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Designing the Quantum Curriculum Leadership Model at Farhangian University: A Mixed Method Study

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Abstract
The principles and concepts of the quantum theory have been extensively developed and have become a paradigm in various disciplines, including management and leadership sciences. This is particularly evident in the management leadership of educational organizations within universities. Universities must restructure their management leadership methods to effectively address issues and align with the successful higher education systems of other countries. The present study aimed to design a model of quantum curriculum leadership at Farhangian University. The research design was based on mixed methods, with an exploratory approach in the qualitative part and a descriptive-correlative approach in the quantitative part. The sample size in the qualitative section was 17 interviewees (faculty members) selected through purposive sampling based on saturation principle, and in the quantitative section, it was 283 individuals selected through cluster random sampling. In the qualitative part, validity was assessed by expert judgment and reliability by test-retest and internal consistency. In the quantitative part, content validity, structural validity and reliability were assessed using Cronbach's alpha and composite reliability, which indicates the validity and reliability of the instruments. Data analysis in the qualitative part included grounded theory analysis (open, axial and selective coding), while in the quantitative part descriptive and inferential statistics (Kolmogorov-Smirnov test, index values and path analysis) were used. The results of the Kolmogorov-Smirnov test showed that these assumptions were confirmed ($p>0.05$). The results of the study also showed that the presented model fits well. The results showed that quantum curriculum leadership consists of two factors including dimensions and components; causal conditions including planning in the higher education system and assessment of the quantum curriculum; and consequences, including learning and professional development. The strategies include management, applied training and leadership organization, while the context includes environmental, economic and scientific factors. Obstacles include technology, focused training and structured organization. Based on the identified factors, a systematic data-based model was proposed and validated by experts.
Keywords: *Curriculum Leadership, Quantum leadership, Quantum Curriculum Leadership, Model*

Introduction

In today's world, the success and development of organizations depend heavily on their human resources. Due to the growth of their economic and social activities, companies are forced to continuously attract, retain and effectively manage skilled workers (Jaafari et al., 2021). In the current dynamic and interconnected business environment, it is no longer sufficient to rely solely on traditional management skills such as planning, organizing, directing and controlling. The level of familiarity that companies have with concepts related to

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quality and productivity is of paramount importance in managing production units. This familiarity plays a crucial role in determining the status and performance of organizations in both internal and external competitive arenas (Soltani & Amanat, 2019). This research proposes a new set of management skills that draw inspiration from quantum mechanics and chaos theory, allowing managers to effectively use their leadership skills. The 21st century has witnessed a new technological era, often referred to as the “Quantum Age,” characterized by rapid and continuous changes that have disrupted the stability and predictability of the world. Quantum theory, which dates back to Max Planck's ideas, explains that energy behaves as both a wave and a particle. Quantum refers to the division of energy into discrete packets of particles that, when moved, spread like waves across the surface of a pond (Razi & Nadi, 2022). From a quantum perspective, leadership acquires its own meaning and concept and is seen as a driving force in creating unique attractions. According to the quantum leadership approach, leaders must adopt a new approach to people, processes and objects in order to effectively increase performance. This approach should address the psychological, irrational and chaotic aspects of both their behavior and that of their subordinates (Bilgen & Elçi, 2022). The theory of quantum leadership suggests that organizations and their members are based on the principles of quantum physics. Instead of perceiving uncertainty and complexity as obstacles, leaders should accept and manage them. By recognizing the nonlinear and ever-changing nature of the quantum world, leaders can gain new insights into and effectively influence human systems.

Quantum management has a profound impact on various fields, including the natural sciences and humanities. It challenges the traditional Newtonian perspective, which is based on absolute and deterministic viewpoints. Instead, quantum management is based on the idea that uncertainty, nonlinearity and complexity play a significant role in human behavior and organizational processes (Safari et al., 2023).

The basic principle of quantum theory is that everything in the universe, including humans, is connected and conscious. Our understanding is greatly influenced by our thoughts, and to foster innovative thinking we must harness our inspirational and insightful abilities. Quantum competencies lead managers to adopt a new approach to managing people and resolving conflicts, moving from an external, hierarchical method to an internal, collaborative approach (Krogel, 2016).

Universities have long been known for their important missions and mandates, which include teaching, research and social service. However, universities in the 21st century are facing rapid changes and transformations that require them to adapt and take on new tasks (Mahdavi et al., 2022). One of these new mandates is the need to respond appropriately to the economic, social and cultural needs of the societies in which they operate. To carry out their missions effectively, universities need strong academic leadership. In this context, quantum leadership has emerged as a proposed solution for leading modern organizations, including universities (Najafi & Maroofi, 2020). Farhangian University is a mission-driven university that trains teachers based on the needs of the community and admits students based on an actual assessment of needs. This university is considered one of the fundamental institutions for promoting education and training of teachers in Iran (Khanifar, 2019).

Farhangian University adopts a comprehensive approach to higher education with the primary aim of becoming a leading institution in the areas of teaching, research, knowledge production and its application for educational and developmental purposes. This university strives to provide a world-class education and to promote professional and specialized skills through focused training. Farhangian University is committed to integrating innovative educational and pedagogical technologies to effectively fulfill its mission while adhering to the criteria of the Islamic system, which is consistent with the goals of all higher education institutions in the country. However, the university recognizes that further efforts are required from planners, faculty members and students to successfully achieve its intended goal and vision (Sadeghi & Mirsepasi, 2020)

The education system in the Islamic Republic of Iran places great emphasis on training teachers and is guided by the overall goals of the government. This goal is achieved through the dedicated efforts of academic faculty members and experts who continually work to improve the quality of education. A key factor in achieving educational goals is the high quality of the curricula. However, it is not enough to simply have high-quality curricula; Their effective implementation in the academic environment is also crucial. This requires the involvement of both teaching and administrative staff. The implementation of curriculum programs in universities is crucial, and proper leadership is essential for organizing future educational products and ensuring a self-renewal process (Malaki et al., 2018)

The aim of this study is to examine the dimensions, competencies and quantum characteristics of curriculum leadership in Farhangian University. The study involves collaborative ideation with teachers, academic administrators and curriculum specialists at Farhangian University. By involving experts from different areas, the study aims to develop a framework based on quantum leadership theory specifically for higher education. The research hopes that this framework will provide innovative guidance for the effective management of curriculum reforms and improvement initiatives at the institution.

Literature Review

Today, companies are more competitive than ever to survive in the turbulent business world. Since the quality of work of human resources is an important factor in the success of organizations, especially under uncertain conditions, energetic and hard-working employees can be valuable assets for organizations (Karlou et al., 2019). The success of modern organizations depends largely on effective and efficient management and leadership. In today's competitive landscape, organizational leaders are forced to have knowledge of new approaches to management, leadership, and creative and innovative thinking. This is critical for achieving organizational goals, promoting a positive work culture, and motivating employees (Delgarm et al., 2021). Effective management and leadership skills are crucial in the field of organizational science. Organizational psychology studies have found a strong connection between the quality of management and a number of outcomes, such as: employee satisfaction, safety culture and the overall success of the organization (Hosseini Dronkolaei et al., 2024). The role of managers is crucial in promoting a positive work environment. They are responsible for building personal and meaningful relationships with their employees, which is critical to developing desired work attitudes. When management is perceived as healthy and puts the balance between people and productivity first, it creates an engaging workplace and ultimately benefits the company with higher returns (Tirabadi et al., 2024). In the 1920s, physicists introduced a branch of physics called quantum physics, which today is not only used in the field of physics, but also finds application in leadership and management. Quantum leadership is a concept that draws inspiration from the principles of quantum physics and applies them to leadership and management practices. It recognizes that organizations are complex and dynamic systems, much like the quantum world, that traditional leadership approaches may not be sufficient to meet the challenges of today's rapidly changing and uncertain business environment (Turner, 2020).

The application of the quantum leadership paradigm in the 20th century was a significant revolution with immense potential for future scientific advances. This paradigm has had an impact on the natural sciences and influenced the way concepts are organized in the humanities (Saran, 2019). The seven principles of quantum mechanics, such as wave-particle duality, the principle of uncertainty, the observer effect on reality, the distortion of time and space perception, the concept of parallel universes, the theory of a unified field and the understanding that everything is energy, prompt us to consider the effectiveness of university professors as leaders in implementing a quantum curriculum structure that can have a transformative impact similar to that of physics (Dadgaran & Khalkhali, 2016).

In the quantum paradigm, a leader's primary role is to help release quantum energy, unlock and realize the individual's potential capabilities, and promote their growth by building sustainable relationships with employees. In this approach, leadership involves the creation and maintenance of energy fields in which relationships, growth and development take place and gradually become purposeful, dynamic and impactful. Excitement and energy come from imagining and wondering about future events (Hamzehpour, 2018). Leaders guide their followers not only through past experiences and successes, but also through future explorations and tensions. Therefore, leadership cannot be defined only as the exercise of influence over others to achieve certain goals; Rather, it should be defined as a process in which the pursuit of a purpose and movement toward the goal are more important and valuable than achieving the goal itself (Hamzehpour, 2018).

Quantum leaders in modern organizations are able to align their intentions and purposes and effectively seize opportunities with deep understanding, clear vision and goals. They have realized that linear, logical and rational thinking is not enough to answer many questions and requires a multi-layered understanding of reality and seemingly contradictory decisions, in which quantum skills help them (Nazarzadeh et al., 2021). Quantum leaders understand that a leader's decisions and actions not only impact themselves, but also influence the decisions of others in the present and future. Therefore, they act with greater responsiveness and social responsibility, work for the benefit of the larger system, and promote ethical behavior in organizational leadership (Dargahi et al., 2016). Quantum leaders are capable of adapting to rapid and dynamic environmental changes. They nurture the leadership potential of their followers and share and distribute leadership. A Quantum leader radiates their light, brightness, and capacities among the organization's employees while simultaneously drawing inspiration from the group of employees under their supervision (Azimi Sanavi & Razavi, 2015).

The concepts of quantum leadership were derived from the study of Shelton (2001) and are considered a novel topic for management leadership (Shelton & Darling, 2001). It offers a model of new interactive skills and a paradigmatic thinking framework that enables effective management leadership. Shelton's (2001) seven skills of quantum leadership are: quantum seeing, quantum thinking, quantum feeling, quantum knowledge, quantum action, quantum trust and quantum being. The Quantum Seeing skill enables leaders to consciously select their goals and shape their assumptions and beliefs during the process of developing and testing hypotheses (Zeynali et al., 2020). It highlights the importance of being aware and recognizing that reality is subjective and internal assumptions and beliefs influence 80% of what is perceived in the external world. A clear intention or purpose is crucial to transforming an organization into a learning organization (Hamzehpour, 2018). This ability enables leaders to specifically observe and identify hidden opportunities within the complexity of their people, changes, and issues while avoiding cognitive biases (Aghababayi et al., 2013).

To generate innovative solutions, leaders must have the ability to think quantum. This skill involves exploring seemingly contradictory options and embracing paradoxes. Quantum thinking enables leaders and managers to effectively control both internal and external organizational events while overcoming the limitations of linear thinking. It unlocks creativity and facilitates significant transformations, even with minor changes (Bozorgi et al., 2020).

The ability of quantum feeling allows leaders to cultivate a deep sense of well-being, leading to greater coherence within organizations and the generation of positive energy (Tavakkoli et al., 2017). This ability is about actively and comprehensively experiencing emotions that arise from the magnetic field in the body. Positive emotions contribute to both individual and organizational coherence, while negative emotions reduce individual enthusiasm and vitality, ultimately impacting the organization. It is believed that human and universal energy have the same essence and that the human heart serves as the source of this energy. Negative emotions such as despair, anger, fear and impatience reflect energy that reduces the individual's enthusiasm and energy. Conversely, positive emotions such as love, enthusiasm, gratitude and forgiveness promote a sense of well-being. This ability and skill are characterized by the coherence of heart waves and energies that transform weaknesses into strengths and threats into opportunities, ultimately evoking vibrant enthusiasm in individuals and organizations (Zybandeh & Paziresh, 2020).

The field of quantum knowledge recognizes that possessing a large amount of information does not automatically lead to effective decision making. Pioneers in this field are working to create a new type of learning organization that incorporates this capability into the decision-making process. Quantum knowledge is about understanding the world as an energy field in which everything is interconnected and infinite. It recognizes that the universe has consciousness and an information field with unlimited capacity. This does not reduce certainty, but people who strictly adhere to absolute thinking are closed to new observations (Safari et al., 2023).

The concept of Quantum Acting emphasizes the importance of leaders demonstrating kindness, compassion and honesty, which in turn enables employees to do their best work. This approach focuses on actions that benefit both the individual and the system as a whole. This capability allows organizations to quickly adapt to changes in one area, leading to corresponding changes in other components and highlighting the interconnectedness of all elements. Quantum actions also promote a sense of responsibility by acknowledging how interconnectedness, interdependence, and consequences impact individuals (Esmailzadeh Qamsari & Rahimi, 2023).

The Quantum Trust skill explores the power-seeking and controlling tendencies of leaders, rooted in chaos theory and the need for imbalance to promote growth. This ability is influenced by complexity and chaos principles and recognizes the role of chaos in enabling self-organization at higher levels. Confidence in the natural flow of life in individual, group and organizational activities is a crucial element of this skill. Although there is inequality and disorder, ultimately order emerges through the underlying organizing principle that demonstrates belief in the inherent processes of life (Tavakkoli et al., 2017).

Quantum Being focuses on building organizational relationships that foster a culture of learning. Employees can freely interact and interact with each other without fear of punishment or criticism. These relationships provide valuable learning opportunities. By thriving in these relationships, individuals develop a shared sense of identity and boundaries that facilitate problem solving through open discussion and conversation. This strengthens relationships (Nazarzadeh et al., 2021).

In their article, (Zybandeh & Paziresh, 2020) emphasized a strong connection between quantum competencies and organizational performance. Their study found that through quantum leadership, managers can increase their employees' critical thinking and confidence, leading to positive outcomes such as increased productivity, effective communication, and high performance.

(Harris et al., 2020) conducted a study of curriculum leadership in Wales, examining international assessment of the curriculum. Their findings showed that curriculum reform in Wales has created new opportunities for teachers to engage with changes in the education system. Teachers are crucial as curriculum planners and contribute to the development of new curriculum frameworks. However, their involvement in curriculum development was limited, particularly at the international level where they had minimal interactions with regional agencies. Instead, their involvement was primarily focused on creating micro-level school-based curricula. In contrast, their influence as independent leaders in shaping macro-level curricula, such as national policy, was minimal.

(Bozorgi et al., 2020) in their study recognized the emergence of quantum leadership as a new intellectual and competency-based advancement in organizations. According to the results, these dimensions and skills are highly desirable in public universities. They introduced properties such as fluidity, dynamism, flexibility and a coaching role in quantum leadership.

(Dadgaran & Khalkhali, 2016) conducted a study on the impact of quantum learning methods on students' academic learning. Their results showed that implementing this model not only increases teacher effectiveness but also student performance. The authors identified five essential components (foundation, atmosphere, environment, design and liberation) that work together to create a positive impact. They also emphasized that the integration of quantum concepts into the learning process has proven to be particularly effective.

(Tshelane & Mahlomaholo, 2015) conducted a study to examine the impact of integrating information and communications technology (ICT) in the development of professional curriculum leadership approaches, with a focus on promoting sustainable learning environments. The research results suggest that integrating ICT into these approaches has significant and positive impacts. This integration empowers the individual by expanding their skills in various ways.

While the introduction and literature review provide an overview of quantum leadership and its potential application in various fields, including higher education, there is a research gap regarding the specific dimensions, competencies and quantum characteristics of curricular leadership at Farhangian University. Although the study aims to develop a framework for effective curriculum management based on quantum leadership theory, there is limited research on the practical implementation and outcomes of quantum leadership in the context of curriculum reforms and improvement initiatives in higher education institutions. Therefore, further research is needed to investigate and understand how quantum leadership principles can be effectively applied to curriculum leadership to improve educational outcomes and fulfill the mission and vision of Farhangian University. Further research is needed to explore and understand the potential benefits and challenges of integrating quantum leadership principles into curriculum leadership practices, particularly in the context of educational reforms and macro-level curriculum development. Furthermore, the implications of integrating information and communications technology (ICT) with quantum-based curriculum leadership approaches need to be explored to promote sustainable learning environments and improve curriculum delivery and student learning outcomes. Therefore, the study's literature review highlighted a significant gap in research on quantum curriculum leadership in universities. To fill this gap, higher education institutions and universities need to conduct an environmental assessment of both internal and external factors and then develop, implement, evaluate and control policies accordingly. To improve curriculum leadership and prevent potential harm, universities need to implement a quantum curriculum leadership model that combines scientific and practical approaches. Since no such model has been presented so far, this study aims to design a model for guiding quantum curriculum leadership in Farhangian University. The application of quantum curriculum leadership represents a novel approach that is being investigated for the first time at Farhangian University in Iran. According to the authors, this can be achieved by considering university professors as curriculum leaders. Therefore, the present study addressed the following questions:

1) What are the dimensions and components of quantum curriculum leadership in Farhangian University?

2) What is the fit of the appropriate model of the quantum curriculum leadership in Farhangian University?

Methodology

The present study aimed to propose a model for quantum curriculum leadership. The research method was applied in a purpose-oriented manner and the mixed method (qualitative-quantitative) was used to collect data. In order to gain a deeper understanding and further knowledge of the topic, the literature research and relevant background information were first examined. Interviews and basic data analysis were then used as research techniques to better understand and identify the indicators, components and dimensions of quantum curriculum leadership.

In the qualitative section, a non-random purposive sampling method was used to select the interviewees based on the inclusion criteria mentioned in the study population section. The selection of sample cases in this method is based on the researcher's consideration of the study objectives and the nature of the research. It should be noted that 17 interviewees were considered in this study based on the principle of saturation, meaning that interviewees number 18 and 19 did not provide any new information, and the interviews were concluded. The demographic information of the interviewees is presented in Table (1).

In the quantitative part, there are different opinions regarding sample size in correlational research studies using structural equation modeling. However, there is general agreement that structural equation modeling, similar to factor analysis, can be implemented with a large sample size (Creswell & Clark, 2017) with a sample size of approximately 200 considered sufficient for model fitting. Therefore, the sample size in the present study was 288 professors of Farhangian University. Questionnaires were distributed among these individuals, excluding five incomplete questionnaires, resulting in statistical analysis being conducted on 283 participants. The sampling method used in this study was multistage cluster random sampling due to the geographical distribution of universities across Iran. Specifically, 12 provinces were randomly selected from all provinces in Iran, and two sister and brother campuses were selected from each province. Three majors were then randomly selected from each campus and finally questionnaires were distributed to seven randomly selected professors from each major.

Table 1.
Demographic Statistics of the Interviews

Occupation	No	Field of study	No	Degree	No	Variable	Age	No
Academic Experts	6	Education Management	5	PhD	14	Age	Below45 years	2
							46-50years	8
		Curriculum Studies	12	Master's degree	3		51-55years	4
Organizational Experts	11			Female	4		Over55 years	3

Occupation	No	Field of study	No	Degree	No	Variable	Age	No
				Male/Female	17	Work-Experienced	under10 years	4
							10-20years	8
							Above21	5

In the current research, retest reliability and intra-subject agreement method were used to calculate the reliability of text analysis. To calculate test-retest reliability, several interviews were selected as samples and each recoded at a short and specific time interval. The identified codes for each interview were then compared in the two-time intervals. The retest method is used to assess the coding stability of the encoder. In each interview, codes that are similar between the two-time intervals are labeled as a “match,” while codes that are different are labeled as a “mismatch.” The method of calculating reliability between coding is carried out by the researcher at each two-time interval is as follows:

In this study, a reliability coefficient between the carried -out coding was found to be 77.6%, indicating their acceptability. To calculate reliability using the intra-subject agreement method, a secondary coder who was familiar with coding was asked to participate in the research as a secondary coder. The researcher then coded five interviews with this employee. The percentage of intra-subject agreement, which serves as an indicator of the reliability of the analysis, was calculated using the following formula:

Intra-subject agreement percentage = (2(55) / 150) * 100 = 73.33%

In this formula, the number of agreements refers to the number of shared and identical codes between the researcher and the collaborating coder. The total number of codes represents the sum of the extracted codes between the researcher and the collaborating coder. Therefore, the reliability of the two coders resulting from the calculations was determined to be 73.33%. To determine the validity of the questionnaire, face, content and construct validity were used. Regarding face validity, the questionnaires were checked by several members of the sample as well as university experts and officials before distribution by the researcher. Regarding content validity, the content of the questionnaire was evaluated using a Delphi method and using CVR and CVI forms using additional or modified questions by ten experts, including respondents, university experts, some participants, etc. The CVI form showed that all Questionnaire items were considered appropriate in terms of simplicity, clarity and relevance (the coefficient for each question was above 0.79). Furthermore, since the CVR value for all questions was above 0.62, no question had to be deleted. Regarding construct validity, both convergent and discriminant validity were examined using the Smart-Pls 3 software. When examining convergent validity, the results showed that the factor loadings of all latent variables were significant, with values above 0.58 (t-statistic), indicating that all factor loadings were statistically significant at the 99% confidence level. The values of all factor loadings were also above 0.50 (the relationship between the manifest and latent variables) and the average variance extracted (AVE) for all constructs exceeded 0.50. Furthermore, the composite reliability of all constructs was higher than the average variance extracted. It can be concluded that the convergent validity of the model structures is confirmed. In this study, reliability is assessed using Cronbach's alpha coefficient and composite reliability. The values of these two coefficients were above 0.70 for all research variables, indicating the stability of the measurement instrument.

Ethical considerations were also taken into account in this study, including: ensuring the anonymity of the questionnaires and the names of the respondents, as well as the use of codes instead of the names of people; Providing an explanation of the objectives and procedures of the study before presenting the questionnaire; Maintaining the confidentiality of participant information; Providing research results to participants upon their request; voluntary and optional participation in the study; obtaining permission to record interviews; Do not manipulate data; and respect the integrity of the sources used.

Findings

The qualitative part of the research

In the qualitative part, semi-structured interviews were conducted with 17 experts to collect data and obtain reliable results. The semi-structured interview method included predetermined interview questions asked of all participants; However, they were free to give their answers in any way they wished. The data obtained from the interviews with the experts in the qualitative part were analyzed using the MAXQDA 2020 software. The coding process used in this study consisted of the following steps based on the methodology proposed by (Corbin & Strauss, 2008). During the coding phase, open coding was used to make connections between the created categories. Open coding is an analytical process that identifies concepts, their characteristics and dimensions in the data. The grounded theory data processing approach forms the initial categories of information about the phenomenon under study through data segmentation (Creswell, 2017). The second step of the process was to implement axial encoding. Axial coding is a method that connects categories and creates links between them based on their properties and dimensions. The term "axial coding" is used because it refers to one main category. In this phase, the categories, features, and dimensions obtained from the initial open coding phase are refined and organized to gain a deeper understanding of their relationships. In simpler terms, axial coding leads to the creation of categories and subcategories. In this phase, all final open codes were thoroughly reviewed and compared with the existing research literature. Selective coding is a systematic process that involves carefully selecting major categories and making connections to other categories. This step is essential for theory development because it builds on the insights of open coding and axial coding. It validates and refines the relationships between categories that require further development. Additionally, selective coding involves linking the central category to other categories, representing these relationships in a narrative framework, and expanding and evolving the categories as needed (Creswell, 2017). The results are presented in Table (1), which identified a total of 135 indexes, 6 dimensions and 27 components.

Table 2.

Integration of indexes extracted from (open, axial and selective coding) and formation of categories

Structure	Category	Component	Index Number
Quantum Curriculum Leadership	Dimensions	Knowledge	5
		Attitude	7
		Skill	5
	Elements	Transformational Leadership	5
		Servant Leadership	6
		Military Leadership	4
Causal conditions	Planning in the Higher Education System	Structure	6
		Professor	7
		Curriculum Content	4
		PerformanceEvaluation	7

Structure	Category	Component	Index Number
	Quantum Curriculum Evaluation	Self-assessment	4
		Differentiation	4
Consequences	learning	Quality of Learning	8
		Learning Responsibility	4
		Persistence in Learning	4
	Professional Development	Technical Skills	4
		Professional Skill	3
		Environmental Skills	3
Strategy	Managerial		8
	Practical Training		4
	Executive Organization		4
Context	Environmental		5
	Economic		5
	Academic		4
Obstacles	Technological		6
	Concentrated Training		5
	Structured Organization		4

The quantitative part of the research

1) What are the dimensions and components of quantum curriculum leadership in Farhangian University?

To examine and answer this research question, the Quantum Curriculum Leadership questionnaire was used as a data collection tool. We developed a questionnaire with 135 items. Questionnaires were distributed to 283 participants and then the data were analyzed using the Kolmogorov-Smirnov test and centrality and dispersion measures to identify the dimensions and components and rank them accordingly. The normality of the data of the research variables was examined using the Kolmogorov-Smirnov test and the results are presented in the following table.

Table 3.
Results of the Kolmogorov-Smirnov Test for Normality

Structure	Dimension	Component	Test statistics	Significance level
Quantum Curriculum Leadership	Dimensions	Knowledge	0.581	0.201
		Attitude	0.592	0.199
		Skill	0.809	0.156
	Elements	Transformational leadership	0.932	0.125
		Servant Leadership	0.615	0.197
		Military leadership	0.561	0.203
Causal Conditions	Planning in the higher education system	Structure	0.534	0.207
		Professor	0.953	0.119
		Curriculum content	0.782	0.174
	Quantum Curriculum Evaluation	Performance evaluation	0.683	0.181
		Self assessment	0.622	0.194
		Differentiation	0.975	0.111
Consequences	learning	Quality of learning	0.738	0.183
		Learning responsibility	0.986	0.107
		Persistence in learning	0.647	0.192
	Professional development	Technical skills	0.991	0.103

Structure	Dimension	Component	Test statistics	Significance level
		Professional skill	0.894	0.129
		Environmental skills	0.592	0.199
Strategy	-	Managerial	0.546	0.205
		Educational	0.614	0.197
		Organizational	0.714	0.185
Context	-	Environmental	0.822	0.142
		Economic	0.657	0.191
		Academic	0.672	0.189
Obstacles	-	Technological	0.608	0.198
		Educational	0.863	0.135
		Organizational	0.671	0.189

The Kolmogorov-Smirnov test was used to assess the normality of the data related to the research variables. According to the information in the table above, the significance level of the Kolmogorov-Smirnov test statistic for each variable is greater than 0.05. Therefore, the null hypothesis (normality of the data) is accepted and the alternative hypothesis is rejected. This means that the data is normally distributed. In the table (4) below, the central and dispersion measures related to the research variables are displayed. It should be noted that the minimum and maximum values for each of the variables are 1 and 5, respectively.

Table 4.
Central and Dispersion Measures for Research Variables

Structure	Category	Component	Mean	The Standard Deviation	Skewness	Kurtosis
Quantum Curriculum Leadership	Dimensions	Knowledge	3.65	0.87	-0.46	-0.01
		Attitude	3.26	0.89	-0.06	-0.34
		Skill	3.27	0.96	0.11	-0.40
	Elements	Transformationa l Leadership	3.13	0.84	0.20	-0.47
		Servant Leadership	3.31	0.86	-0.09	-0.52
		Systematic Leadership	3.29	0.79	-0.07	-0.57
Causal conditions	Planning in the E ducationalSystem	Structure	3.38	0.84	-0.10	-0.06
		Professor	3.21	0.81	-0.02	-0.13
		Curriculum Content	3.15	0.79	-0.09	-0.22
	Curriculum Evaluation	Performance Evaluation	3.31	0.74	-0.07	0.45
		Self-assessment	3.14	0.72	-0.04	0.24
		Differentiation	3.16	0.78	-0.12	0.39
Consequences	Learning	Quality of Learning	3.23	0.79	0.03	0.04
		Learning Responsibility	3.11	0.78	0.05	0.16
		Persistence in Learning	3.13	0.81	0.08	0.019
	Professional Development	TechnicalSkills	3.18	0.80	-0.04	0.25
		Professional Skill	3.19	0.83	-0.02	0.05
		Environmental Skills	3.22	0.79	-0.06	0.21

Structure	**Category**	**Component**	**Mean**	**The Standard Deviation**	**Skewness**	**Kurtosis**
Strategy	Managerial		3.31	0.77	-0.08	0.12
	Practical Training		3.24	0.79	-0.15	0.19
	Executive Organization		3.17	0.76	-0.21	0.29
Context	Environmental		3.29	0.78	-0.29	0.51
	Economic		3.36	0.67	-0.19	0.48
	Academic		3.27	0.71	-0.24	0.34
Obstacles	Technological		3.41	0.66	-0.27	0.49
	Concentrated Training		3.34	0.73	-0.18	0.21
	Structured Organization		3.39	0.63	-0.26	0.35

Table (4) shows the statistical characteristics of the research variables such as mean, standard deviation, skewness and kurtosis. Furthermore, considering the acceptable range of skewness and kurtosis values (between -2 and +2) to assume the normality of the data, it is possible to propose the normality assumption for the data. Based on the above results, it can be concluded that in the Quantum Curriculum Leadership aspect, the highest mean value is related to the knowledge component (3.65) and the lowest mean value is related to the transformational leadership component (3.13). In the causal condition aspect, the highest mean is associated with the structural component (3.38) and the lowest mean is associated with the self-assessment (3.14). In the "Consequences" aspect, the highest mean refers to the learning quality component (3.23) and the lowest mean refers to learning responsibility (3.11). In the strategy-oriented aspect, the highest mean is associated with the leadership variable (3.31) and the lowest mean is associated with the leadership organization (3.17). In the contextual aspect, the highest mean refers to the economic variable (3.36) and the lowest mean refers to the academic variable (3.27). In the obstacle-oriented aspect, the highest mean value is assigned to the technological variable (3.41) and the lowest mean value is assigned to the concentrated training variable (3.34).

Table 5.
Cronbach's Alpha Values, Composite Reliability, and Average-Variance Extracted Index for Research Variables

Component	Cronbach's Alpha	CR	AVE	MSV	ASV	1	2	3	4	5	6	7	8	9
Dimensions	0.76	0.82	0.63	0.43	0.32	0.79	-	-	-	-	-	-	-	-
Elements	0.79	0.85	0.59	0.40	0.29	0.47	0.76	-	-	-	-	-	-	-
Planning in the Higher Education System	0.77	0.86	0.64	0.38	0.33	0.49	0.44	0.80	-	-	-	-	-	-
Quantum Curriculum Evaluation	0.8	.085	0.58	0.28	0.26	0.48	0.53	0.45	0.76	-	-	-	-	-
learning	0.75	0.83	0.63	0.43	0.31	0.53	0.76	0.32	0.48	0.79	-	-	-	-
Professional Development	0.83	0.85	0.79	0.55	0.51	0.45	0.72	0.36	0.55	0.64	0.88	-	-	-
Strategy	0.75	0.80	0.73	0.63	0.59	0.43	0.46	0.57	0.68	0.43	0.75	0.85	-	-
Context	0.78	0.89	0.69	0.66	0.57	0.53	0.61	0.48	0.52	0.63	0.37	0.63	0.83	-
Obstacles	0.81	0.83	0.71	0.57	0.55	0.67	0.56	0.46	0.37	0.51	0.56	0.62	0.71	0.84

Cronbach's alpha and composite reliability indices were used to assess the internal consistency reliability of measurement model variables. The composite reliability and

Cronbach's alpha coefficient for all constructs were above the recommended threshold of 0.70, indicating adequate internal consistency across multiple items for each construct. Therefore, the reliability and internal consistency of the research variables were confirmed. The extracted average variance index was used to evaluate the convergent validity of the research measurement model. Convergent validity indicates whether a test intended to measure a particular construct correlates with other tests that assess the same or a similar construct. The extracted average variance index (AVE) estimates the explanation of the variance of the questions by the latent variable. The minimum accepted value for the extracted average variance index was set to 0.5. According to the values of the extracted average variance index in Table (5), the convergent validity is confirmed. Based on table (5) it can be determined that the reliability of the dimensions is confirmed. This is supported by the high Cronbach's alpha and composite reliability coefficient, both above 0.7, as well as the average variance extracted (AVE), which is greater than 0.5. In addition, convergent validity is confirmed when construct reliability (CR) exceeds 0.7, CR is greater than AVE, and AVE is greater than 0.5. Furthermore, the discriminant validity is also confirmed as the maximum common variance (MSV) is smaller than the AVE and the average common variance (ASV) is smaller than the AVE.

2) What is the fit of the appropriate model of the quantum curriculum leadership in Farhangian University?

To investigate this question, Index values and predictive power of the research measurement model and the path analysis were used.

Table 6.

Index values and predictive power of the research measurement model

Components	**Shared Index Q^2**	**R^2**	**Significance Level**
Quantum curriculum leadership	0.42	0.72	**0.001**
Causal Conditions	0.38	0.55	**0.001**
Consequences	0.16	0.75	**0.001**
Strategy	0.11	0.66	**0.001**
Context	0.19	0.30	**0.001**
Obstacles	0.38	0.38	**0.001**

Based on the results of Table (6), the coefficient of determination (R2) of the research model is favorable. The coefficient of determination index (R2) determines the accuracy of the prediction and the index (Q2) determines the correlation of the prediction. According to the results of Table (6), the values of the variables are generally in the range of 0.15 to 0.35 or greater than 0.35. Therefore, the predictive power of the research constructs is assessed as moderate to strong. The Stone-Geisser Q2 value is used to predict the performance of the model. Stone-Geisser Q2 is predictive relevance, which measures whether a model has predictive relevance or not (>0 is good). The Stone-Geisser Q2 determines the predictive relevance of the endogenous constructs. Stone-Geisser Q2 values above zero indicate that your values are well reconstructed and the model has predictive relevance. The value of the Stone-Geisser Q2 index is positive, confirming the validity of the prediction.

Table 7.

The results of path analysis

Variable	Statics T	Standard coefficient	**R^2**
quantum leadership	24.526	0.815	0.645

The results of the path analysis show that the leadership variables of the quantum curriculum are determined based on the factorial path coefficients of 0.815. According to the value of T-score which is outside the range (2.58 and -2.58), the quantum curriculum leadership model has gained significance at the 99% confidence level. According to the value of R2 for the Quantum Curriculum Leadership variable (0.645), the prediction has become almost strong. The appropriate fit of the research structural model is confirmed.

The final model of the research

After the analysis and measurement of various data, the final model of the research is presented as follows.

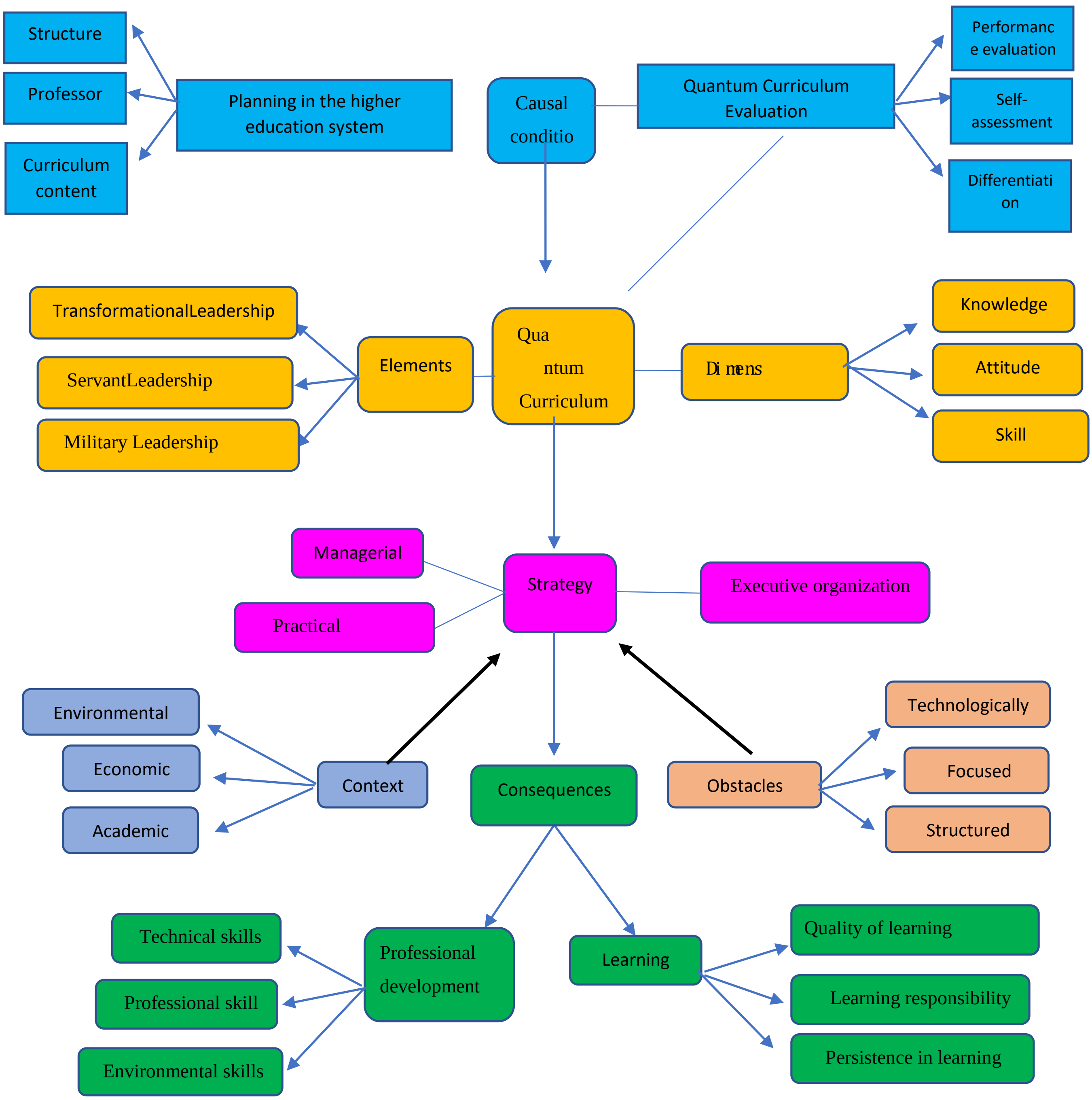

Figure 1. *Conceptual model of the Quantum Curriculum Leadership Model in Farhangian University*

Discussion and Conclusion

Higher education institutions are important organizations that play a crucial role in the country's progress. The aim of the present study was to design a model for quantum curriculum leadership at Farhangian University. The results showed that quantum curriculum leadership consists of two factors including dimensions and components; causal conditions including planning in the higher education system and assessment of the quantum curriculum; Consequences including learning and professional development. The strategies include management, applied training and leadership organization, while the context includes environmental, economic and scientific factors. The hurdles include technical, focused training and structured organization. Based on the results, it can be concluded that in the Quantum Curriculum Leadership aspect, the highest mean value is related to the knowledge component (3.65) and the lowest mean value is related to the transformational leadership component (3.13). In the causal condition aspect, the highest mean is associated with the structural component (3.38) and the lowest mean is associated with the self-assessment (3.14). In the “Consequences” aspect, the highest mean refers to the learning quality component (3.23) and the lowest mean refers to learning responsibility (3.11). In the strategy-oriented aspect, the highest mean is associated with the leadership variable (3.31) and the lowest mean is associated with the leadership organization (3.17). In the contextual aspect, the highest mean refers to the economic variable (3.36) and the lowest mean refers to the academic variable (3.27). In the obstacle-oriented aspect, the highest mean value is assigned to the technological variable (3.41) and the lowest mean value is assigned to the concentrated training variable (3.34). The results of this research are consistent with the results of (Esmailzadeh Qamsari & Rahimi, 2023); (Delgarm et al., 2021); (Nazarzadeh et al., 2021); (Turner, 2020); (Harris et al., 2020); (Bozorgi et al., 2020); (Hamzehpour, 2018; Malaki et al., 2018); (Azimi Sanavi & Razavi, 2015); and (Dadgaran & Khalkhali, 2016). To explain these results, professors should have flexibility to provide effective leadership in the quantum curriculum. This flexibility allows them to adapt to the content and educational environment of the curriculum. In addition, professors should have cognitive knowledge to gain a comprehensive understanding of the quantum curriculum. This knowledge enables them to develop written principles for the implementation of the curriculum and to apply them according to the specific conditions of their university. Professors must have knowledge of self-monitoring to effectively lead the quantum curriculum. This knowledge is essential for self-assessment and self-monitoring before implementing the curriculum. Individuals with self-monitoring skills can accurately assess the fast-paced and student-centered nature of the quantum curriculum. The aim of the quantum curriculum is to introduce innovative educational management techniques (Malaki et al., 2018). Therefore, professors should also have a comprehensive understanding of equity to ensure educational equity and a holistic perspective to provide a well-rounded curriculum framework. A positive attitude towards the curriculum is also crucial to the successful management of the quantum curriculum. To achieve this type of leadership, professors need metacognitive insights for broader thinking. Additionally, they should adopt a quantum perspective to align with the curriculum. Developing a quantum mentality is another important feature for quantum curriculum leadership. Professors who cultivate this mindset will better understand the curriculum, its structure, and its audience, leading to better compatibility (Bozorgi et al., 2020). Scholars have also emphasized understanding quantum principles. In other words, quantum curriculum leadership should create an effective connection between curriculum structures and learners. When university professors take the lead on the quantum curriculum, they are essentially detecting disruptions and preventing their impact on the curriculum. Although knowledge and attitude are paramount, skills play a crucial role. Among the dimensions of quantum curriculum management, professors' teaching skills are essential. They enrich the teaching of the quantum curriculum by specifically improving their perspectives. This type of leadership requires systems thinking to identify internal, process, and external aspects of the curriculum, as well as problem-solving skills and creativity (Delgarm et al., 2021). For quantum curriculum leadership, influential leadership styles that impact learners and teachers can be chosen, such as transformational leadership. Attention to student empowerment within the quantum curriculum, promoting respect, admiration and loyalty among students and professors, promoting communication and participation of students and colleagues in shaping the future vision to increase their commitment, sufficient consideration of the needs of the audience (students) and a forward-thinking perspective on curriculum-related topics are all indicators of transformational leadership. Professors need a leadership style that promotes forward-looking vision and enables forecasting. Transformational leadership is such an effective style that supports leadership in the quantum curriculum, but servant leadership also plays a critical role. With servant leadership, professors want to promote collaboration and ensure that everyone is seen as a stakeholder in the quantum curriculum. This style also emphasizes purposeful learning by identifying influential forces and leveraging their skills in curriculum implementation and service delivery. Professors who use servant leadership encourage students to share their ideas to maximize the university's intellectual capital and improve the curriculum. Furthermore, systematic leadership is required to manage the quantum curriculum as it is based on a structured system. The professors responsible for this curriculum must adhere to established rules and apply structured teaching guidelines when implementing it. You can also delegate authority to others to speed up tasks. Time and resource management are essential aspects of systematic leadership in the quantum curriculum to ensure effective use of resources and avoid waste. This research study also examined the factors that impact leadership in quantum curricula, including structure, professors, curriculum content, and assessment. These factors were identified and highlighted. It is worth noting that for effective leadership in the quantum curriculum, attention must first be paid to structure, and sometimes structural changes are essential. In order to ensure a structure that is consistent with the quantum curriculum, it is necessary to use informal structures in lesson planning that avoid unnecessary complexity and take responsibility for the smooth implementation of the curriculum. This structure should minimize isolated efforts and prioritize the needs of the university. Implementing leadership in the quantum curriculum is expected to generate initial feedback on changes in learners' learning and behavior. In addition, throughout the implementation process, we will observe collaboration in addressing educational crises and providing relevant and timely content aligned with emerging educational topics at the university. The introduction of this curriculum will lead to flexible learning, approaches based on critical thinking and improved competitiveness. Additionally, self-directed learning will promote commitment to academic progress and facilitate the transition to transformative learning. This implementation of the curriculum will also promote accountability in learning, resulting in an appropriate and effective response to the achievements of the quantum curriculum. Both students and professors take responsibility for their learning and cultivate a culture of accountability. In addition, students and professors will actively participate in joint learning activities around quantum content.

Based on the research findings, the following recommendations are suggested: Hiring flexible and adaptable lecturers: It is recommended to hire lecturers who have flexibility in their personality traits. This can help create a conducive learning environment that supports the development of cognitive, social and emotional skills. Assessing lecturers' cognitive knowledge: Conducting assessments to assess lecturers' cognitive knowledge can provide a comprehensive understanding of their knowledge of the quantum curriculum. This assessment can help ensure that teachers have the knowledge and skills necessary to teach quantum concepts effectively. Assessing instructors' self-monitoring skills: Assessing instructors' self-monitoring skills can be beneficial in terms of self-regulation and control prior to curriculum implementation. This assessment can help identify teachers who are able to effectively monitor and adapt their teaching strategies to student needs. Conducting interviews with faculty: Interviews with faculty can be conducted to assess their understanding and perspective on quantum approaches. This assessment can help determine teachers' fit with the curriculum and their ability to adapt and integrate quantum perspectives into their teaching practices. This study has some limitations. It is limited to Farhangian University and does not include other universities. The study focuses exclusively on faculty members, therefore the generalizability of the results to this specific group is limited. Educational factors such as in-service training and cultural influences were not examined in this study. In this context, they are considered confounding variables. Furthermore, the study relied exclusively on researcher-developed interviews and questionnaires as research tools. No other methods or data sources were used in this study.

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Conflict of interest

The authors have no conflict of interest to declare.

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