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Development and validation of a questionnaire to measure educational agility: a psychometric assessment using exploratory factor analysis

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Abstract

Background To effectively navigate the growing complexities and rapid changes in today's environment, universities must cultivate agility among their members. Over the past decade, students have encountered a variety of experiences related to E-Learning and the provision of educational services through electronic platforms. This study aimed to develop and validate a Questionnaire of Educational Agility (QEdu-Agility) to assess the capacity of educational institutions to adapt to these evolving demands.

Method This survey research aimed to validate QEdu-Agility. The statistical sample consisted of 372 students from Shiraz University of Medical Sciences in Iran, who had completed at least one academic year online during the COVID-19 pandemic in 2022. Participants were selected using the Cochran formula. The initial questionnaire was based on three standard instruments related to organizational agility and adapted for educational contexts. After establishing face and content validity, the preliminary version was validated by a focus group of five educational experts, comprising 30 items across five dimensions: responsiveness, adequacy, flexibility, speed, and integrity, measured on a 5-point Likert scale. To confirm the construct validity, the questionnaire was randomly distributed to students via email. Data analysis was conducted using Exploratory Factor Analysis (EFA) with varimax rotation, employing SPSS 24 software.

Results The content validity was confirmed with Content Validity Ratio (CVR) = 0.847, Content Validity Index (CVI) = 0.877, and the reliability with internal consistency was confirmed with $R = 0.944$. The CVI sub-components for relevance, clarity, and simplicity were obtained as 0.867, 0.853, and 0.847, respectively. According to EFA, the sample adequacy was confirmed with Kaiser-Meyer-Olkin (KMO) index = 0.928 and significant Bartlett's test ($P < 0.001$). The total variance explained of the QEdu-Agility was about 60%. The first component of responsiveness accounted for 38.79% of the variance, followed by adequacy (7.99%), flexibility (5.17%), speed (3.91%), and integrity (3.57%) in subsequent components.

Conclusion The findings of the construct validity indicated a good fit of the QEdu-Agility. Given that the concept of agility is highly contingent on the context, this tool could be retested for measuring educational agility in educational organizations, such as universities.

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Keywords Organizational Development, Agility, Educational Agility, Validity, Exploratory Factor Analysis, Psychometrics, Questionnaire, QEdu-Agility

Introduction

The academic roles of universities have changed and developed over time. Initially, universities emerged with a focus on education and knowledge transfer. However, they gradually faced new functions such as research and knowledge production, providing services to the community, establishing connections with industry, fostering entrepreneurial initiatives, and enhancing responsiveness. Over time, universities have evolved through multiple generations [1].

The emergence of new technologies, demographic changes, health patterns and lifestyles shift, environmental challenges, and other factors necessitate a comprehensive review of university structures and mechanisms. These factors emphasize that "Change" is the most common event, and universities cannot prepare students for the new era by employing old strategies [2]. Experts believe that agile individuals have high potential who know how to demonstrate the necessary skills or learn new skills when faced with challenging conditions for the first time. In other words, individuals who know what to do and how to act in uncertain situations are considered agile [3, 4]. Amidst all the surrounding changes, the COVID-19 pandemic drastically transformed the way universities operate, compelling them to adapt to new learning environments and methods. The sudden closure of campuses and the transition to online-only classes necessitated a complete redefinition of educational communication between professors and students [5, 6]. The widespread adoption of synchronous and asynchronous online methods, along with the sharing of experiences through virtual communication, marked a significant shift in educational approaches [7]. The realization that nothing can be predicted is evident as the world adapts to a *"New normal"* in higher education. This period underscored the need for flexibility and adaptability in education, enabling quick adjustments to new circumstances and the exploration of innovative methods to manage the educational process. These conditions required the identification of environmental changes, the ability and speed of response, timely reactions, strategic thinking, and flexibility in challenging situations [8, 9]—elements that we refer to as "*Educational agility*." This concept urges universities to reevaluate their structures, programs, and processes not only during the pandemic but also in its aftermath. However, a pertinent question arises: what components define educational agility, and what dimensions does it encompass?

Of course, organizational agility as a philosophy in producing and providing goods and services began with the Agile Manifesto in 2001. The most important feature of this concept is the emphasis on the organization's ability to change and adapt to environmental changes [10, 11]. This concept has evolved into an intellectual movement. The agility mindset focuses on consistently adding value to services for customers, with the customer at the center of this philosophy [12]. Organizational agility refers to a combination of flexibility, agility, and speed, recognized as a source of competitive advantage within dynamic and competitive environments [13]. This relatively new concept has been the subject of numerous studies conducted in various environments over the recent decades. Multiple definitions have been proposed due to its evolving nature and significant dependence on the environment and context [12]. According to Alhadid (2016), organizational agility is defined based on the application field or dimension in which it is used. He states that organizational agility is connected to promptly responding to change and uncertainty in a relevant environment, where organizations must act to overcome obstacles or seize opportunities [14]. Another definition of organizational agility refers to its main competency and competitive advantage, emphasizing requirements such as strategic thinking, innovative mindset, change management, continuous flexibility, and prediction [15] as well as an organization's ability to sense and respond to the environment [13]. Universities must ensure that their members possess the capacity to adapt to the growing complexities and changes in the environment [16, 17].

Improving organizational agility provides numerous benefits, such as enhanced services and reduced costs, faster achievement of goals, and greater stability. Additionally, agility enables quicker responses to customer needs, boosts employee satisfaction, facilitates effective adaptation to changes, and significantly develops employee skills, ultimately leading to a more responsive and efficient organization [18]. So far, various tools have been developed to measure organizational agility in commercial and service settings, which can aid in clarifying the concept of educational agility and contribute to understanding its dimensions. The three-stage model proposed by Jackson and Johannsen for analyzing production systems encompasses the level of environmental and market turbulence, the strategic perspective of the organization, and the evaluation of facility agility

[19]. Goldman and colleagues view agility as a blend of innovative and advanced technologies. They propose that agility encompasses four interrelated principles: enhancing customer experiences, skillfully managing change and uncertainty, fostering participation and collaboration, and maximizing the influence of people and information [20]. The agility measurement model from Dove's perspective also has two key components: knowledge management and change management. Dove believes that these two factors, taken together, are competitive empowerment for agile organizations [21]. The agility implementation model proposed by Sharifi and Zhang is a conceptual framework that identifies three key elements necessary for achieving agile construction: organizational responsiveness, appropriate flexibility, and acceptable operational speed. The core components of this model include responsiveness, competence, flexibility, and speed [22].

While previous studies have sought to define organizational agility, it is evident that this concept is closely intertwined with modern technologies. These technologies impact essential components such as speed, flexibility, and responsiveness, which are particularly crucial in educational settings and universities that need to adapt to ongoing changes. Recognizing technological advancements is vital for all organizations, including universities, as agility in responding to these changes is essential. Furthermore, agility is a multidimensional and context-dependent concept [23, 24]. This topic has gained particular importance following the COVID-19 pandemic, which forced educational institutions to undergo rapid and significant transformations, with virtual learning replacing traditional face-to-face education. Expanding the understanding of educational agility can help assess universities' current status and their capacity to meet new demands. In this research, we aimed to develop a tool for measuring educational agility in both in-person and online environments, focusing on innovative technologies.

Methods

Study design

Initially, a questionnaire for measuring educational agility was developed based on previous standard questionnaires, the characteristics of educational environments, and expert opinions. The questionnaire was implemented to assess the validity and reliability of the QEdu-Agility on the students of Shiraz University of Medical Sciences, Iran. Considering that the educational agility tool was new, the Exploratory Factor Analysis (EFA) was used to determine the construct validity.

Participants

The inclusion criteria for the research samples included all Shiraz University of Medical Sciences students in 2022 who had experienced at least one year of virtual education during the COVID-19 pandemic and had also experienced face-to-face education for at least one year before or after that. The individuals voluntarily participated in the research. The exclusion criteria included questionnaires with more than 20% incomplete answers.

Sampling

In this research, a new tool was employed, and it was necessary to measure the construct validity of the QEdu-Agility using factor analysis. According to Everitt (1975), it is recommended to have 10 times the number of questionnaire items that have been completely answered [25]. Considering the number of items was 30, a minimum of 300 samples was required. However, due to the possibility of sample loss or questionnaire defects, 400 questionnaires were distributed, of which 372 complete questionnaires were collected. The sampling method was random and involved students from different university faculties.

Ethical considerations

This article was extracted from research project number 26,347, which was approved by the Research Deputy of Shiraz University of Medical Sciences. The ethical criteria of this research have been approved by the National Ethics Committee in Biomedical Research with the code IR.SUMS.REC.1401.561. All participants were informed of the research objectives and completed an informed consent form. The questionnaires were collected and analyzed anonymously, and the final report was made available to relevant officials for future planning.

Tool/instrument

Instrument development

Although the concept of organizational agility has become common since the late century, in this study, we examined the "Educational agility" construction. Therefore, we needed a new tool compatible with educational environments' functions and features.

To develop the initial questionnaire and determine the content)items(of the questionnaire, we initially considered three questionnaires pertaining to organizational agility: the standard questionnaire of Sharifi and Zhang (1999), with 28 items in four components of speed (6 items), competence (7 items), responsiveness (7 items), flexibility (9 items) [22], the questionnaire by Goldman and colleagues (1994) with 27 items and four components of customer responsiveness, readiness to cope with

changes, importance of employee skills and knowledge [20] as well as the 35-item questionnaire by Worley and Lawler (2010) for implementation and measurement of organizational agility [26].

In some items, these questionnaires were more compatible with administrative and official environments and were not customized for educational environments. In addition, we endeavored to develop a questionnaire capable of evaluating face-to-face and virtual educational environments. For this purpose, two researchers (in the current research) first listed the primary items extracted from the three mentioned questionnaires [20, 22, 26], and then, by inviting three educational management experts, the items were examined in a focus group of five participants. First, the group secretary gave the necessary explanations about the concept of educational agility and the purpose of the research. Then, voting was done for each item in the list. Finally, the items that had 4–5 votes were selected. At this stage, the initial questionnaire was designed with 30 items in 5 dimensions of responsiveness, adequacy, flexibility, speed, and integrity in a 5-point Likert scale. The score of each item ranged from 1 = very low to 5 = very high, and the cut-off-point at 50% of the score was considered equivalent to 3 out of 5.

Face validity

Face validity was edited by five faculty members (two in medical education, one in e-learning, two in healthcare service management), and five MSc, MD and Ph.D. students in medical sciences who had experienced virtual education during the COVID-19 pandemic. Some sentences that required editing for spelling, grammar, and simplicity were revised.

Content validity

Content validity was determined using the Content Validity Index (CVI) and Content Validity Ratio (CVR) methods by 10 educational specialists (one in e-learning, two in healthcare service management, two in medical educations, one in higher education administration, one in health education, one in nursing, one in clinical students, and one in basic medical sciences). They were asked to rate the appropriateness of the items on the dimensions of relevance, clarity, and simplicity on a scale of 1 to 4. In this stage, the number of experts who selected scores of 3 and 4 is divided by the total number of experts. According to the Waltz and Bausell model, a score of 0.79 or higher is expected to be obtained, and in cases where the score is up to 0.70, it can be acceptable with revisions and reconsideration [27].

To determine the CVR, the necessity of the items was examined in a 3-part spectrum from completely necessary to not necessary. The number of selections for the item "necessary" was acceptable for measuring the amount of CVR. According to the Lawshe model, if there are 10 evaluators, a CVR value of 0.625 or higher is expected [28].

Construct validity

In the first part of tool development, we reached a list of items defining educational agility through a literature review and previous instruments [24, 26, 30], along with a discussion in the focus group. In the next step, reducing and categorizing the components was necessary. Principal Component Analysis (PCA) was used to decompose data into smaller components to explain as much of the cumulative variance in the predictors as possible. PCA looks to identify dimensions that are composites of the observed predictors [29].

Since the QEdu-Agility was designed as a researcher-made tool, the EFA was used to determine the construct validity. In EFA, each component's construct validity and importance (factor loading) were determined, and the components were extracted.

Criteria for conducting exploratory factor analysis

A. Criteria for the suitability of variables before conducting EFA

To validate the obtained results, two critical test criteria must be examined before conducting factor analysis:

- The significance of the "Bartlett's test of sphericity," which confirms the relative correlation between variables for conducting the test.
- Control of the Kaiser-Meyer-Olkin (KMO) coefficient, which is an indicator of the adequacy of the sample size for conducting EFA.

Kaiser (1974) believes that when KMO is greater than 0.6, factor analysis can be performed with confidence. Values above 0.9 are excellent, values in the range of 0.8 are good, values in the range of 0.7 are above average, and those in the range of 0.6 are average [30, 31].

B. Criteria for the suitability of variables after conducting EFA

The criterion of the amount of items communality Upon confirming the adequacy of the sample size for factor analysis, the correlation of each item with the entire construct was determined. The minimum acceptable value for the suitability of a variable in research is above 0.5 [32]. However, some studies also consider values of 0.3 to 0.4 as acceptable [33].

The criterion for determining the number of factors and factor loading The main goal of factor analysis is to

reduce variables to main components and classify variables into appropriate and common categories. Five components were extracted based on the Kaiser criterion. According to the KMO criterion, factors (components) whose eigenvalues are greater than one are acceptable [31].

Reliability

To estimate the reliability of the tool, the internal consistency method of Cronbach's alpha was used. After collecting 50 samples, Cronbach's alpha was calculated (R = 0.818). Since this study aimed to validate the tool, the overall reliability, reliability of each component, and reliability of each item in the "If item deleted" situation were examined with 372 samples at the end of the sampling and questionnaire formation. The Cronbach's alpha index ranges from 0 to 1, with values approaching 1 indicating greater internal consistency among the questionnaire dimensions [34–36]. A stronger correlation between the items leads to a higher Cronbach's alpha value [37]. The expected reliability of a questionnaire is at least 0.70, and a value between 0.80 and 0.90 is considered excellent [38].

Statistical methods

SPSS version 24 was used for data analysis. The EFA was used in the psychometric section of the tool development. The confidence level was estimated at 95%, and the acceptable error rate was 5%.

Results

Out of 400 distributed questionnaires, 372 were fully answered (93%). Demographic information is presented in Table 1.

Psychometric analysis of the QEdu-agility

The measurement tool was first constructed to validate the tool. For this purpose, a researcher-made questionnaire consisting of 34 initial items was extracted from three organizational agility questionnaires by Sharifi and Zhang (2000), Goldman and colleagues (2016), and Worley and Lawler (2010) [20, 22, 26]. The validity and reliability of the tool were then examined.

Face validity

The opinions of 10 educational experts were used to determine face validity. Four items were identified as conceptually and grammatically inappropriate and unnecessary in the formal validity examination, which were removed. Items 1, 12, 24, 25, and 30 required structural/ grammatical modifications, which were made.

Table 1 Demographic characteristics of participants

Characteristics	Sub-categories	Frequency	
		N	%
Gender	• Male	238	64.0
	• Female	134	36.0
	• Total	372	100.0
Age	• 18 ≤ Year ≤ 25	139	37.4
	• 26 ≤ Year ≤ 35	148	39.8
	• 36 ≤ Year	85	22.8
	• Total	372	100.0
Grade	• BSc	62	16.7
	• Professional Doctorate	92	24.7
	• MSc	113	30.4
	• Ph.D./ Clinical Residents	105	28.2
	• Total	372	100.0

• Basic medical sciences (Biochemistry, Immunology, Physiology, Anatomy, etc.)
• Para Medical (Nursing, Midwifery, Health care, Physiotherapy, Nutrition, etc.)
• None Medical Sciences (Computer, English language, Education, Information Technology, etc.)

Content validity

The CVI and CVR indices were used to determine the content validity. Overall, with the collection of opinions from 10 experts in education and management, CVR = 0.847 and CVI Total = 0.877 were obtained. The examination of the three sub-components of CVI also confirmed the relevance (CVI = 0.911), clarity (CVI = 0.853), and simplicity (CVI = 0.867) of the sub-components were confirmed with desirable scores (Table 2).

Reliability

The Reliability analysis of the questionnaire, using the internal consistency method and Cronbach's alpha coefficient, indicated an overall reliability of 0.944. The sub-components also demonstrated the reliability of more than 75%, indicating the tool's suitability (Table 2).

Exploratory Factor Analysis (EFA)

Suitability of variables before conducting EFA

Since the QEdu-Agility was developed as a researcher-made instrument, the EFA technique was employed to assess its construct validity. During the EFA, both the construct validity and the significance (factor loading) of each component were evaluated, leading to the extraction of these components. Initially, the

Table 2 Psychometric properties of content validity and reliability of the QEdu-Agility

Components	Items	Content Validity				Reliability	
		CVR	CVI			Cronbach's Alpha	
		Essential	Simplicity	Clearance	Relevance	Factors	If Item Deleted
Responsiveness	A1	0.6	1.0	0.9	0.7	0.782	0.943
	A2	0.6	0.9	0.8	0.9		0.944
	A3	1.0	0.9	0.8	0.9		0.942
	A4	1.0	0.9	1.0	1.0		0.942
	A5	1.0	0.9	0.8	1.0		0.943
Adequacy	A6	0.6	0.8	0.8	1.0	0.828	0.942
	A7	1.0	1.0	1.0	1.0		0.942
	A8	1.0	0.8	0.8	1.0		0.942
	A9	1.0	0.9	1.0	1.0		0.942
	A10	1.0	1.0	1.0	0.8		0.942
	A11	0.8	0.9	1.0	0.8		0.944
	A12	0.6	0.7	0.9	0.7		0.943
Flexibility	A13	0.8	0.9	0.9	0.9	0.849	0.942
	A14	0.8	0.9	1.0	1.0		0.943
	A15	1.0	1.0	1.0	1.0		0.942
	A16	1.0	1.0	0.9	1.0		0.942
	A17	1.0	1.0	0.9	0.8		0.942
Speed	A18	0.8	1.0	0.9	1.0	0.882	0.942
	A19	0.6	1.0	1.0	0.9		0.942
	A20	0.8	1.0	1.0	0.8		0.941
	A21	1.0	1.0	0.8	1.0		0.942
	A22	1.0	1.0	0.8	0.9		0.942
	A23	0.6	0.8	0.9	0.9		0.941
	A24	0.6	0.9	0.8	0.8		0.941
	A25	0.6	0.9	1.0	0.9		0.941
Integrity	A26	1.0	1.0	1.0	0.9	0.805	0.942
	A27	1.0	0.9	0.9	0.9		0.942
	A28	1.0	1.0	1.0	1.0		0.942
	A29	1.0	0.9	1.0	1.0		0.942
	A30	0.6	0.8	0.9	0.8		0.944
Total		CVR_{Total} =0.847	0.911	0.853	0.867	R_{Total} =0.944	-
			CVI_{Total} = 0.877				

Table 3 KMO and Bartlett's test for determining QEdu-Agility factor analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
	Sig	df	χ 2
KMO = 0.928	< 0.0001	435	5752.407

significance of Bartlett's test of sphericity and the KMO coefficient were analyzed. The results indicate that the sample size is appropriate and sufficient for using the test [KMO = 0.928] (Table 3).

Suitability of variables after conducting EFA

Items communality

The minimum acceptable threshold for the communality of the questionnaires' items is typically above 0.5; however, some studies also regard values ranging from 0.3 to 0.4 as acceptable. In the present study, all items showed an acceptable level of communality (R > 0.4) (Table 4).

Table 4 The communalities of items of QEdu-Agility

No	Extracted	No	Extracted	No	Extracted
A1	0.587	A11	0.502	A21	0.548
A2	0.518	A12	0.470	A22	0.562
A3	0.546	A13	0.707	A23	0.647
A4	0.580	A14	0.694	A24	0.678
A5	0.416	A15	0.578	A25	0.692
A6	0.488	A16	0.708	A26	0.614
A7	0.622	A17	0.711	A27	0.662
A8	0.548	A18	0.595	A28	0.662
A9	0.570	A19	0.530	A29	0.684
A10	0.592	A20	0.614	A30	0.504

Number of factors and factor loading

Based on the KMO criterion, factors (or components) with eigenvalues exceeding one are deemed acceptable. The number of factors and their corresponding factor loadings are shown in Table 5 (Table 5).

According to the obtained results, five factors were extracted, which explain a total of 59.43% of the QEdu-Agility construction. In other words, based on the analysis of participants' responses to this questionnaire, the five main components explain or fit approximately 60% of the organizational agility concept at the 1.0 point. The consistency of the EFA results with previous organizational agility theories indicates the appropriate validity of the tool. The Scree Plot is also shown in Fig. 1.

The varimax method of factor rotation, which is a technique used in factor analysis to reduce data and categorize variables based on their inner relationships and differences with other components, was used. This method also determines the loading of each variable, which is the degree to which it contributes to the factor. Based on Table 5, *Responsiveness* is the first component, having the highest loading at 38.79%, followed by other components such as *Adequacy*, *Flexibility*, *Speed*, and *Integrity*.

Table 6 presents the final version of the QEdu-Agility tool, which has been confirmed with 30 items and five main components: Responsiveness (5 items), Adequacy (7 items), Flexibility (5 items), Speed (8 items), and Integrity (5 items).

Discussion

Psychometric characteristics

The QEdu-Agility tool underwent a thorough evaluation of its psychometric properties, confirming its content and construct validity, and reliability as an effective instrument for educational agility.

Content validity was assessed using the CVI, which yielded scores exceeding 0.85, indicating highly favorable levels of simplicity, clarity, and relevance. These results are consistent with the findings of Waltz and Bausell (1981), who proposed that scores above 0.79 for individual items are acceptable [27]. Furthermore, the content validity of QEdu-Agility was corroborated through the CVR established by Lawshe in 1975. According to the Lawshe index [28], an average agreement rate of at least 0.62 is required when feedback is obtained from 10 experts. In our study, we achieved an overall average CVR of 0.847, with each item receiving approval at a minimum score of 0.60. The close alignment of CVI and CVR scores further validates the appropriateness of this tool. Breu and colleagues (2002) proposed a model for evaluating workforce agility that aligns with our findings, suggesting that a high CVI reflects the tool's effectiveness in capturing the dimensions of organizational agility, thereby enhancing its reliability and practical application in real-world contexts [39]. In our research, we relied on expert opinions to compute both CVI and CVR, ensuring that all items met the necessary criteria for inclusion in the final instrument. Petermann and Zacher (2022)

Table 5 Total Variance explained of the QEdu-Agility

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
Total variance explained									
1	11.64	38.79	38.79	11.64	38.79	38.79	4.45	14.82	14.82
2	2.40	7.99	46.78	2.40	7.99	46.78	4.29	14.30	29.12
3	1.55	5.17	51.95	1.55	5.17	51.95	4.19	13.97	43.09
4	1.17	3.91	55.86	1.17	3.91	55.86	3.06	10.18	53.27
5	1.07	3.57	**59.43**	1.09	3.57	59.43	1.85	6.16	59.43
6	0.88	2.92	62.35						
7	0.82	2.72	65.08						

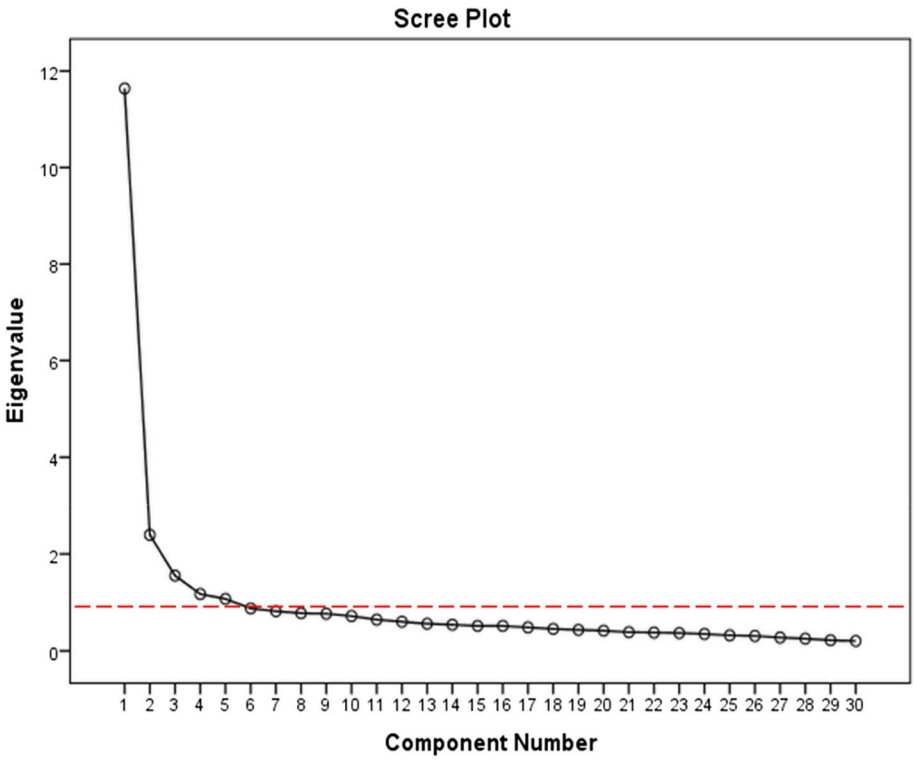

Fig. 1 Scree Plot of exploratory analysis of the QEdu-Agility

exemplified this process by developing a leadership learning agility scale [40].

This is consistent with our observations of similarly high CVI values across various components of our agility questionnaire, which bolsters its credibility. Moreover, Alavi and colleagues (2014) highlighted the significance of organizational learning in promoting workforce agility, asserting that effective measurement tools must exhibit strong content validity to accurately evaluate these constructs [41]. Sherehiy and Karwowski (2014) also emphasized that assessing workforce agility necessitates a comprehensive understanding of its multidimensional nature [42]. By utilizing CVI and CVR assessments, we ensured that our tool effectively captured critical dimensions such as responsiveness, flexibility, and integrity—elements essential for evaluating organizational and educational agility. The reliability of the QEdu-Agility tool developed by researchers was validated with a Cronbach's alpha of 0.944, indicating a high level of reliability as supported by the literature [34–36]. This result is especially significant when contrasted with other established tools in the fields of organizational agility and leadership learning. In the study by Dam in 2022, the reliability of the Leadership Learning Agility tool was examined. The results showed that the overall reliability of this tool was confirmed with a value of 0.890. Also, high reliability was observed for its sub-components, with Developing Leadership having a reliability of 0.87, Seeking Feedback having a reliability of 0.810, and Developing Systematically having a reliability of 0.820, which are close to the reliability values of the present study [24]. In Petermann and Zacher's study (2022), the reliability of the 30-item Workforce Agility-I questionnaire components was examined. The results showed that the reliability of the Accepting changes component was 0.71, Decision making was 0.52, Creating Transparency was 0.49, Collaboration was unclear, Reflection was 0.69, User centricity was 0.82, Iteration was 0.82, Testing was 0.88, Self-organization was 0.70, and Learning was 0.76. Additionally, this study showed that the educational agility tool under investigation had higher reliability than Workforce Agility-I [40]. This variability is a potential limitation in existing tools. It should also be noted that different organizations have significant inherent differences, and it seems that measuring agility needs to be customized for various settings.

Furthermore, in the Deleted If Item analysis, each item was sequentially removed, and the reliability of the remaining items was calculated. As observed in the reliability results of the questionnaire, the removal of each item led to a decrease in the reliability of the remaining questions, indicating that the items had a positive impact on the overall reliability. The reliability of the subscales

Table 6 Factor analysis and the loading percentages of the items of the QEdu-Agility

Items / Components	Responsiveness 1	Adequacy 2	Flexibility 3	Speed 4	Integrity 5
Ability to observe, understand, and predict environmental changes	0.693				
Ability to react quickly and adapt to changes in the environment	0.695				
Ability to create, modify, change, and improve in a timely manner	0.645				
Ability of the organization to solve problems and respond to surrounding challenges	0.676				
Ability to provide appropriate and timely responses to customers	0.507				
Strengthening self-learning and acquiring new knowledge and skills		0.478			
Strengthening learning from each other		0.619			
Strengthening the skill and knowledge of using technology		0.467			
Creating opportunities for empowerment and updating knowledge		0.554			
Increasing the quality of educational services provided		0.582			
Increasing communication with others (other universities, faculties, professors, students)		0.542			
Deepening relationships with others (scientific interactions, sustainability of relationships, etc.)		0.704			
Reducing the costs of education and learning and providing services			0.776		
Reducing bureaucratic barriers and administrative formalities			0.794		
Flexibility (removing time and space constraints) in providing educational services			0.788		
Flexibility (removing time and space constraints) in the diversity of educational services			0.691		
Time and space flexibility in meeting the needs of students			0.510		
Increasing the volume of activities and educational services provided				0.688	
Accelerating and facilitating the use of various teaching methods for professors				0.499	
Accelerating access to resources and course content appropriate to the student's conditions				0.641	
Accelerating access to library educational resources (books, theses, etc.)				0.649	
Reducing the time required for activities and increasing the speed of tasks				0.508	
Accelerating the dissemination and sharing of knowledge and experiences				0.657	
Accelerating documentation of information and retrieval of knowledge				0.584	
Accelerating data analysis, reporting, and monitoring of activities				0.540	
Facilitating interactions and coordination between individuals and organizations					0.598
Coordination and coherence of work activities between different departments					0.709
Increasing participatory activities among individuals					0.664
Increasing the possibility of helping and help seeking in performing each tasks					0.631
Possibility of replacing people together in each other's absence and performing other's tasks					0.563

was also calculated, with the highest reliability belonging to the Speed subscale (0.882) and the lowest belonging to Responsiveness (0.782). It is important to note that the Cronbach's alpha coefficient is not only influenced by the internal consistency of the questions but also by the number of items, and a lower number of items leads to a decrease in Cronbach's alpha [43].

For the construct validity, the EFA method was used. The KMO was obtained with a value of 0.946, and the Bartlett's test of sphericity yielded a significant result with a p-value less than 0.0001, indicating sample adequacy and suitability for factor analysis. Generally, a KMO value above 0.6 is acceptable, and values above 0.8 are considered very good and suitable [31]. Based on the findings, except for items 5 and 12, the amount of variance explained by each variable was more than 0.5. Some sources consider the value of 0.5 as acceptable [32], while others consider the values of 0.4 and 0.3 as acceptable [33]. The total variance explained by the questionnaire was 59.43%, and the factor loadings of each factor were as follows: Responsiveness, Adequacy, Flexibility, Speed, and Integrity/Coherence, explaining approximately 60% of the organizational agility construction in educational environments. Dawson (2016) considers a value ranging

from 0.5 to 0.9 as acceptable [44], so the total variance explained value of approximately 60% is acceptable. In total, the psychometric characteristics of the tool indicate that QEdu-Agility is a valid instrument for measuring educational agility.

Educational agility components

In addition to the psychometric analysis and validity assessment of the instrument, the results can also be analyzed from a theoretical perspective.

One notable observation in categorizing the components is that the two components of Responsiveness and Adequacy had the highest factor loadings. These two components refer to the nature of educational services and the fulfillment of the expectations of educational organizations. This explains the concept of "Doing the right thing" [45, 46]. The next two components, the Flexibility and Speed, refer to how the work is done or "Doing the work the right way" [45, 46]. Finally, the fifth component is Integrity, which refers to the coherence of the activities. All these five dimensions of educational agility create the basis for productivity in the organization, which is a combination of the components of effectiveness (Doing the right thing) and efficiency (Doing the work the right way) [47]. In this regard, Zaleznik refers to two categories of leadership and management capabilities as separate functions. In this categorization, leadership skills are defined as visionary and confronting the organization for "Doing the right thing", while managerial skills, with a task-oriented approach, emphasize "Doing things right" [48].

However, recent studies suggest that a combined set of management and leadership dimensions can be effective for current organizations, and these two terms are no longer easily separable. Current organizations need agility and require far-sighted individuals who can adapt to the evolution of changing organizations. Therefore, we need both leadership skills for human resource motivation and developmental infrastructure [47, 48]. It is worth noting that the relative importance of the different dimensions of this questionnaire may differ in face-to-face and virtual environments, which can be explored in future research.

It is worth mentioning, the concept of organizational agility is relatively new and derived from organizational flexibility, which makes it challenging to find articles that specifically address this topic. However, the research conducted by Peng and colleagues (2022) provides a different perspective on the "Agility of Learning and Development Professionals" during the COVID-19 pandemic, focusing on four key dimensions [49]. First, the willingness to adapt to job requirements reflects professionals' readiness to modify their approaches in response to evolving demands. Second, the ability to continuously learn new things emphasizes the importance of ongoing skill acquisition as essential for success in a rapidly changing environment. Third, the ability to overcome difficulties highlights resilience and problem-solving capabilities when faced with challenges. Lastly, the ability to handle jobs with increasing complexity refers to professionals' capacity to manage increasingly intricate tasks that require advanced skills and adaptability. Together, these dimensions illustrate how Learning and Development professionals navigated the unprecedented challenges of the pandemic, showcasing their agility in adapting to new circumstances and enhancing their effectiveness in their roles.

Conclusion

Based on the findings of the study, it appears that the overall reliability and content validity of the questionnaire indicate that the initial version is well-suited for quantitative research. The results of the EFA also show that this tool has suitable construct validity and is consistent with previous tools. It seems that this instrument can be appropriate for measuring educational agility in educational organizations such as universities. Additionally, from the perspective of factor importance, the high factor loadings of the Responsiveness and Adequacy components highlight their central role in capturing the essence of meeting expectations and fulfilling the needs of educational organizations. The salience of this matter lies in the fact that responsiveness is an indicator of all agility dimensions and is also reflective of the organization's ability to respond appropriately to environmental changes. The subsequent components of Flexibility and Speed reflect the importance of emphasizing the process and execution of educational activities. Finally, the Integrity component underscores the coherence and alignment of these various elements.

Advantages and limitations

This tool is a new approach based on the educational environment, and with appropriate validity and reliability indices, it can be used in future studies to measure educational agility construction. However, this research was carried out for the first time and involved students from a single medical university. Accordingly, the differences in the statistical population could potentially impact the results. Therefore, retesting the tool in diverse environments in future studies is recommended.

Abbreviations

SUMS	Shiraz University of Medical Sciences
QEdu-Agility	Questionnaire of Educational Agility
CVR	Content Validity Ratio
CVI	Content Validity Index
EFA	Exploratory Factor Analysis

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Ethical considerations
The research project conducted by the Research Deputy of Shiraz University of Medical Sciences. It was approved by the National Ethics Committee for Biomedical Research with the code IR.SUMS.REC.1401.561. All participants were informed of the research objectives and completed an informed consent form. The questionnaires were collected and analyzed anonymously, and the final report was made available to relevant officials for future planning purposes.

Authors' contributions
Z.K has has participated designing the research, writing the proposal, reviewing the literatures, collecting data, determining the validity of the questionnaire, analyzing data and writing the manuscript. F.Ch has participated in the proposal preparation, Reviewing the literatures, collecting data. All authors have critically reviewed and approved the final article.

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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
Et Board at the School of Public Health, Shandong University. All study participants provided informed consent prior to participation in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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