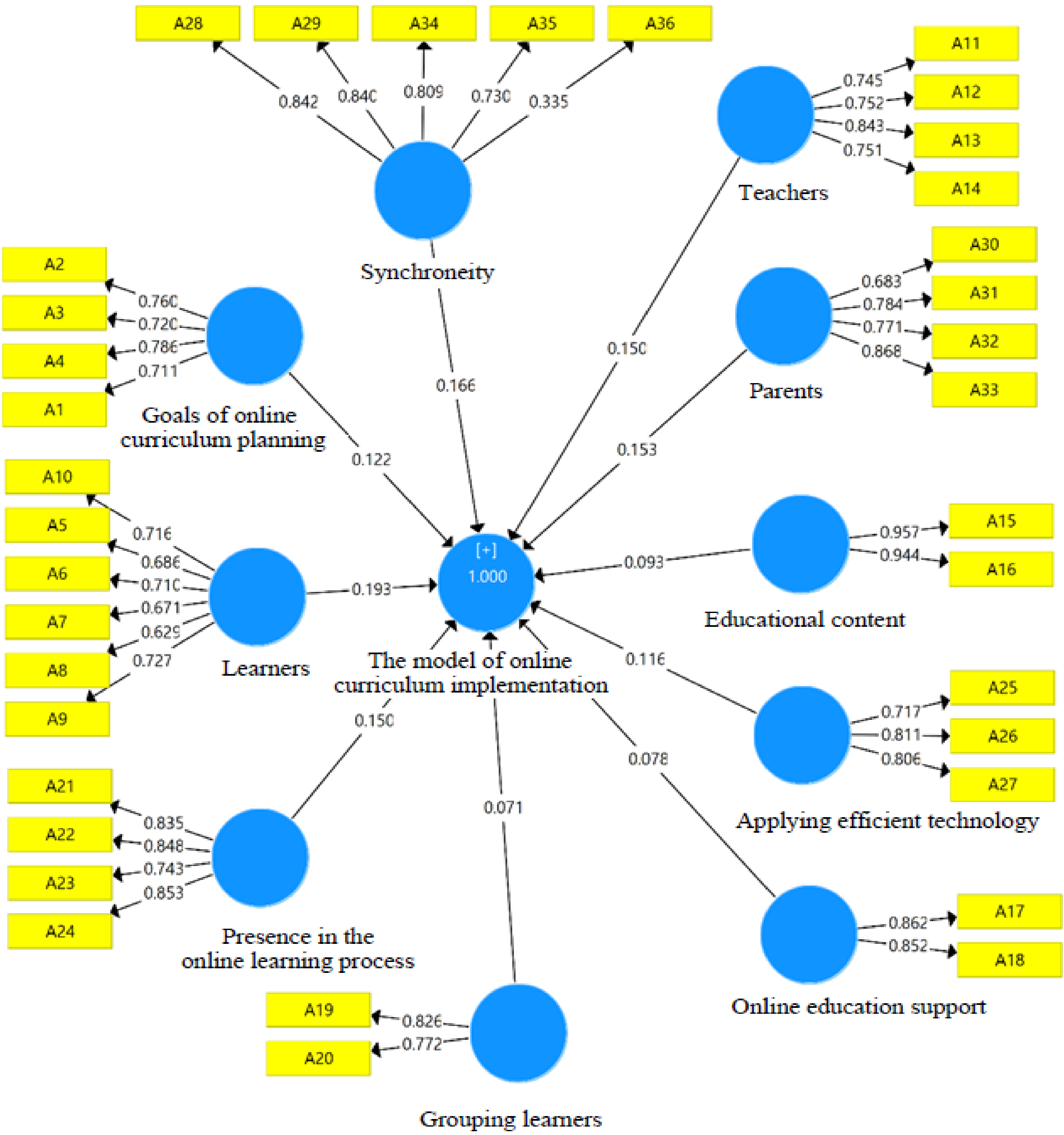

Figure 1. Standard regression coefficients of the research model

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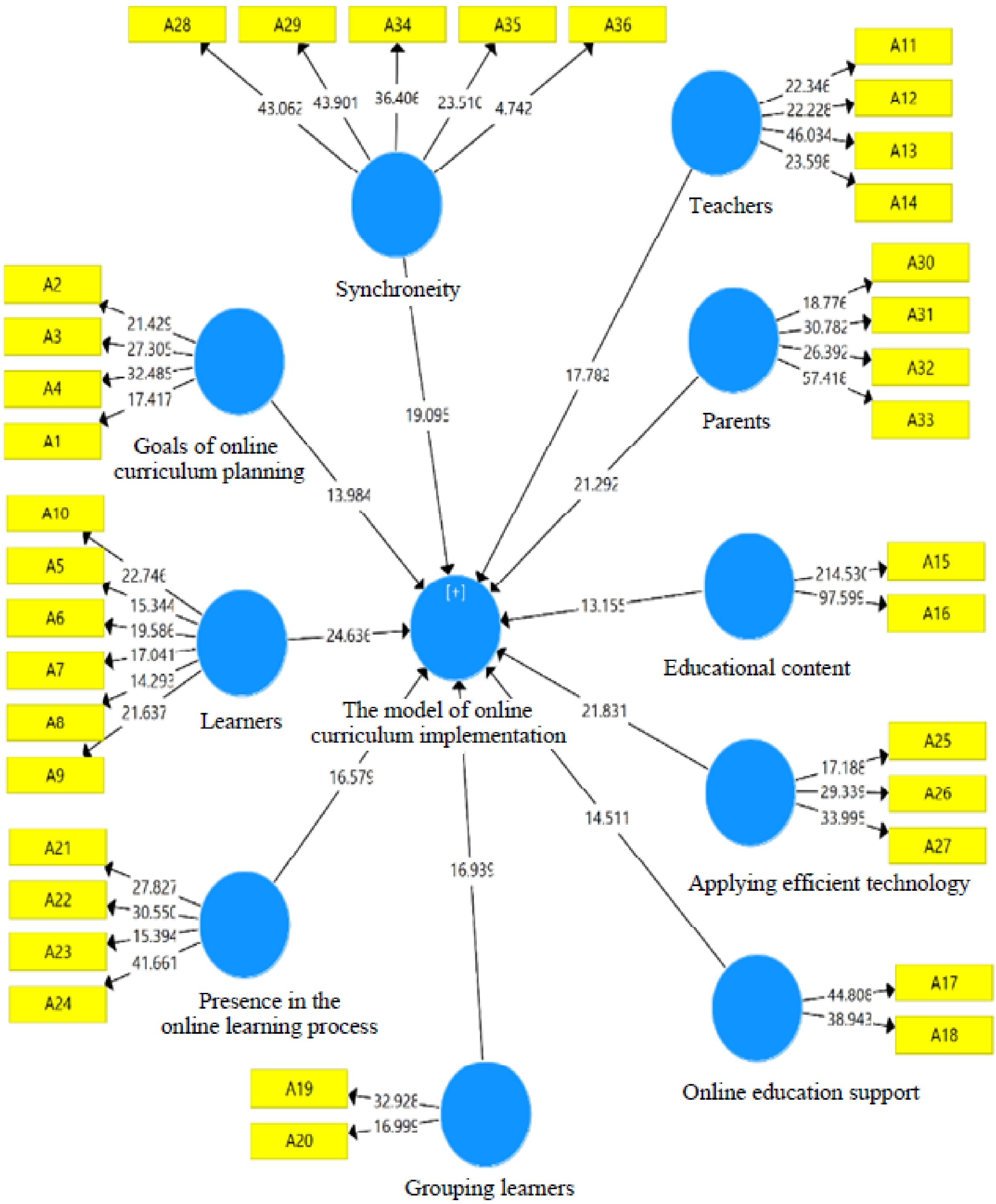

Figure 2. T-values of the research model

Cronbach's alpha, reliability, and convergent validity Is shown in table 3.

Fronell-Larcker test

It measures the relationship between a structure and its indicators by comparing the relationship of that structure with other structures. The acceptable divergent validity of a model indicates that a structure in the model interacts more with its indicators than with other structures. Divergent validity is acceptable when the AVE for each structure is higher than the shared variance between that structure and other structures in the model.

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Table 3. The results of three measures of Cronbach's alpha, reliability, and convergent validity

Variables	Cronbach's alpha (Alpha>0.7)	Composite reliability (Cr>0.7)	Average variance extracted (AVE>0.5)
The online curriculum implementation model	0.947	0.952	0.558
Goals of online curriculum planning	0.732	0.832	0.554
Applying efficient technology	0.775	0.822	0.607
Presence in the online learning process	0.838	0.892	0.674
Educational content	0.893	0.949	0.903
Professors	0.776	0.856	0.599
Parents	0.782	0.860	0.607
learners	0.780	0.845	0.477
Online education support	0.739	0.847	0.734
Synchroneity	0.768	0.847	0.543
Grouping learners	0.738	0.780	0.640

In simpler terms, the model has acceptable divergent validity if the numbers in the original diameter are higher than the values below it. Based on this criterion, a latent variable should have more dispersion among its observables compared to other latent variables to state that the desired latent variable has high diagnostic validity (7). To calculate the Fronell-Larcker value from the average variance extracted table, the root was taken from the AVE of latent variables. Table 4 presents these values.

Goodness of fit criteria of the research model

Based on the obtained values, the data collected for the measurement of latent variables have the necessary adequacy and fit. Thus, the results of the estimation of the research model are reliable Table 5.

Examining the predictive fit of the model

The Q2 (Stone-Geisser) value determines the predictive power of the model in endogenous structures. Models that have an acceptable structural fit should predict the endogenous variables of the model. This means that if the relationships between the structures are correctly defined in a model, the structures have a sufficient impact on each other and accordingly the hypotheses are confirmed.

Table 4. Fronell-Larcker matrix

Row	The model of online curriculum implementation	Goals of online curriculum planning	Applying efficient technology	Presence in the online learning process	Educational content	Teachers	Parents	Learners	Online education support	ynchroneity	Grouping learners
The model of online curriculum implementation	0.598										
Goals of online curriculum planning	0.715	0.745									
Applying efficient technology	0.824	0.489	0.779								
Presence in the online learning process	0.717	0.362	0.739	0.821							
Educational content	0.668	0.462	0.395	0.296	0.950						
Teachers	0.809	0.558	0.562	0.448	0.628	0.774					
Parents	0.810	0.496	0.707	0.559	0.399	0.537	0.779				
Learners	0.870	0.705	0.648	0.557	0.532	0.722	0.611	0.691			
Online education support	0.680	0.472	0.387	0.317	0.812	0.658	0.398	0.555	0.857		
synchroneity	0.789	0.467	0.697	0.526	0.344	0.528	0.792	0.591	0.378	0.737	
Grouping learners	0.717	0.411	0.534	0.538	0.708	0.561	0.460	0.562	0.673	0.435	0.800

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Factor load

Table 5. Factor loads of the variables of each structure

Factor load	Question description	Dimensions	Factor load	Question description	Dimensions
0.842	Emotional presence	Presence in the online learning process	0.711	Development of multiple relationship	Goals of online curriculum planning
0.84	Emotional presence		0.716	Adaptation to online training	
0.72	Emotional presence		0.745	Improving independent learning	
0.683	Social presence		0.752	Developing online learning skills	
0.784	Social presence	Applying efficient technology	0.843	Motivation	Learners
0.771	Learning facilitating Technology		0.751	Individual differences	
0.868	Privacy protecting technology		0.957	Self-centeredness and independence	
0.809	Education flexibility	synchroneity	0.944	Learning skills	
0.73	Unpredictable access to the curriculum		0.862	Self -evaluation	
0.335	Online education awareness	Parents	0.852	Digital literacy	
0.786	Parent support from students		0.826	Media literacy	Teachers
0.686	A desire to participate in the child's education process		0.76	Creativity	
0.71	Sufficient time to assign to child education		0.772	Communication	
0.671	Evaluation strategies		0.835	Online teaching skills	
0.629	Evaluation to fit the online environment	Evaluation	0.848	Persuasive content	Educational content
0.727	The constructive evaluation		0.743	Optimized and up -to -date content	
0.811	Non -homogeneous grouping	Grouping learners	0.853	Support from students	Online education support
0.806	Flexible group learning		0.717	Support from teachers	

Hensler et al. (2009) determined three values of 0.02, 0.15, and 0.35 as values of low, moderate, and strong predictive power. This value for the online curriculum implementation model variable is 0.326. The moderate value of these values indicates the fit of the predictor with these constructs.

Examining the status of online curriculum implementation

In this section, the descriptive statistics and sample T-Tech test of the online curriculum implementation model status were first examined to examine the status of the online curriculum implementation model:

As shown in Table 6, the one-sample mean statistics showed that the mean status of online curriculum implementation dimensions is more than 3. Thus, it can be said that the online curriculum implementation is moderate to high. Also, since the t-statistic is higher than the critical statistic of the Table 6 and the significance level of this statistic is 0.00, which is smaller than 0.05, it can be said that the status of online curriculum implementation dimensions is moderate to high.

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Table 6. One-sample t-test of online curriculum implementation status

Statistical index Dimensions	Test Value = 3					
	T	Df	Sig	Mean difference	95% confidence interval	
					Lower bound	Upper bound
goals of the online curriculum	24.461	379	0.000	0.87237	0.8022	0.9425
learners	32.849	379	0.000	1.09518	1.0296	1.1607
teachers	24.140	379	0.000	1.00461	0.9228	1.0864
Educational content	15.705	379	0.000	0.93947	0.8219	1.0571
grouping learners	38.392	379	0.000	1.41316	1.3408	1.4855
Presence in the online learning process	59.755	379	0.000	1.67829	1.6231	1.7335
Applying efficient technology	36.472	379	0.000	1.27895	1.2100	1.3479
synchroneity	27.732	379	0.000	1.22500	1.1381	1.3119
parents	29.874	379	0.000	1.10789	1.0350	1.1808
evaluation	25.008	379	0.000	0.99912	0.9206	1.0777

Discussion

Educational systems experienced a big shock in pandemic conditions, especially in the recent pandemic of COVID-19 disease in 2020 (8). A stop in learning, a gap in the care of children at home by parents, costs imposed on families and educators, an increase in school dropouts, social isolation, lack of planning, and increasing the hours of students' presence in cyberspace and uncontrolled use of smartphones were among the challenges in the field of education arisen due to the pandemic conditions (9). The implementation of online education was the only way to continue the education process in many parts of the world due to the development and progress of the pandemic conditions. Additionally, many problems were created in the online curriculum implementation during this period. Some of these problems were related to the insufficient infrastructure of schools and families, weak technological infrastructure, weak digital literacy of families and active forces in education, shortage of parental time, and lack of knowledge about online education (10). According to the results, the dimensions and components of the online curriculum implementation model in the country during the outbreak of widespread diseases were identified.

The first dimension was related to the goals of the online curriculum. This dimension was identified and categorized with 4 components including the development of multiple communications and relationships, adaptability to online education, improvement of independent learning, and development of online learning skills. In explaining these results based on the findings of the qualitative section of this study, it can be stated that the online curriculum goals should focus on improving cooperation, and communication skills, fostering creativity, creating a balance between the curriculum goals, the characteristics of the online learning environment, developing independent learning, and developing technological skills. In this regard, researchers such as Razaghi et al. (7), SajediFar et al. (10), Khorasani (11), Ghanbarypour Talami et al. (12) referred to the online curriculum goals .

The second dimension was related to learners. This dimension was identified and categorized with 6 components including motivation, individual differences, self-centeredness and independence, learning skills, self-evaluation, and digital literacy. In explaining these results based on the findings of the qualitative section of this study, it can be stated that the online curriculum implementation requires learners motivated for online education, learners' access to online education, autonomous and self-paced learners, and learners with the necessary social skills, self-evaluator, and digitally literate learners. In this regard, researchers such as

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Kardan et al. (1), Razaghi et al. (7), Khorasani (11) and Ghanbarypour Talami et al. (12) referred to the characteristics of learners.

The third dimension was related to teachers. This dimension was identified and categorized with 4 components including media literacy, creativity, ability to establish communication, and online teaching skills. In explaining these results based on the findings of the qualitative section of this study, it can be stated that the online curriculum implementation requires digitally literate teachers, who have communication skills, are creative in online education, and are skillful in online teaching and learning methods. In this regard, researchers such as Razaghi et al. (7), SajediFar et al. (10), Ghanbarypour Talami et al. (12), Peimani & Kamalipour (13) and Sun & Chen (14) referred to the characteristics of teachers.

The fourth dimension was related to educational content. This dimension was identified and categorized into 2 components including persuasive content and optimal and up-to-date content. In explaining these results based on the findings of the qualitative section of this study, it can be stated that the online curriculum implementation requires optimal and attractive educational materials tailored to the interests and expectations of students, are based on key competencies, and foster cognitive development. In this regard, researchers such as Kardan et al. (1), Razaghi et al. (7), SajediFar et al. (10), Khorasani (11), Ghanbarypour Talami et al. (12), Teymori & Fardin (15), and Zhao & Watterston (9) referred to the characteristics of educational content.

The fifth dimension was related to online education support. This dimension was identified and categorized with 2 components including student support and teacher support. In explaining these results based on the findings of the qualitative section of this study, it can be stated that the online curriculum implementation requires the support of consultants, the technology support team in the school to prepare the requirements and infrastructure of the online curriculum and technical support from teachers for effective and optimal online teaching. In this regard, researchers such as Mayadas et al. (3) and Razaghi et al. (7) referred to the characteristics of online education support .

The sixth dimension was related to the grouping of learners. This dimension was identified and categorized with 2 components including non-homogeneous grouping and flexible group learning. In explaining these results based on the findings of the qualitative section of this study, it can be stated that the online curriculum implementation requires grouping students based on the education subject and goal, developing relationships and interactions between students, determining expectations from each member of the group, knowing the capabilities of each of members and their support, group learning before individual learning, emphasis on experiential and active learning in the classroom, teaching group-oriented skills among students, developing online activities, class activities in the form of working groups, forming flexible groups, and presenting instructions for group work in the online classroom. In this regard, researchers such as Kardan et al. (1), Razaghi et al. (7), Khorasani (11), and Haydari (16) referred to the characteristics of grouping learners.

The seventh dimension was related to the presence in the online learning process. This dimension was identified and categorized into 4 components including emotional presence, cognitive presence, educational presence, and social presence. In explaining these results based on the findings of the qualitative section of this study, it can be stated that the online curriculum implementation requires the emotional presence of teachers by establishing interaction between learners in the online classroom, observing and

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analyzing emotions to adapt students to the new role, the teacher's efforts to develop thinking skills among students, the cognitive presence of teachers through the provision of educational content that encourages problem solving and critical thinking, the educational presence of teachers through the design and organization of students' learning experiences, the educational presence of teachers through the dialogue environment, the educational presence of teachers through the implementation of learning activities, the educational presence of teacher education through forming a dialogue environment and direct training, clarifying the expectations from students by teachers in the classroom due to the lack of physical presence of the teacher and students, social presence of the teacher by providing quick and timely feedback to students in the online classroom, lack of psychological distance between the teacher and students and intimacy in the online classroom, and forming a sense of belonging among students by the teacher in the classroom. In this regard, researchers such as Razaghi et al. (7) and Haydari (16) referred to the characteristics of being present in the online learning process.

The eighth dimension was related to applying efficient technology. This dimension was identified and categorized into 3 components including accessible technology, learning facilitator technology, and privacy-protecting technology. In explaining these results based on the findings of the qualitative section of this study, it can be stated that online curriculum implementation requires technology accessibility from the viewpoints of students and teachers (appropriate educational hardware and software), low-cost technology, ease of using technology in the classroom, up-to-date and modern educational technology, attractiveness for students, learning facilitating technology, the possibility of creating assignments virtually, the possibility of multimedia in educational technology, the speed of the network used, the technology usefulness in the classroom, the various possibilities of educational technologies used in the classroom, the trust of students and parents in the educational context, ensuring that cheating is not possible in the online learning platform, and respecting the privacy of students. In this regard, researchers such as Kardan et al. (1) and Razaghi et al. (7) referred to the characteristics of applying efficient technology.

The ninth dimension was related to synchroneity. This dimension was identified and categorized with 2 components including education flexibility and access to course materials without time limits. In explaining these results according to the findings of the qualitative section of this study, it can be stated that the online curriculum implementation requires the combination of synchronous and asynchronous teaching in the online curriculum, flexibility in response time in the classroom, defining the necessary rules in the classroom, and providing teacher control over group interaction with a specific time limit not merely classroom hours, an opportunity to review students for better participation in the classroom, access of high school students to subjects at any time, and establishing communication and interaction between students and teachers regardless of classroom time. In this regard, researchers such as Razaghi et al. (7), Zhao & Watterston (9) and SajediFar et al. (10) referred to the characteristics of synchroneity.

The tenth dimension was related to parents. This dimension was identified and categorized with 4 components including knowledge about online education, parents' support from students, desire to participate in the child education process, and sufficient time to allocate to child education (9). In explaining these results according to the findings of the qualitative section of this study, it can be stated that the online curriculum implementation requires a

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positive attitude of parents toward online education, their knowledge about their child's online learning processes, parents' knowledge and awareness of online and virtual learning, providing the necessary tools and infrastructure for online education of children, giving self-confidence to students by parents and reducing their anxiety, emotional and social support of parents to their children during online education, cooperation with teachers and schools in online education, providing criticism and suggestions to improve online education of children, active participation of parents in the education process, time management for online education of children and other responsibilities, planning for children education, learning the necessary skills for better participation in the online education process. In this regard, several researchers have referred to the characteristics of parents (11, 12).

The eleventh dimension was related to evaluation. This dimension was identified and categorized with 3 components including evaluation strategies, evaluation appropriate to the online environment, and constructive evaluation. In explaining these results according to the findings of the qualitative section of this study, it can be stated that online curriculum implementation requires self-evaluation, group evaluation, synchronous and asynchronous evaluation, peer evaluation, fit between strategies and e-learning, paying attention to individual differences, fit between tools and curriculum goals, continuous and two-way feedback to improve the online learning process, evaluation of problem-solving skills and critical thinking among students, evaluation of communication skills, and students' participation level. In this regard, researchers such as Kardan et al. (1), Razaghi et al. (7), Zhao & Watterston (9), SajediFar et al. (10), Khorasani (11), Ghanbarypour Talami et al. (12) and Dadgaran et al. (17) referred to the characteristics of evaluation.

Conclusion

The online curriculum implementation requires the combination of synchronous and asynchronous teaching in the online curriculum, flexibility in response time in the classroom along with the definition of the necessary rules in the classroom, providing teacher control over group interaction by setting a specific time limit not merely classroom hours, the opportunity to review students for better participation in the classroom, students access to subjects at any time without restrictions and communication, and interaction between students and teachers regardless of the classroom time.

Authors' contribution

Gita Zandieh and Aladdin Etemad Ahri developed the study concept and design. Zolfaghar Rashidi and Gita Zandieh acquired the data. Gita Zandieh and Aladdin Etemad Ahri analyzed and interpreted the data, and wrote the first draft of the manuscript. All authors contributed to the intellectual content, manuscript editing and read and approved the final manuscript.

Informed consent

Questionnaires were filled with the participants' satisfaction and written consent was obtained from the participants in this study.

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Conflict of interest

The authors declare that they have no conflict of interests.

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