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Adapting amidst adversity: investigating medical educators' attitudes towards change and resilience in the face of educational barriers during COVID-19 pandemic

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Introduction: Resilience in the face of educational barriers refers to faculty members' ability to effectively navigate, overcome, and adapt to challenges encountered in the educational environment. These challenges may include curriculum changes, transitions to online instruction, resource limitations, or disruptions caused by external factors, such as a pandemic. This study aims to explore the relationship between medical educators' attitudes toward change and their resilience in overcoming these educational barriers.

Methods: This survey was conducted on 130 medical teachers of Shiraz University of Medical Sciences (SUMS) in 2021-2022. A standard questionnaire with 18 items was used to assess the teachers' attitudes to change. A researcher-made questionnaire, including 36 items in eight components, was designed to assess the teachers' resilience to educational barriers.

Results: Based on findings, teachers' attitudes towards change were moderate in the affective and behavioral aspects but strongly positive in the cognitive aspect ($p < 0.001$). Teachers with more positive attitudes, compared to those with weaker attitudes, reported significantly fewer barriers in areas such as previous readiness ($p = 0.025$) and technical support ($p = 0.005$). Faculty members with better computer skills ($p < 0.001$) not only perceived fewer barriers but also exhibited more positive attitudes toward change ($p = 0.002$).

Conclusion: Attitudinal barriers are influenced by a person's knowledge and skills, affecting their attitude toward change and willingness to face challenges. Involving teachers in diverse online education experiences and improving their competencies can enhance their acceptance of technological changes.

KEYWORDS

online learning, educational obstacles, medical teacher, educational resilience, COVID-19 pandemic

Introduction

Resistance to technological change is a well-known phenomenon in educational contexts, where many educators prefer traditional teaching methods over new technologies (Lomba-Portela et al., 2022), particularly before the COVID-19 pandemic highlighted the necessity for digital tools in education. Teachers tend to prefer maintaining the status quo and are cautious

when faced with changes. Several factors contribute to this resistance, including uncertainty about the objectives and outcomes of new initiatives, fear of the unknown, and a lack of skills or training to effectively implement new technologies (Robinson and Goodey, 2018). Additionally, cultural and organizational factors play significant roles in shaping attitudes towards change, as teachers may resist reforms if they feel their input is not valued or perceive a threat to their professional identity and status (Aldridge and McLure, 2024). Resistance is often emotionally driven, with feelings of anxiety, frustration, and loss of control inhibiting the adoption of new practices (Harper, 2012; Lomba-Portela et al., 2022). This is also because many aspects of the initiative require time to be implemented (Gutierrez et al., 2016; Akdeniz and Konaklı, 2022).

Before the COVID-19 pandemic, many teachers did not utilize technology in the classroom (Cheong et al., 2021; Fox, 2018). Institutional lack of motivation, support, and incentives hinders faculty adoption of e-learning tools (Rizvi et al., 2017). However, while resistance to change has always existed, the COVID-19 pandemic played a pivotal role in forcing educators to rapidly transition from traditional methods to digital tools, significantly altering the landscape of education. The pandemic caused widespread closures of educational institutions and forced a rapid transition from in-person teaching to online learning, compelling all educators to adopt digital tools (Rose, 2020). Medical educators, in particular, faced significant barriers, including technological limitations, shifts in pedagogy, and the need for rapid curriculum adjustments. These challenges underscored the importance of resilience—the ability of educators to adapt and thrive despite adversity (Yang and Wang, 2022).

Resilience is a dynamic process of adaptation, where both internal factors (e.g., personal coping strategies) and external factors (e.g., institutional support) interact to help educators navigate educational disruptions (AlQashouti et al., 2023; Darabi et al., 2023; Shengyao et al., 2024). Resilience plays a crucial role in educators' ability to cope with and overcome the barriers posed by technological change. Despite the challenges, teachers who demonstrated high resilience were able to navigate the complexities of online teaching, adapt their methods, and continue providing quality education (García-Morales et al., 2021). Yet, many educators were not adequately prepared to confront this abrupt shift. Many teachers faced challenges due to a lack of access to essential equipment such as laptops, headsets, cameras, and other necessary tools. Additionally, there was a significant shortage of hands-on experience in training programs, particularly regarding pedagogical training for content generation. This combination of factors hindered teachers' ability to effectively transition to online teaching and create engaging learning experiences for their students (Ahmad et al., 2021; Ameri et al., 2023).

An important point is that although the conditions during the pandemic were the same for all professors, teachers' resilience levels in facing these barriers varied (Mojahedi et al., 2023). Research has shown that various factors played a role in helping educators adapt to changes during the pandemic, and the attitudes of teachers toward change itself emerged as a significant element (Azadianbojnordi et al., 2022; Cheong et al., 2021; Waltman-Payne, 2023). This highlights the importance of understanding how educators' perceptions and willingness to embrace new methods can influence their effectiveness in navigating such

transitions. Factors such as professional development, perceived support from administrators, and personal circumstances were also found to impact these attitudes, ultimately shaping the overall experience of faculty during the shift to online learning (Mahmudi et al., 2020; Dahri et al., 2024; Xiao et al., 2024).

In recent years, significant transformations have occurred in education and learning, and the requirements of a teacher have changed dramatically (Kareem and Kin, 2018). The attitude of teachers, as those who ultimately apply and implement changes, is of particular importance, and this attitude towards change is even more important given the speed of change during the COVID-19 era. Most of the time, the main problem in any organizational change, including changes in the education system, is whether there is acceptance of change or not. Resistance to change is the primary reason for failure in any type of organizational change (Mei Kin et al., 2018). Although the education system is constantly evolving and changing due to its dynamic nature, until teachers, as the implementers of these changes in schools, accept or implement the changes, the reform and change of educational programs will be superficial or even fail. It is clear that teachers' attitudes toward change are one of the main factors in their intention to accept or resist change (Fernandez et al., 2022).

Teachers' attitudes towards change can be understood through three key dimensions. The cognitive component reflects their beliefs about the importance and necessity of change, as well as how beneficial it may be for them personally and within the organization. The affective component pertains to their emotional responses to change, particularly feelings of satisfaction or anxiety. Lastly, the behavioral component involves the actions teachers take in response to change, indicating their level of support or resistance. Overall, these beliefs, emotions, and behaviors are essential for understanding how educators navigate the change process, making it crucial for addressing resistance and facilitating educational reforms (Kareem and Kin, 2018).

The problem

Shiraz University of Medical Sciences is one of the most prominent universities in Iran, which began developing online education in 2010 and undertook activities to enhance e-learning infrastructure and empower faculty members in applying e-learning in classrooms. However, before the COVID-19 pandemic, there was limited enthusiasm for this change, and many professors considered themselves unaffected by online teaching. During the pandemic, we observed diverse reactions from faculty members in adapting to educational changes, with differences in their ability to adapt to the new conditions, what we refer to as resilience in the face of educational barriers. This study aims to provide insights into the relationship between faculty members' attitudes toward change and their level of resilience or adaptation to the new circumstances imposed by the COVID-19 pandemic. By identifying the factors influencing their attitudes and resilience, the findings can inform strategies to support faculty members in navigating educational reforms and technological advancements in the future.

The research objectives are to identify and determine:

- To assess teachers' attitudes toward change during the COVID-19 pandemic.
- To evaluate teachers' resilience in overcoming educational barriers during the COVID-19 pandemic.

Abbreviations: SUMS, Shiraz University of Medical Sciences; LMS, Learning Management System.

- To explore the relationship between teachers' attitudes toward change and their resilience in addressing educational barriers.
- To examine the influence of computer skills on teachers' attitudes toward change.
- To investigate the impact of contextual factors on teachers' resilience during the COVID-19 pandemic.

Methods

Study design

Considering the characteristics of the pandemic period and the different ways of coping with the conditions of this time, a cross-sectional approach was used in this research, drawing on the perspectives of faculty members regarding this matter. This cross-sectional research was conducted on the faculty members of Shiraz University of Medical Sciences, Iran, in 2022.

Participants' background and nature of work

The participants in this study were faculty members from Shiraz University of Medical Sciences, Iran, across various disciplines (e.g., medical sciences and paramedical sciences). All participants had at least two years of teaching experience and a minimum of one year of online teaching experience during the COVID-19 pandemic. These faculty members were selected because they had been involved in both face-to-face teaching before the pandemic and the adaptation to online methods during the early phase of the pandemic. Some faculty members had prior experience using digital tools for hybrid teaching, while others had to rapidly adopt e-learning platforms and technology due to the necessity of the pandemic. The study aimed to examine how these varying levels of prior exposure to online education influenced their resilience and ability to navigate the challenges posed by the sudden transition to remote teaching.

Sampling

The statistical population of the research includes all academic members of Shiraz University of Medical Sciences, Iran, during the 2020–2021 academic year who have at least two years of teaching experience and a minimum of one year of online teaching experience during the COVID-19 pandemic ($N = 600$). The reason for choosing this criterion was that the participating professors in this research had experienced both face-to-face teaching before the COVID-19 pandemic and the educational barriers and difficulties of the early pandemic period, as well as the conditions for adapting to online methods during the pandemic. Therefore, professors were selected who had at least 2 years of work experience. Participants who refused to participate in the research or did not answer more than 20% of the questions were excluded from the data analysis.

Sample size

The Cochran formula was used to calculate sample size. The confidence level was set at 95%, $d = 0.05$, $z = 1.96$, and p and q were

30 and 70% based on previous research (Ahmadi et al., 2013). Finally, 196 samples were estimated.

$$n = \frac{\frac{Z^2 pq}{d^2}}{1 + \frac{1}{N} \left(\frac{Z^2 pq}{d^2} - 1 \right)} = \frac{1.96^2 \cdot 0.3^* \cdot 0.7 / 0.05^2}{1 + \left[\left(1 / 600 \right) * \left(1.96^2 \cdot 0.3^* \cdot 0.7 / 0.05^2 \right) - 1 \right]}$$

$$n = 196$$

Sampling method

It was conducted using a stratified proportional method based on the different faculties. Simple random sampling was used to select the participants. First, the email list of professors was obtained from the university's educational vice presidency, and then, in proportion to the number of professors in each faculty, the link to the e-questionnaire was randomly sent to the professors' emails. Considering that there was no possibility of in-person access to the research samples and the risk of significant sample attrition, three reminders were sent to the participants to complete the questionnaire.

Tools/instruments

Demographic characteristics

The first section of the questionnaire consisted of personal and professional attributes of faculty members, including age, gender, major, academic rank, years of teaching in education, and the school in which they teach. Additionally, participants' computer skills were assessed through self-reporting at three levels: low, to some extent, and to the extent of mastery. The 5-point Likert scale ranged from 1 = very low to 5 = very high. A score of $1 \leq x \leq 2$ indicates a low skill level, a score of $2 < x < 4$ indicates an average skill level, and a score of $4 \leq x \leq 5$ indicates a high level of proficiency.

Q1. Attitudes towards Change: To gather data on attitudes towards change, the 18-item "Attitudes towards Change" questionnaire, originally devised by Dunham et al. (1989) and Gardner et al. (1989), was used after being translated into the Persian language. Three aspects were included: Affective, Cognitive, and Behavioral, each containing six questions. The questionnaire used a 7-point Likert scale, with the following responses (Gardner et al., 1989): 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral (Neither Agree nor Disagree), 5 = Somewhat Agree, 6 = Agree, and 7 = Strongly Agree.

Attitudes of the participants were categorized as low or negative ($1 \leq x < 3$), medium or moderate ($3 \leq x < 5$), and good or positive ($5 \leq x \leq 7$).

Q2. Resilience in Educational Barriers: To examine resilience in educational barriers during COVID-19, a researcher-made questionnaire was developed to assess perceived educational barriers encountered by educators in the online teaching environment. This questionnaire was designed based on two online focus groups with 10 faculty members representing expertise in medical education (1 participant), e-learning (1 participant), higher education management (1 participant), medicine (2 participants), basic medical sciences (2

participants), and paramedicine (3 participants). The questionnaire contained 36 items divided into eight components:

- Technological Infrastructure (5 items),
- Knowledge and Skills (4 items),
- Attitudes Toward Technology (4 items),
- Previous Readiness or Professional Development (4 items),
- Self-Management Skills (4 items),
- Technical Support (5 items),
- Personal Barriers (5 items),
- Learning Management System (LMS) Barriers (5 items).

The Likert scale responses were scored on a 7-point scale (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, and 7 = Strongly Agree), with a cut-off value of 4 for analysis. Higher scores indicated more barriers, while lower scores indicated less perceived resistance or better resilience in overcoming barriers. It is important to note that, due to the nature of the statements, higher scores in the barrier's questionnaire indicated lower resilience in facing these challenges.

The online survey included open-ended questions to further explore participants' views on technological barriers.

Validity and reliability

The "Attitudes towards Change" questionnaire has been widely used in various research contexts. The construct validity was confirmed through factor loadings ranging from 0.64 to 0.83, which indicates a moderate to strong relationship between the items and the underlying constructs. The composite reliability indices for the dimensions of the questionnaire ranged between 0.62 and 0.67, indicating acceptable internal consistency. Additionally, face validity of the Persian version was established by five academic members, who reviewed the translation and the cultural appropriateness of the items (Kareem and Kin, 2018).

The "Resilience in Educational Barriers" questionnaire is a researcher-made instrument developed specifically for this study. The face validity of the questionnaire was tested by ten medical faculty members who reviewed the clarity and relevance of the items. The original questionnaire included 40 items, of which four were removed due to redundancy, and 12 items were linguistically modified to improve clarity.

Content validity was assessed by ten experts in medical education and e-learning using the Content Validity Index (CVI) and Content Validity Ratio (CVR). The experts validated the necessity of the items, with a CVR score of 80.5%. The CVI was calculated for three sub-components: relevance (93.6%), clarity (91.9%), and simplicity (91.3%).

The construct validity of the instrument was confirmed through exploratory factor analysis (EFA). The Kaiser-Meyer-Olkin (KMO) value was 0.814, indicating adequate sampling, and the significance level for the Bartlett's Test of Sphericity was $p < 0.001$, confirming the appropriateness of the data for factor analysis. The analysis explained 66.88% of the variance with eight factors, suggesting a robust factor structure for the resilience construct.

The reliability of the "Resilience in Educational Barriers" questionnaire was established through Cronbach's alpha, which yielded a value of 0.844 for the entire instrument, indicating excellent internal consistency. Similarly, the Attitudes towards Change questionnaire was also assessed for reliability, with a Cronbach's alpha of 0.89, reflecting strong internal consistency.

Data collection

Given that this research was conducted during the COVID-19 pandemic and in accordance with protocols that restricted in-person access to professors, the questionnaire was designed electronically using the Porsline platform.¹ The link to the questionnaire was sent to professors via email. The questionnaire link was also shared with professors through social media networks.

Data analysis

To determine the mean scores of the dimensions of the questionnaire on attitudes toward change and resilience in educational barriers, a one-sample t-test was employed, and the obtained mean was compared to a cut-off point of 4. ANOVA was utilized to examine the relationship between attitudes toward change and the components of resilience. For assessing teachers' resilience based on computer skills, given that there were ultimately two levels—medium and good—according to students' self-reports, an independent samples t-test was conducted. In analyzing resilience by contextual variables, independent samples t-tests (gender, two levels of computer skills) and ANOVA (three levels of age and years of experience) were used. For post-hoc tests and subgroup comparisons, Tukey's test was applied. The significance level was set at 0.50, and the confidence interval for the tests was 95%. Data analysis was performed using SPSS version 24.

At the end of our questionnaire, we had asked an open-ended question: 'If there is any other point that has not been mentioned in the items of the questionnaire, please state it.' The points extracted from this section were analyzed and categorized based on semantic similarities through content analysis.

Results

Based on the research findings from 196 distributed questionnaires, 130 faculty members completed the questionnaires (response rate = 66%). The demographic characteristics are presented in Table 1.

The following are the research findings based on the main research questions (RQ1-RQ5):

RQ1: Using a one-sample t-test, the mean score of teachers' attitudes toward change was examined and compared against a cut-off point of 4. Table 2 reveals that the overall mean score for attitudes and each component of attitudes toward change was greater than 4 (cut-off point = 4), indicating a favorable attitude toward change. In this research, the attitudes of the participants toward change were categorized as low or negative ($1 \leq x \leq 3$), medium ($3 < x < 5$), and positive or good ($5 \leq x \leq 7$). The faculty members' attitudes toward change were moderate in the affective ($m = 4.92 \pm 0.68$), behavioral ($m = 4.14 \pm 0.43$), and cognitive ($m = 5.00 \pm 0.63$) aspects. The overall attitudes of the faculty toward change were found to be moderate ($m = 4.64 \pm 0.44$), with no evidence of negative or low attitudes (Table 2).

¹ <https://porsline.ir>

TABLE 1 Demographic characteristics of participants.

Demographic characteristics	Groups	Frequency	Percentage
Age	30–40 Y	62	47.7
	41–50 Y	47	36.2
	>50 Y	21	16.2
	Mode	40	-
	Mean	42.82	-
	Std. Deviation	7.510	-
	Minimum	30	-
	Maximum	65	-
Years of experience	2–10 Y	62	47.7
	11–20 Y	42	32.3
	>21 Y	26	20.0
	Mode	5	-
	Mean	12.79	-
	Std. deviation	8.409	-
	Minimum	1	-
	Maximum	38	-
Major	Clinical	30	23.1
	Basic medical sciences	31	23.8
	Health & para clinical	38	29.2
	None-medical sciences	31	23.8
Gender	Female	93	71.5
	Male	37	28.5
Academic Rank	Instructor	18	13.8
	Assistant professor	76	58.5
	Associated professor	26	20.0
	Professor	10	7.70
Computer skills	Low ($1 \leq x \leq 2$)	0	0.00
	To some extent ($3 < x < 4$)	76	58.5
	To the extent of mastery ($4 \leq x \leq 5$)	54	41.5
Previous experience in online education	Yes	48	36.9
	No	82	63.1

TABLE 2 Mean score of teachers' attitudes toward change.

Components (attitudes to change)	Mean score	St. D	t	P-Value
Affective	4.92	0.68	15.35	< 0.001
Cognitive	5.00	0.63	18.21	< 0.001
Behavioral	4.14	0.43	3.66	< 0.001
Total score	4.68	0.44	17.87	< 0.001

St. D: standard deviation cut-off point = 4.

RQ2. In the second question of the study, the mean score of teachers' resilience in educational barriers and its eight components was examined using a one-sample *t*-test (Table 3).

Since the cut point was 4, a score greater than 4 indicates more perceived barriers in online teaching. According to Table 3, the most

challenging areas were technological knowledge and competence ($m = 5.25 \pm 1.26$), self-management skill ($m = 4.87 \pm 1.09$), technology infrastructure ($m = 4.66 \pm 1.41$), technical support ($m = 4.37 \pm 1.14$), and attitudes towards technology ($m = 4.25 \pm 1.26$). Persistent personal barriers ($m = 3.65 \pm 1.57$) were determined to be the least bothersome. Online teaching issues such as LMS barriers and previous preparedness had a score below the cut threshold but were not statistically significant. It was found that the total mean score for online teaching tasks was 4.33 ± 0.88 ($p < 0.001$).

RQ3: Teachers' attitudes to change were classified as low or Negative ($1 < x < 3$), Medium ($3 < x < 5$), and good or Positive ($5 \leq x \leq 7$). An analysis of educational barriers to integrating technology during the COVID-19 pandemic is shown in Table 1. Only medium and high attitude ratings were found (Figure 1; Appendix Table 1). According to Figure 1, participants with a high positive attitude to change reported lower technological barriers in all components. This difference is

significant in two areas: prior preparation ($m = 4.04, p = 0.005$) and technical support ($m = 4.65, p = 0.005$). Therefore, people better equipped for online education and with greater technical help from universities and colleges felt less challenged (Figure 1; Appendix Table 1).

RQ4: We examined whether medical teachers' computer skills affect their attitudes toward change. As previously shown in Table 1, faculty members' computer skills were acquired at "to some extent" and "to the extent of mastery" levels. The difference between the attitudes of the faculty members according to the level of computer skills is shown in Table 4.

The results indicate that the attitudes of medical teachers towards change differ significantly based on their level of computer skills ($p = 0.002$). There is a positive relationship between attitudes towards

change and computer skills, particularly in the affective ($p = 0.021$) and cognitive components ($p < 0.001$), where mastery leads to significantly more favorable attitudes. However, this relationship does not hold significantly for the behavioral component ($p = 0.446$).

RQ5: In addressing the fifth question, the focus is on examining the scores of teachers' resilience to educational barriers, specifically based on contextual components.

Gender

The independent sample *t*-test showed that there was no significant difference between the total score of medical teachers' views on educational barriers with regard to gender ($p > 0.05$).

Age

The medical teachers were categorized into three age groups: 30–40 years, 41–50 years, and over 50 years. According to the ANOVA test results, younger faculty members exhibited fewer barriers and adapted more rapidly to online education in the areas of "Technological knowledge and skills" ($p = 0.031$) and "Self-management skills" ($p = 0.001$). However, in the "Personal challenges" component, teachers aged over 40 reported experiencing significantly greater barriers compared to their younger counterparts ($p = 0.039$) (see Table 5).

Computer skills

The researchers calculated the mean scores for each barrier based on medical teachers' levels of computer skills, categorized as either

TABLE 3 Mean score of teachers' perceived educational barriers.

Components (perceived educational barriers)	Mean score	St. D	<i>t</i>	<i>P</i> -value
Technological infrastructure	4.66	1.41	5.34	<0.001
Technological knowledge and skill	5.25	1.26	11.33	<0.001
Attitudes towards technology	4.25	1.26	2.24	0.026
Previous readiness	3.79	1.34	1.74	0.083
Self-management skill	4.87	1.09	9.16	<0.001
Technical Support	4.37	1.14	3.75	<0.001
Personal barriers	3.65	1.57	2.52	0.013
LMS barriers	3.80	1.22	1.77	0.079
Total score of barriers	4.33	0.88	4.32	<0.001

St. D: standard deviation cut-off point = 4.

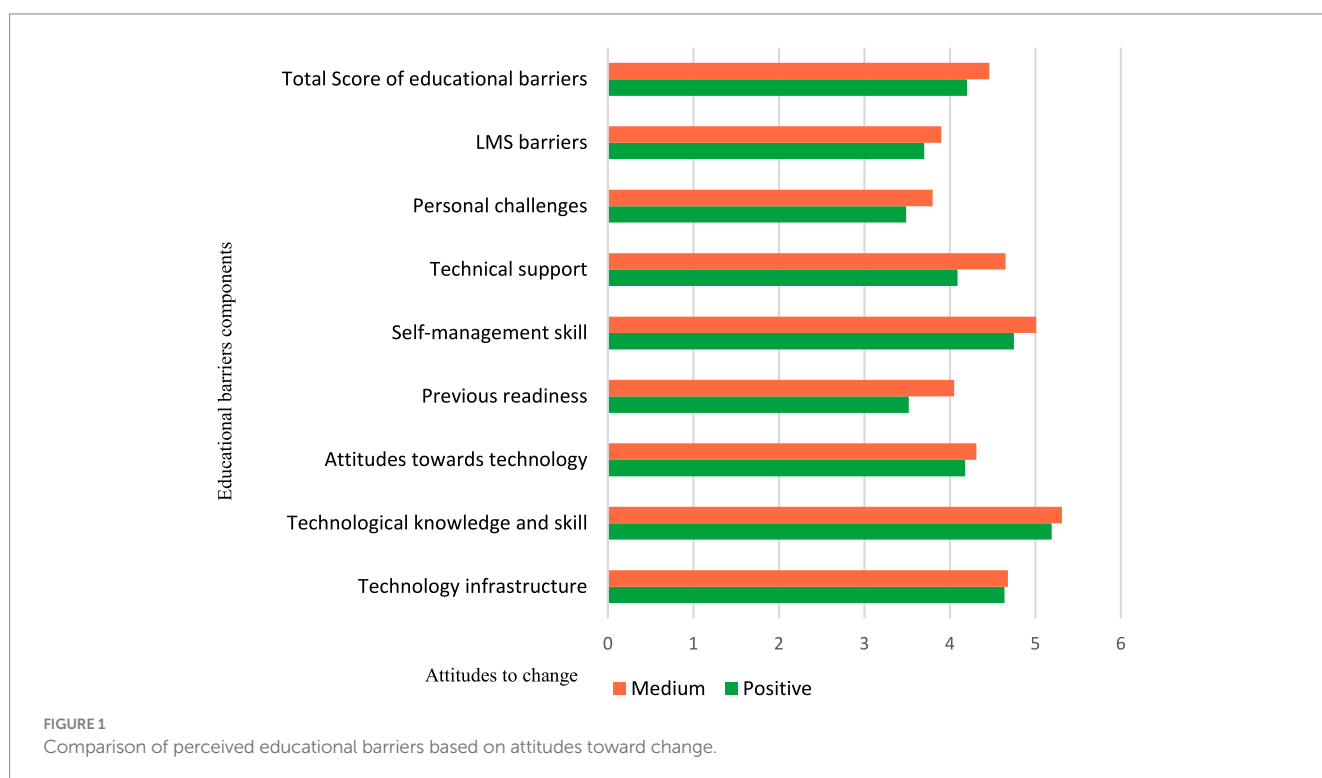


TABLE 4 The relationship between attitude to change and computer skills.

Components	Computer skills	Mean score of attitudes to change	St. D	t	P-value
Affective	To some extent	4.80	0.69	2.32	0.021
	To the extent of mastery	5.08	0.63		
Cognitive	To some extent	4.84	0.63	3.66	<0.001
	To the extent of mastery	5.23	0.55		
Behavioral	To some extent	4.11	0.44	0.76	0.446
	To the extent of mastery	4.17	0.42		
Total score	To some extent	4.58	0.45	3.34	0.002
	To the extent of mastery	4.83	0.37		

St. D: standard deviation.

TABLE 5 Mean score of teachers' perspectives about educational barriers based on age.

Components (barriers)	F	df	P-value
Technology infrastructure	0.034	127	0.967
Technological knowledge and skill	3.573	127	0.031
Attitudes towards technology	0.116	127	0.890
Previous readiness	0.765	127	0.467
Self-management skill	8.012	127	0.001
Technical support	0.123	127	0.884
Personal challenges	3.317	127	0.039
LMS barriers	1.434	127	0.242
Total score	0.376	127	0.687

medium or high. As previously noted in Table 1, faculty members' computer skills were divided into two groups: "to some extent" and "to the extent of mastery." Table 6 indicates that teachers with high computer skills encountered fewer barriers to online education compared to those with medium skills ($p < 0.001$). However, the reduced barriers faced by academics with high computer skills were statistically significant only in specific areas, including technology infrastructure ($p = 0.003$), skill and knowledge ($p < 0.001$), previous readiness ($p = 0.002$), self-management ($p < 0.001$), and LMS barriers ($p = 0.035$) (see Table 6).

Years of experience

Job experience was categorized into 2–10 years, 11–20 years, and 21+ years. The ANOVA test revealed that the overall mean attitudes of medical teachers varied significantly based on their years of experience ($p = 0.043$). Specifically, experience had a notable impact on several factors, including facilities, equipment, and technological infrastructure ($p = 0.014$), technological knowledge and skills ($p = 0.004$), self-management ($p = 0.002$), personal challenges ($p = 0.042$), and barriers related to LMS ($p = 0.017$) (Table 7).

Also, in examining the differences between groups with Tukey's test, teachers with 11–20 years of job experience had more computer facilities and equipment and used the internet more ($p = 0.01$). Regarding computer knowledge and competence, individuals with

2–10 years of experience outperformed those with 11–20 years ($p = 0.01$) and above 20 years ($p = 0.015$). Also, younger faculty members outperformed older faculty members in self-management ($p = 0.001$). In terms of personal difficulties, professors with more than 21 years of experience reported fewer troubles than those with 2–10 years of experience ($p = 0.036$), which is consistent with the age-related results.

Results of open-ended question

We asked an open-ended question at the end of the questionnaire to allow participants to express any additional points that had not been mentioned. About 34 participants provided some open feedback, highlighting various issues. However, there were also positive aspects noted in the comments from faculty members. Below are some positive and negative comments regarding this matter.

The reflections from faculty members in the fields of pharmacy and medicine reveal significant challenges during the COVID-19 pandemic.

Pharmacy faculty perspective

A pharmacy professor noted that:

(Challenges): "while some students have access to advanced software and hardware, others lack essential electronic devices such as smart tools or laptops. This disparity creates unequal conditions for both students and teachers, affecting the quality of education and student evaluations. Previously, technical support was readily available from colleagues, but the current high demand for assistance, combined with a limited number of experts and lack of face-to-face interaction, has slowed down troubleshooting processes. The professor expressed initial unpreparedness for these circumstances and highlighted the inadequacies in electronic infrastructures."

Medical faculty perspective

In contrast, a medical faculty member emphasized that:

TABLE 6 The relationship between perceived educational barriers and computer skills.

Components (barriers)	Computer skills	Mean score of perceived barriers	St. D	t	P-value
Technology infrastructure	To some extent	5.10	1.36	3.04	0.003
	To the extent of mastery	4.35	1.38		
Technological knowledge and skill	To some extent	5.85	1.06	4.95	<0.001
	To the extent of mastery	4.82	1.22		
Attitudes towards technology	To some extent	4.41	1.34	1.22	0.221
	To the extent of mastery	4.13	1.20		
Previous readiness	To some extent	4.22	1.53	3.16	0.002
	To the extent of mastery	3.49	1.09		
Self-management skill	To some extent	5.37	0.89	4.75	<0.001
	To the extent of mastery	4.52	1.08		
Technical support	To some extent	4.49	1.33	1.00	0.318
	To the extent of mastery	4.29	0.98		
Personal challenges	To some extent	3.78	1.71	0.83	0.406
	To the extent of mastery	3.55	1.46		
LMS barriers	To some extent	4.07	1.35	2.13	0.035
	To the extent of mastery	3.61	1.10		
Total score	To some extent	4.66	0.90	3.78	<0.001
	To the extent of mastery	4.09	0.79		

St. D: standard deviation.

TABLE 7 Mean score of teachers' perceived educational barriers based on years of experience.

Components (barriers)	F	df	P-value
Technology infrastructure	4.378	127	0.014
Technological knowledge and skill	5.857	127	0.004
Attitudes towards technology	0.173	127	0.841
Previous readiness	2.249	127	0.110
Self-management skill	6.742	127	0.002
Technical support	0.095	127	0.909
Personal challenges	3.120	127	0.048
LMS barriers	4.208	127	0.017
Total score	3.217	127	0.043

(Positive aspects): "Nothing could have compelled educators to learn computer skills and navigate virtual platforms as effectively as the pandemic did. Before COVID-19, there was considerable resistance to online education among faculty, with many believing that effective teaching could only occur in person. However, the pandemic forced even those with no prior experience in online teaching to engage with its benefits. The professor reported unprecedented participation in international webinars and collaboration with peers from other universities, leading to a significant shift in attitudes towards online education."

The results of the content analysis and categorization of these comments are summarized in Table 8.

Overall, the results indicated that attitudes toward change among medical teachers are related to resilience in facing educational barriers. In other words, individuals with a more positive attitude toward change perceived educational barriers as less significant. This finding underscores the importance of faculty attitudes in developing virtual education and their response to the educational barriers associated with it. Additionally, based on the research findings, contextual factors such as facilities and equipment, work experience, age, and computer skills also influence resilience and the ability to adapt to changing conditions. However, the results showed that faculty members with more work experience (greater job stability and income) faced fewer issues with equipment and facilities. In contrast, younger faculty members, being closer to the digital native generation, possess greater computer skills and thus have a higher capacity for adaptation and flexibility compared to older age groups. It is noteworthy that when developing virtual education, attention must be paid to the differing conditions and situations of individuals, and the diverse needs of faculty should be considered in educational planning and capacity-building initiatives.

Discussion

As the results indicated, the overall attitude of the faculty members towards change was found to be moderate, with no evidence of negative or low attitudes. The conclusion drawn contrasts with some recent studies that highlight significant challenges and barriers in adapting to changes in instructional styles. Obratzsova (2018) observed that there are instances where teachers' beliefs and actions conflict. The concept of "Diffusion of Innovations" may explain these

TABLE 8 Content analysis of participants' comments regarding their experiences during COVID-19 pandemic.

Challenges and difficulties	Repetition
• Software and hardware problems	22
• Network and internet issues	23
• Being far from the university environment	16
• Lack of access to technical support experts	13
• Problems related to the learning management system (LMS)	28
• Poor performance of some modules of LMS	30
• Unequal conditions for students regarding internet access and hardware	15
• Lack of face-to-face interaction with students	26
• Insufficient preparedness especially at the beginning of the pandemic	29

Positive aspects and advantages	Repetition
• Improvement of Instructors computer skills through virtual education.	31
• Positive attitudes towards e-learning emerged during the pandemic.	26
• Increased content development skills and software familiarity noted.	14
• Virtual education enhanced time efficiency and flexibility.	16
• Faculty plan to continue using these skills post-pandemic.	15

Repetition refers to the number of participants who have referenced this item.

findings. As the workforce recognizes the necessity for change, the knowledge stage becomes critical, as it is during this phase that an individual's willingness to adopt new tools increases. The COVID-19 pandemic has compelled professors to adopt innovative technologies. Diffusion of Innovations Theory, developed by Rogers (1962), explains how, why, and at what rate new ideas and technology spread within a population. It emphasizes that the adoption of innovations is a process that occurs over time and is influenced by various factors, including the characteristics of the adopters and the innovation itself (Rogers, 1962) or a unique event such as the Covid-19 pandemic. The pandemic has accelerated the need for educators to embrace technology, highlighting the importance of understanding the barriers and facilitators in the adoption of online teaching methods. Despite the push for technological integration, many educators face difficulties in adapting to new instructional styles, as noted in various studies. This suggests that while awareness of the need for change exists, the actual implementation may be hindered by personal beliefs, skills, and available resources. In summary, while there is a recognized need for change in instructional approaches, the transition is often complicated by various factors, including individual beliefs, technological competencies, and the broader context of the educational environment. Another point is that people's attitudes and people's resistance to technological changes that require their involvement are also affected. In fact, people have a phobia of a subject when they have not yet encountered it directly, but when they are exposed to it, they accept it better and learn from their experiences (Faloye et al., 2022; Khasawneh, 2018). Also, the most challenging areas or barriers identified in this research were technological

knowledge and competence, self-management skills related to technology, technology infrastructure, technical support, and attitudes toward technology. Participants with a high positive attitude towards change reported lower technological barriers across all components.

The research highlights several significant barriers to the adoption of technology in educational settings, including technological knowledge and competence, self-management skills, technology infrastructure, technical support, and attitudes toward technology. Additionally, it notes that participants with a positive attitude toward change reported experiencing fewer technological barriers across all areas. Some researchers highlight the need for educators to possess adequate technological knowledge and competence to effectively integrate new tools into their teaching practices. It emphasizes the importance of assessing and fostering these skills among teachers to ensure successful technology adoption (Seufert et al., 2021).

Also self-management skills are crucial for educators to navigate the complexities of integrating technology into their teaching. Research showed that competence involves factors such as knowledge, skills, and attitudes. Educators with strong self-management skills are likely to be more resilient and adaptable to technological changes (Jose et al., 2022).

Related to technology infrastructure and technical support, Tong et al. (2022) underscore the importance of technology infrastructure in maintaining a firm's competitiveness. It suggests that a robust technology infrastructure facilitates the organization's internal capabilities and enhances its ability to compete. In the context of education, providing adequate technology infrastructure and technical support is essential for successful technology adoption (Tong et al., 2022).

In relation to attitudes toward technology, Jain et al. (2022) found that the need for medical professionals to be proficient in technology. They suggest that a positive attitude towards technology is necessary for successful adoption and implementation. Similarly, Cao et al. (2023) highlight the importance of digital competency, which encompasses knowledge, skills, and attitudes, in facilitating technology adoption.

The results indicated that a positive attitude towards change can help educators overcome perceived barriers to online teaching. This aligns with Jain et al. (2022), who suggest that a positive attitude is essential for the successful adoption of technology. A favorable attitude toward change fosters resilience, enabling educators to adapt more effectively to new educational challenges. Additionally, results showed respondents with strong computer skills demonstrated a more positive attitude in all aspects of the survey.

The results of past research indicate that the level of digital skills among teachers significantly predicts the use of their online instruction, and teachers' digital competencies positively correlate with their willingness to engage in online teaching. The study found that teachers with higher digital skills are better equipped to handle online instruction (Ebrahimi, 2022).

Winter et al. (2021), in their study on effective teacher characteristics in virtual education during the COVID-19 pandemic, emphasize that teachers' adaptability to technology plays a crucial role in the success of online teaching. They argue that teachers who actively embrace digital tools and possess the necessary technological skills are better equipped to create engaging and effective online learning environments, ultimately enhancing the quality of education.

Context variables

Gender

In analyzing the results based on contextual variables, the findings revealed no significant difference in the overall resilience scores (perceived barriers) of faculty members when compared by gender. This finding contrasts with the research by [Adeoye \(2023\)](#), which indicated that female teachers tend to demonstrate better skills in utilizing technology for teaching compared to their male counterparts. One possible explanation for this discrepancy is that at Shiraz University of Medical Sciences, all faculty members are encouraged to participate in digital literacy empowerment courses at the start of their service. These courses are designed to ensure that both male and female faculty members have equal opportunities to enhance their technological skills, potentially minimizing any gender-related differences in technology adoption and resilience.

Age

The average scores for barriers related to technological knowledge and skills, as well as self-management skills, were lower in individuals of younger age. In other words, younger faculty members faced fewer obstacles and adapted more quickly to online education. However, in the component of personal challenges, younger teachers reported higher obstacles than their older counterparts. This result is consistent with several studies ([Ball et al., 2019](#); [Prensky, 2001](#); [Reid et al., 2023](#); [Vergara-Rodríguez et al., 2022](#)). This result is consistent with several studies. In fact, the nature of technology is characterized by renewal and change, which is more closely associated with youth. Additionally, younger individuals are generationally closer to the digital age and possess a greater ability to adapt to technological advancements. However, in the current research, personal obstacles were reported to be greater among younger teachers. This issue may be influenced by other underlying factors, such as financial and livelihood barriers. Older professors, having more experience and tenure, often enjoy higher job security, greater income, and better housing and living conditions, while these problems may be more prevalent among newly hired professors.

Experience

The results of examining the effect of work experience revealed a pattern similar to that observed with age. The findings indicated that work experience significantly influences faculty members' resistance to change and their perception of barriers. Faculty members with 11 to 20 years of experience had better access to computer resources and equipment and made more frequent use of the internet compared to their peers. This group appeared to be more comfortable with digital tools and technologies, contributing to a lower perception of barriers in online teaching. On the other hand, faculty members with 2 to 10 years of experience demonstrated higher proficiency in computer skills and knowledge than their more experienced colleagues. This suggests that more recent entrants into academia may have received more formal training in technology use or have had greater exposure to digital tools during their academic training, enabling them to adapt more quickly to the demands of online teaching. Additionally, younger faculty members demonstrated superior self-management skills in the context of online teaching compared to their older counterparts. In terms of personal challenges, professors with over 21 years of experience reported encountering fewer difficulties than those with

only 2 to 10 years of experience. This paraphrase maintains the original meaning while using different wording and sentence structures. Despite their lower status and income, younger faculty members (with 2–10 years of experience) are becoming more familiar with and interested in digital tools and technologies. This trend suggests that newer faculty members are generally more adaptable and open to technological advancements compared to their more experienced colleagues. Faculty members with 10–20 years of experience, however, tended to outperform their younger counterparts in terms of adapting to the demands of online teaching, as they generally had better access to resources and more frequent internet use. Interestingly, younger faculty members were favored in self-management skills. This may be attributed to their greater comfort with digital platforms, which can enhance their organizational and time management abilities in the virtual environment. Conversely, faculty members with over 21 years of experience reported fewer personal concerns than their younger colleagues, potentially due to the greater financial stability and job security that come with seniority. The challenges faced by senior faculty members also include work-life balance difficulties, particularly for those with young children at home. This added stress contributed to higher levels of perceived personal barriers in their teaching. As noted by [Cachón-Zagalaz et al. \(2020\)](#), many teachers reported feeling frightened and overwhelmed by the pandemic's rapid shift to online teaching. Research by [Al Lily et al. \(2020\)](#) further supports this, suggesting that the stress experienced by teachers during the pandemic has been linked to serious mental health issues, including domestic violence, broken family bonds, and even divorce. These additional pressures faced by senior faculty could negatively impact their resilience and ability to effectively adapt to online teaching, making the need for targeted support systems and stress management strategies more pressing ([Cachón-Zagalaz et al., 2020](#); [Al Lily et al., 2020](#)).

Strengths and limitations of the research

This research utilized both a standard questionnaire and a researcher-developed questionnaire, both of which demonstrated very good validity and reliability. The study investigated various aspects of change and resilience in relation to educational barriers. However, there are limitations to this research. The research was conducted at a single university of medical sciences, which may limit the generalizability of the findings to other educational institutions or disciplines. Furthermore, while the response rate was approximately 67%, which is acceptable for survey research, the sample size may still be considered modest. To improve the robustness and generalizability of the results, future research could benefit from larger, more diverse samples, potentially including multiple universities or even faculties from various academic fields.

Conclusion

In summary, this research highlights the complex interplay between faculty attitudes and the barriers associated with adopting new educational practices in the context of online learning. It appears that individuals who have a more positive outlook towards technological changes exhibit greater resilience when faced with barriers. On the

other hand, the level of resilience among teachers is influenced by their technological competencies, self-management skills, and the degree of organizational support they receive. Despite barriers during the COVID-19 pandemic, the necessity for digital tools in education has never been more apparent. The pandemic has acted as a catalyst for change, compelling educators to reassess their teaching methodologies and embrace technology. To support this transition, it is crucial for institutions to provide comprehensive training, resources, and incentives that address the specific needs and concerns of faculty members. The findings indicate that younger faculty members tend to face fewer barriers related to technological knowledge and self-management skills, allowing them to adapt more swiftly to online education. However, they reported greater personal challenges, suggesting that while they may be more comfortable with technology, they still encounter significant obstacles in their professional lives. By understanding the barriers and motivators that influence faculty attitudes toward change, educational institutions can foster a more supportive environment that encourages the effective integration of technology in teaching and learning. Additionally, holding empowerment courses for faculty members to increase their familiarity with digital skills, online teaching methods, and the latest developments in e-learning can create more readiness in them to deal with difficult situations. This is especially important since attitudinal barriers are largely influenced by individuals' knowledge and skills. In other words, the attitude towards changes and readiness to face obstacles are closely related, and by involving teachers in novel and diverse online education experiences and increasing their competencies, the level of acceptance of technological changes will increase.

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 humans were approved by the Shiraz University of Medical Sciences's local ethics committee (approval number) (ref. no. IR.SUMS.REC.1399.476). The studies were conducted in accordance with the local legislation and institutional

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requirements. Written informed consent for participation in this study was provided by the participants.

Author contributions

LK: Conceptualization, Data curation, Investigation, Project administration, Supervision, Writing – original draft, Writing – review & editing. ZK: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing. EN: Data curation, Writing – review & editing. RK: Data curation, Writing – review & editing.

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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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Appendix

TABLE A1 Resilience in educational barriers based on attitudes to change.

Components	Attitude	Mean score of perceived barriers	St. D	t	P-value
Technology infrastructure	Positive	4.64	1.35	0.14	0.889
	Medium	4.68	1.49		
Technological knowledge and skill	Positive	5.19	1.18	0.52	0.604
	Medium	5.31	1.33		
Attitudes towards technology	Positive	4.18	1.23	0.55	0.582
	Medium	4.31	1.31		
Previous readiness	Positive	3.52	1.06	2.26	0.025
	Medium	4.05	1.52		
Self-management skill	Positive	4.75	0.98	1.28	0.201
	Medium	5.00	1.18		
Technical support	Positive	4.09	1.04	2.88	0.005
	Medium	4.65	1.17		
Personal barriers	Positive	3.49	1.47	1.11	0.268
	Medium	3.80	1.65		
LMS barriers	Positive	3.70	1.05	0.91	0.363
	Medium	3.90	1.37		
Total score	Positive	4.20	0.78	1.71	0.088
	Medium	4.46	0.95		

St. D: standard deviation.