Designing a Professional Competency Model For Principals Based on Open Innovation Approach In Technical And Vocational Schools

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Abstract

An efficient and effective system in the field of technical and vocational education depends to a large extent on the professional competencies of principals, especially in accordance with the open innovation approach. Therefore, the present study was conducted with the aim of designing a model of professional competencies of vocational school principals with an open innovation approach and its validation. Qualitative research is a classic foundation data type. Participants include 20 experts and the director of the conservatory, purposefully sampled and interviewed in a semi-structured manner. The data are encoded using MAXQDAv2020 software, and the researcher has used the Strauss and Corbin acceptance indicators, the technique of visit by members and the self-review approach for validation of the research model. The findings show that the model of professional competencies of the directors of technical and vocational schools with open innovation approach includes 9 main competencies and 20 sub-competencies as follow: social competencies (cultural competence, social responsibility); Cognitive competencies (self-confidence and self-assurance, perfectionism and professional development); Specialized competencies (technical, scientific and functional competencies); Knowledge competencies (general level knowledge, basic level knowledge and professional level knowledge competencies); Attitudinal competencies (systemic thinking and problem solving strategy competencies); Personality competencies (self-awareness and independence, positivity and realism); Communication and networking (competence to establish external and internal communications); Developmental competencies (advocacy for IT, transformation and change management); Strategic and leadership competencies (goal-oriented and planning competencies). The listed methods for validating the model show that it has the necessary validity. The findings of this study provide implications for training and improving the directors of vocational schools in accordance with the identified professional competencies.

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Introduction

As one of the most important educational subsystems, the technical and vocational education assumes an added significance. In any country that is on the verge of transition from traditional to knowledge-based economy, technical and vocational education is the most effective tool to meet future challenges. Technical and vocational education, as a reliable tool, will have the ability to build a strong bridge both between the classroom and the community and the classroom and the labor market (Sern et al., 2018). The mission of technical and vocational schools is to train students who, after graduation or completion of the training course, can use their skills in the workplace and cope with the tasks assigned to them and adapt to technological changes (Abbaszadeh et al., 2016). In fact, technical and vocational education is a bridge between education and the labor market, and the most basic applications of technical and vocational education are the transfer and promotion of knowledge, the technology to create jobs and meeting the needs of the labor market (Kamareiee et al., 2021). It is internationally recognized that technical and vocational education plays a key role in promoting economic and social growth, increasing productivity, empowering citizens, and reducing poverty (Yunus et al., 2017); however, creating favorable conditions in technical and vocational education requires principals' high level of competence, and wherever education is developed, the role of educators and professional principals has been prominent. Therefore, the management and educational planning of technical and vocational colleges to train technicians requires attention to the professional competence of teachers and principals in the technical and vocational training centers (Khanifar et al., 2021). It is essential to upgrade the principals' technical and professional competencies so that they can effectively perform their job-related activities according to the expected standards (Lauerman et al., 2016). In addition to their specialized field, the principals of these centers, must update their knowledge and skills in new technologies so that they can both use them in teaching and prepare the ground for open innovation in the development of vocational schools as well as the country's industry and economy. Open education shares common goals with open innovation; empowered educators and learners accept open education in public educational organizations by increasing access to knowledge, innovation of teaching methods and sharing culture (Ismail et al., 2017). Open innovation is beyond technological devices and aims to empower all players in the education ecosystem (Kabul Green et al., 2017). This goal is achieved through designing competency models for principals and educators of technical and vocational schools. In general, the qualifications of designing the professional competency model lead to improving the quality, selection and appointment of principals and education experts, thus increasing the efficiency and effectiveness of the organizations. Therefore, according to many critics, the current technical and vocational education system is not able to respond to the demands, needs and expectations of the society; hence, a fundamental change is required. This change needs developing professional competence of principals of these organizations because, in appointing educational principals, the necessary professional skills and competencies are not considered as their selection criterion in order to advance the goals. And, the principals do not pay attention to the effects of applying these competencies in advancing the goals. In addition, technical and vocational schools need capable management with professional competence to communicate with industries, universities and colleagues according to the open innovation approach. There is also a need to provide an environment for teachers and students to acquire and develop new ideas and

implement them in the industry and create a network where the knowledge and competencies of principals and teachers of technical and vocational schools are shared so that graduates are trained according to the demands of society and industry.

Therefore, noting the importance of open innovation in technical and vocational schools, this study poses the following questions: What are the necessary professional competencies for the principals of technical and vocational schools with an open innovation approach? What is the validity of the model designed for the necessary professional competencies of the principals of technical and vocational schools with an open innovation approach?

Theoretical Foundations

One of the modern methods for optimal innovation management is the concept of open innovation (Ahmadi et al., 2016). The concept of open innovation is based on the theory of Henry Chesbrough (2006), a professor at the University of California, Berkeley. He illustrates open innovation as a new necessity for creating and profiting from technology and explains how companies in the twentieth century invested heavily in research and development by hiring the best people and enabling them to develop their innovative ideas, and supported them with intellectual property strategies and re-invested the profits in research and development (Madhoshi and Kiakjouri, 2018). Nowadays, open innovation has emerged as an important concept, both in academic research and in industrial activities, and has become increasingly important in public policy. Open innovation in its fundamental definition means "valuable ideas can come from inside or outside of the company, and their commercialization can also come from inside or outside of the company." In this paradigm, companies accept both benefits and risks concurrently while opening the barriers between organizational knowledge and the outside (Bogers et al, 2018). In fact, open innovation is a new approach that deeply challenges the traditional approach to innovation management and is one of the new topics in management science (Temel & Vanhaverbeke, 2020). The following table summarizes the definitions of the concept of open innovation:

Table 1: Different definitions of open innovation

Expert and year	Summary of definitions / concepts
Bogerzo et al (2018)	Targeted use of knowledge inflows and outflows to accelerate internal innovation and, subsequently, the development of markets for external use of innovation.
Fachrurrazi (2017)	Open innovation is to link and provide opportunities for powerful and self-reliant human resources who have new ideas and thoughts and always create new ways of working.
Chesbrough (2006)	Open innovation is a paradigm in which an organization can use both external and internal ideas for technology.
Moretti and Biancardi (2018)	Open Innovation is the cause of many deep connections and network members of organizations consisting of partners, customers, suppliers and distributors to enhance the quality and value of ideas.
Zhang et al (2018)	Open Innovation is the establishment of relationships between innovative companies and other organizations in order to access and develop or absorb new technologies and commercialize new products.
Sajjad et al (2018)	Open Innovation is the creation of a laboratory network and communication with experts for some industries.
Temel & Vanhaverbeke (2020)	Open innovation encourages companies to work with foreign partners to make the highest profit
Ahn et al (2017)	Knowledge management strategies and human aspects accelerate the understanding of open innovation structures and processes.
Natalicchio et al (2018)	Open innovation is a new form of knowledge management within the boundaries of the organization and includes open external to internal innovation, internal to external innovation and bilateral open innovation.
Wu & Hu (2018)	Open innovation is a hybrid process, representing the combination of an external process with an internal to external process, to open the innovation process to discover knowledge and exploit it to create new products.
Zhanga et al (2018)	The increasing growth of skilled human capital is called the open innovation paradigm.

Creating an innovative environment in educational centers requires principals with professional qualifications and competencies in this field (Technical and Vocational Education Organization, 2018). 21st century administrators must ensure the development of school-supporting cultures and the use of human and other resources in creating appropriate school and classroom environments, and engage in new forms of policy formulation and implementation (Kamareiee et al., 2021). This is achieved through the competence, ability and skill of principals. Nowadays, being equipped with professional qualifications in one's field of specialization is one of the prerequisites for remaining in an unbalanced and challenging environment (Pourkarimi, 2017). Lack of professional competence causes inefficiency and a kind of entropy in achieving organizational goals (Khanifar et al., 2021). The knowledge, qualifications and competence of principals and employees are considered the most important competitive advantages of organizations, and the role of human resources has become more important due to scarcity, value and irreplaceability. If skills and competencies of educational principals are taken into account in selecting, transferring and promoting criteria, and the principals also pay attention to the effects of applying the mentioned competencies in advancing goals, the ground will be prepared to use all the facilities and resources of the organization optimally (Khairabadi et al., 2021). Competencies are among the provable characteristics of an individual that enable employees to perform the necessary knowledge,

skills and behaviors to achieve results. It can be said that most definitions of competence refer to knowledge, abilities, skills, individual characteristics, behaviors and competencies that are related to organizational goals and play a key role in achieving the goals (Vazir, 2016).

Table 2: Different definitions of principals' competencies

Expert and year	Summary of definitions / concepts
Pourkarimi (2017)	Equipping oneself with professional qualifications in one's specialized field is one of the prerequisites to face today's unbalanced and challenging environment.
Kamareiee et al., (2021)	Professional competence means having efficiency in achieving organizational goals.
Khanifar et al. (2021)	The characteristics of people who can achieve the criteria of effectiveness are called the competencies of those people.
Armstrong (2013)	Competence is a set of knowledge, skills, personality traits, interests, experiences, and job-related abilities that enable one to perform at an above-average level of responsibility.
McClelland (2014)	Competence is a combination of motivation, characteristics, self-image, attitudes or values, content knowledge and cognitive behavioral skills and can distinguish an individual from other employees.
Lucia and Lepsinger (2015)	Competence is defined as a set of related knowledge, skills, and attitudes that affect an individual's job and correlate with job performance.
Yousefi et al., (2020)	The set of knowledge, skills and abilities of principals in order to advance organizational programs and the formation of communication networks is called the competence of principals.

Review of Literature

Reviewing the related literature, 11 domestic and foreign researches have been examined with regard to the competencies of school principals, especially in primary schools:

Table 3: literature review of related foreign research

Research title	Author and year	Results
Identification and Prioritization of Competency Components of School Principals with Emphasis on Islamic Management	Arefnejad (2018)	Components of work conscience, lawfulness, foresight, kindness and discipline are some of the competencies required of school principals.
School Management Competencies: Perceptions and Self-Efficacy Beliefs of School Principals.	Bouchamma, Basque and Caroline (2017)	The two main competencies of school principals are professional development and self-efficacy ideas.
Therough Open Innovation Concept Integrating Information Tecnology R technology	Chen,Benson (2018)	Competence and ability to transfer information in the context of information technology is the most important competence of educational principals and teachers.
Student Customized Creative Education Model Based on Open Innovation	Sunah Kim (2017)	Individual creativity competencies, imagination and ideas have been introduced as the most important competencies of educational principals in the open innovation approach.
Antecedents, moderators, and outcomes of innovation climate and open innovation: An empirical study in SMEs	Pupa et al (2017)	Commitment is one of the most important competencies affecting open innovation.

Table 4: literature review of related domestic Research

Research title	Author and year	Results
Designing a competency model for educational principals to use in evaluation and development centers	Khanifar et al. (2021)	Competencies of education principals include knowledge competence, professional competence, personality competence, executive competence, leadership and guidance competence, communication competence, and perceptual competence.
Competency model for principals of Headquarters of sports and youth of Iran with data theory approach	Marandi et al. (2017)	Competencies of education principals are behavioral, communication, social, psychological, ideological, moral, personal, operational, professional, political and managerial competence.
Designing a model of core competencies of faculty members in commercializing academic research in the field of sports	Nouri Khanyordi et al. (2021)	Communication, behavioral, technical, personality, value, strategic, creativity, professional, leadership, financial management and market knowledge competence.
Professional development model of school principals of technical and vocational colleges (using the data theorizing approach of the foundation)	Kamareiee et al., (2021)	Dimensions of principals' professional development are knowledge, attitude, intellectual and mental abilities, managerial abilities, transformational leadership skills, professional and job skills, and psychological and personality characteristics.
Designing a professional development model for school principals on the horizon of 1404 based on data theory	Yousefi et al. (2020)	Individual, organizational, legal, knowledge, skills and attitude competencies
Identifying the suitability of school principals to use in the assessment center	Khanifar et al (2019)	Qualifications required of school principals include knowledge, awareness, intelligence and talent, belief and moral issues, and personality traits.

Studies on the professional competence of the directors of technical and vocational colleges have described dimensions that are very important in developing and conceiving the theoretical framework of this research; however, a review of these studies reveals that they have examined the general competencies and competencies of principals in the field of education. So far, these studies have not been able to retrieve an integrated and coherent competency model for principals of technical and vocational schools, considering their important position in the industry and open innovation, in which internal, external and bilinear factors are classified and framed and cause-and-effect relationships are demonstrated. Past studies and literature are insufficient, and they do not include numerous factors affecting professional competence of principals of technical and vocational colleges with an open innovation

approach. Therefore, this research has identified the competencies and factors through qualitative study and interviews with experts and has drawn a comprehensive model in which all necessary competencies are included, and the validity of the model has been assessed through three scientific methods.

Research Methods

The purpose of this study is to design a professional competency model for principals of technical and vocational schools based on open innovation approach; therefore, it is generally stated that the research design is exploratory (qualitative) and the method is according to the basic purpose. The research method in terms of exploratory purpose is based on the classical data foundation theory, and the data type is qualitative. At first, due to the lack of present and comprehensive factors on the dimensions of professional competence of the directors of

technical and vocational schools based on the open innovation approach, the researcher selected 20 directors of technical and vocational schools with resume and subject-related experience through targeted sampling method (snowball), and semi-structured interview was conducted. After selecting the sample members, in order to justify, encourage their cooperation, achieve the best result and also get acquainted with the research topic, a scientific text on open innovation was prepared from the latest scientific sources in which key principals were characterized by open innovation and determined indicators. The prepared text was sent to the sample members 10 days before the interview and the principals were asked to express their intention to participate in the interview by reading the text, provided that they have the conditions and criteria. After one week, following up the sample members, 20 out of 25 sample members expressed their intention to cooperate in the research process, and the interview was coordinated. Then, the received audio answers were transcribed as a typed file and encoded by the classical foundation data method in three stages of open coding, axial coding and selective coding with MAXQDAv2020 software. The competencies of technical and vocational school principals were restored based on the innovation approach. In this way, in the open coding stage, according to the research topic, the concepts and dimensions of defining the professional competence of the directors of technical and vocational schools were considered as the basic dimensions and concepts based on the innovation approach. Then line by line, the texts of the interviews were studied by the researcher; the codes and key points in the text were identified as basic concepts, and 66 open codes were identified and categorized in the form of open codes (initial category). In the coding phase, the sub-themes were linked to the main themes. In fact, one of the presented themes was selected as the main theme,

and the other themes were related to it in a regular and systematic manner. At this stage, the open-source code from the previous step was linked to the core code and categorized and converted into concepts (20 main categories). In the selective coding stage, the concepts and themes introduced in the previous stage were systematically categorized into 9 general concepts and 20 subsets of nomenclature. Finally, in order to validate the competencies identified in the research model, the researcher assessed the research model by three methods: self-monitoring technique, the Strauss and Corbin acceptance index and the members' review method. For the validity of the interviews and the interview protocol, a coherent executive plan and a steering committee was used with guidance of the supervisors and the consultant, as well as the researcher's self-review during the data collection and analysis process. The intercoder reliability method was used to evaluate the reliability of the interviews. Two interviews were randomly selected (interviews 4 and 10) and coded by the researcher and another evaluator (PhD student and research-aware) and the findings of intercoder reliability showed that the obtained reliability of the interviews is equal to 80%. The reliability of more than 60% is acceptable.

Research Findings

The answer to the first research question: What are the necessary professional competencies for the directors of technical and vocational colleges with an open innovation approach?

In response to the first question of the research and in order to identify the professional competence of the directors of technical and vocational schools based on the open innovation approach, the classical foundation data method was used based on Strauss and Corbin instructions in three stages of open coding, axial coding and Selective coding to analyze the

interviews. The results of the coding process and   data reduction are shown in four steps:
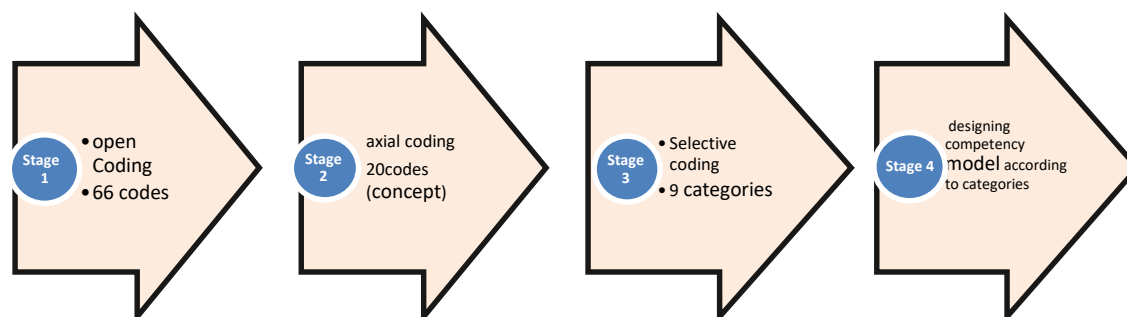

Figure 1. Data coding and reduction process

Table 5: Sample open and key codes in the text of the interviews

Extracted codes	Interview	Interview text
1. Having a scientific view of issues 2. Participatory decision making 3.Indirect monitoring 4. Support and co-workers 5. High social relations 6. Positive attitude to change 7. Ability to communicate effectively with senior Principals 8. Creativity and innovation	Interview 8	Professional and developed Principals have very good characteristics. First, such Principals have a scientific view of education issues in the technical and professional fields, as well as industry. They believe in the principle of participatory decision making. Individuals do not control their subordinates directly. They do not put the slogan "I'm just doing my job" at the forefront of their work. They pay attention to the problems and issues of their subordinates. They establish good human relationships with their subordinates. They have a leadership aspect and can create a revolution in their organization. Their other characteristic is that they always believe in change and deny stability and stillness. They are interested in creating a supportive and gentle organizational environment. They enforce the rules and regulations in a firm, gentle and understandable way for everyone. They are logically related to higher levels of management. Creativity and innovation are the characteristics of developed Principals. Another feature is that they look at all educational issues and problems through scientific and research lenses.
1. Belief in the culture of meritocracy 2. Transparency 3. Freedom of thought 4. Cultivating an innovative culture	Interview 1	In my opinion, another competence that Principals should pay attention to, which originates in the first place from their own type of choice (whether it was based on competence or not); belief and attention to meritocracy in society. This means that the whole focus of the principal should be that the output of his management period be qualified and experienced students for the society. The principal, in terms of personality, should have freedom of thought and and independence. A successful principal, for open innovation, must avoid vague, general and incomprehensible actions. Creating an innovation-based environment requires the right culture. One of the ways to create an innovation based culture is giving an innovation award to both students and staff at the vocational school level.
1. Supporting the development of electronic infrastructure 2. Respecting for cultural differences and values	Interview 20	Open innovation is an action in the context of information technology (meaning that it will develop more in the context of information technology); therefore, principals must take action to create an IT platform and have the necessary ability, care and support in this regard. The use of new technologies such as social networks and IT platforms is an important feature of principals. Principals who cannot use this technology will surely fail to create an innovative

Extracted codes	Interview	Interview text
3. Being capable of applying modern technology 4. Familiarity with specialized management knowledge 5. High social relations with the aim of transferring experiences and creating an innovative atmosphere		environment since technology is the basis of open innovation. Believing in students' cultural, ideological, and value differences in promoting open innovation by administrators is also a strategic tool. Management science is a requirement for principals. A knowledgeable principal is a blessing for organizations. Successful principals in technical and vocational colleges, due to the high number of beneficiaries, must have high communication skills and be able to establish appropriate communication with all beneficiaries in order to transfer experiences.

Ultimately, during the process of coding and analyzing the text of the interviews, the model of professional competence of the directors of technical and vocational colleges with an open innovation approach is attained in 9 main categories, 20 subcategories and 66 open codes as follows:

Table 6. Coding Framework in Data Analysis

Category	Concept	Open Code
Social Competencies	**Cultural competence**	- Belief in a culture of meritocacy - Respect for cultural differences and values - Cultivating an innovative culture
	Social Responsibility	- Influencing others to advance innovative and transformative goals - Moving towards innovation as part of community service - Taking responsibility for training innovative students for the community - Responsibility for civil rights
Cognitive Competencies	**Self confidence and self assurance**	- Considering oneself an elite in the field of management and innovation - Confidence in oneself and the program developed in the field of innovation - Having a personality, character and culture of self-confidence - Taking responsibility for innovative actions
	Perfectionism and Professional Growth	- Outlining the vision and future of the conservatory - Developing a scientific understanding of the open innovation concept - Moving towards organizational innovation
Competence of developmentalism	**IT platform supporter**	- Supporting the development of electronic infrastructure - Ability of applying modern technology
	Transformation and change management	- Positive attitude to change, transformation and improvement - Having a scientific view of issues - Transparency - Action to adapt the structure of the conservatory in the context of open innovation
Knowledge competencies	**General level knowledge competence**	- Awareness and familiarity with current issues of the country - Awareness and familiarity with the national innovation system - Awareness and familiarity with government policies in the education system
	Basic level	- Familiarity with specialized management knowledge

	knowledge competence	- Expertise in the field of organizational psychology - Familiarity with the latest technologies and knowledge in the technical and professional field
	Professional level knowledge competence	- Use of managerial experience - Thinking globally and acting indigenously - Knowledge management
Specialized Competencies	**Technical competence**	- Having succession outlook - Creativity and innovation - Specialization - Ability to communicate with organizations and developed countries (high language proficiency level) - Having school / conservatory management experience
	Perceptual competence	- Looking and thinking critically - Multidimensional intelligence and thinking
	Functional Competencies	- Guiding students to commercialize innovative ideas - Transfer of tacit knowledge (experience) - Ability to advise and induce motivation in students and teachers in creating ideas and innovations
Personality competencies	**Self-awareness and independence**	- Freedom of thought - Courage and intellectual independence - Self knowledge
	Positive thinking and realism	- Having a spirit of success, not selfishness - Avoiding rhetoric and offering programs without solutions - Emotional Intelligence - Risk-taking
Strategic and leadership competencies	**Competence of purposefulness**	- Having a clear vision of one's future goals - Familiarity with the philosophy and mission of the conservatory - Ability to identify opportunities and threats
	Competence in planning	- Collaborative decision making - Ability to form different working groups (team building) - Developing a program with an innovative approach and flexibility
Attitudinal competencies	**Having systemic thinking**	- Positive understanding and attitude towards the position of technical and vocational training organization in the industrial structure of the country - Knowing oneself as part of the structure - Futuristic thinking - Positive attitude and commitment to innovation
	Competence of problem solving strategy	- Problem-oriented attitude - Contingent attitude - Indirect support and supervision in relation to the subdivision
Competence in communication and networking	**Competence in establishing external communication**	- Liaison with research and educational centers, industry and other institutions - Interacting with pressure groups on the performance of school principals - Establishing a consistent and appropriate relationship between school, family and community
	Competence in establishing internal communication	- Supporting informal groups at school - Encouraging the units of the organization to support each other in case of problems - High social relationships with the aim of transferring experiences and creating an innovative atmosphere - Effective communication with superiors

Checking the validity of research findings

Credibility includes activities that increase the likelihood of obtaining valid findings. The criterion for evaluating a study using the data-based method is to evaluate the proposed theory and the methods that led to its development. In the systematic approach, the validity of the theory is obtained from the accuracy of the method. Issues such as researcher's sensitivity, methodological coherence, sample suitability and simultaneous data collection and analysis, largely guarantee the scientific accuracy of qualitative research. Therefore, in order to validate the research findings and the proposed model and to answer the second research question ("What is the validity of the model designed for the necessary professional competencies of technical and vocational school principals with an open innovation approach?"), the researcher used three techniques of self-review approach, Strauss and Corbin acceptance index and review by members method. The results are as follow:

• **Self-review approach by the researcher**

Researcher self-review during the data collection and analysis process is another method that can increase credibility (Andreisa, 2003). In qualitative studies, researchers are tools for gathering information and performing the analysis process. Therefore, training researchers, their competencies and experiences are important for producing valid data (Polite and Bask, 2006). A qualitative researcher can express their ability directly and impartially, taking into account their credibility in the research. Therefore, in order to validate the findings, the researcher used the self-review method in such a way that at all stages of data collection, coding and classification, the necessary reviews of the data are constantly done back and forth. First, in order to increase the accuracy of the coding of the audio file of the interviews, it was transcribed into a typed text, and then during the data collection, the text of the interviews was simultaneously examined and

described in more depth to make the concepts more real. The text of the interview was reviewed and coded three times in a specified period of time (5 days) so that the coding process, division of codes and components and validity of the results and research model were approved by the researcher ultimately.

• **Strauss and Corbin Acceptance Index**

Strauss and Corbin (2007) disagree with the use of two criteria of validity and reliability in qualitative research and suggest that researchers use the criterion of acceptability. The acceptance criterion means the extent to which the research findings reflect the experiences of the participants, the researcher and the reader in relation to the phenomenon under study. To assess the acceptability of the data approach, Strauss and Corbin introduce the Ten Acceptance Indicators Foundations. In the present study, these ten indicators were used to determine the acceptability of the research process and provide the final analysis:

Fit index (consistency with other experiences): It indicates if the research data is consistent with the experiences of human resources experts, principals and management consultants and interviewees? For this purpose, the obtained data and the designed conceptual framework were evaluated and approved by three human resource experts; subsequently, three expert principals participating in the interview, who have valid and relevant scientific, research and teaching experience at university level, analyzed and investigated the data and conceptual framework, and their analytical opinions were received and applied.

Logic of research narrative index: It addresses the following questions; does the research model have a logical flow with it and induce it to the audience? Is there any gap in the model that confuses the audience? Is the research model logical? In order to ensure that the research findings are implemented in a completely

scientific and meaningful way and are close to the facts, the methodology and data collection and analysis techniques were sufficiently explained to reassure readers. And, the research process is quite clear.

Applicability or usefulness of the results index: It answers the question of whether the findings of the research can be used in policy-making and knowledge-enhancing actions. Since this research consulted technical and vocational education experts with open innovation approach objectively and scientifically (qualitative research approach), obtained information and the professional competencies of principals were identified. Therefore, the findings of the present study are practical and scientifically and academically applicable to the target community. In scientific field, the extracted conceptual framework is applicable in designing the professional competeny model of pricipals in technical and vocational schools with an open innovation approach.

Depth index (detailed statement of research narrative): Is there enough details in the model? In this research, according to the three stages of open, axial and selective coding, the research findings are expressed with all the details and by mentioning all the codes, concepts and categories in these stages, which indicate the depth of the research.

Variation Index: Are there deviations in the findings, in other words, are there cases that are not consistent with the research model? This index refers to exceptions and inconsistencies within the findings. Deviations in the model have been eliminated by working with 3 experts in the field of human resources and 3 directors of technical and vocational schools, as well as the respected supervisor.

Contextualization of concepts index: Concepts are essential for achieving a common language and a proper understanding of the phenomenon under study, and research findings

are expected to be derived from concepts and categories. As stated in this study, the model presented for the professional competencies of principals in technical and vocational colleges with an open innovation approach has emerged from the concepts extracted from the interviews with repeated classification in main categories and subcategories. An attempt has been made to draw a concise and practical model that has been approved by the relevant experts in the present study. For this purpose, the concepts have been developed under subcategories with their own characteristics and dimensions.

Creativity index: Does the research have anything new to say or has it introduced the same old ideas in the new cover? In the present study, considering the researcher's concern and understanding of the importance of the position of technical and vocational schools in the country's industry; innovation and expression of new concepts have been reflected. Therefore, open innovation as an approach that is more often used in the industry has been considered as a stepping stone in determining the competencies of principals, and relevant competencies of this important paradigm have been developed.

Sensitivity index (the degree of involvement of the researcher in the research): Is the researcher sensitive to the subject and has taken it seriously? Was the data formed in the research process or the researcher had assumptions and collected the data accordingly? Since the researcher is active in the field of industry and has management experience in the industrial sector, she uses the output of technical and vocational colleges as human resources. Also considering the field of study, this subject is very attractive for the researcher and she has done her best to achieve the key points in the professional competence of the directors of technical and vocational colleges with an open innovation approach.

Evidence of memos index: No researcher can

keep in mind all the topics, opinions, insights and statements in the process of analyzing the findings, the use of notes is thus necessary. In this regard, the researcher tried to cite the notes extracted from the data as needed in different parts of the research process. Especially during the interview, using tools such as analysis of notes and multiple references to the interview texts, several notes were recorded simultaneously with the research, which were used during the analysis process without prejudice to review the concepts and categories.

Contextualization (environment) of concepts index: It answers the question of whether the gounds have been properly prepared or not. In fact, findings that have no context are incomplete, and the reader cannot understand the cause of events. In this research, all the concepts identified at every stage from data collection to analysis and presentation of the final report in the environment of technical and vocational schools have been reflected. In fact, the research findings are based on experiences, events and activities related to craftsmanship, and the concepts that emerged from it are based on the context, background and culture of technical and vocational schools.

• Review method by members

This method is a quality control process that is defined as improving the scientific accuracy and validity of a researcher's recorded credit in a research interview (Doyle, 2007). This method is a technique by which researchers controls their findings with one or more informed persons under review, and this technique is used to confirm a researcher's interpretations. In this method, researcher uses the perspective of the participants to establish the reliability of the findings and interpretations (Ellie et al. 1991), (Arlendson et al.1993), (Glens and Peschkin, 1992), (Lincoln and Guba, 1985), and (Miles and Haberman, 1994). This method is known as the most important technique for building reliability

(Crasswell, 2007).

In fact, re-referral to participants to confirm the findings of the study is called review by participants (Guba and Lincoln, 1992). Review by participants also contributes to the importance of the quality control process in qualitative studies during the study period. In addition, participants have the opportunity to re-evaluate their statements for greater accuracy and may also receive therapeutic benefits (Harper and Cole, 2012). The biggest benefit of having participants' review is that it allows the researcher to have enough time to investigate the accuracy and completeness of the findings to improve the scientific accuracy of the study. Bassett (2004) writes: "Scientific accuracy in qualitative study is confirmed, when participants as well as readers with similar human experience, recognize the experiences described by the researcher as their own."

The executive steps in this field are as follow; out of 20 experts sample interviewed, 5 people were randomly selected and while explaining the process and the results obtained, the extracted concepts and model were given to them, and they were asked to submit their comments and approvals regarding the results, coding method and proposed model.

Then, in a meeting, all the main categories and the extracted codes were discussed. Also, all the stages of the research method of this study were described in detail for transferablility. In order to ensure the findings and confirm the correct implementation process of the qualitative study, an experienced external-check (PhD student in educational management) was used to verify and classify the data. After review by experts, almost all categories were confirmed. New suggestions were made for adding codes and categories that were not approved by the researchers in the final conclusion. Eventually, minor modifications were made to the competency literature, as suggested by experts, and the model,

competencies, coding process and interpretations of the interviews were confirmed with consensus.

Conclusions and Suggestions

Innovation fuels the engine of the modern economy; that is, in any organization, if the gounds for innovation is prepared, employment and transfer of technology will emerge. The need to use open innovation to increase the competitiveness of companies in domestic and foreign markets is felt as a new paradigm. Applying open innovation has many benefits in the commercialization process. Technical and vocational schools are no exception to this end. These vocational schools, as the main supplier of manpower in the industrial sector and the drive for the country's economy towards innovation and entrepreneurship, are of great importance to the country's economy. However, the very move of these organizations towards open innovation requires capable, supportive and competent principals. Therefore, unless proper and competent principals are appointed to these vocational schools, their move towards innovation will fail. Principals must have the competencies to steer the organization towards open innovation. Management of technical and vocational schools is more complex and different due to various distinctions such as the quality of planning, organizing, monitoring and controlling human factors, space and equipment, the dominance of workshop training to theoretical

training, differences in technical and specialized management factors of the unit, the need to more connection between the school and real workplace, higher relevance of the education to the objective needs of society, and finally the emphasis on educational outcomes in terms of technical and non-technical competencies. The weakness of the competencies of the principals of technical and vocational schools is more evident in the society and is reflected more explicitly through the employment system in various forms. Therefore, an efficient and effective educational system in the field of skills training depends to a large extent on the competencies of principals in establishing and managing the vocational school properly. In fact, the professional development of principals is part of the philosophy of improving vocational schools since it prepares and develops them to acquire the knowledge, skills, and attitudes necessary to run schools effectively and to make significant differences in the outputs of vocational schools. Therefore, in this study, identification of these competencies was determined as the purpose of the research, and a professional competency model for the directors of technical and vocational schools with an open innovation approach was suggested and designed, which is presented after identifying and careful validating in 9 main competencies and 20 sub-competencies in the following figure.
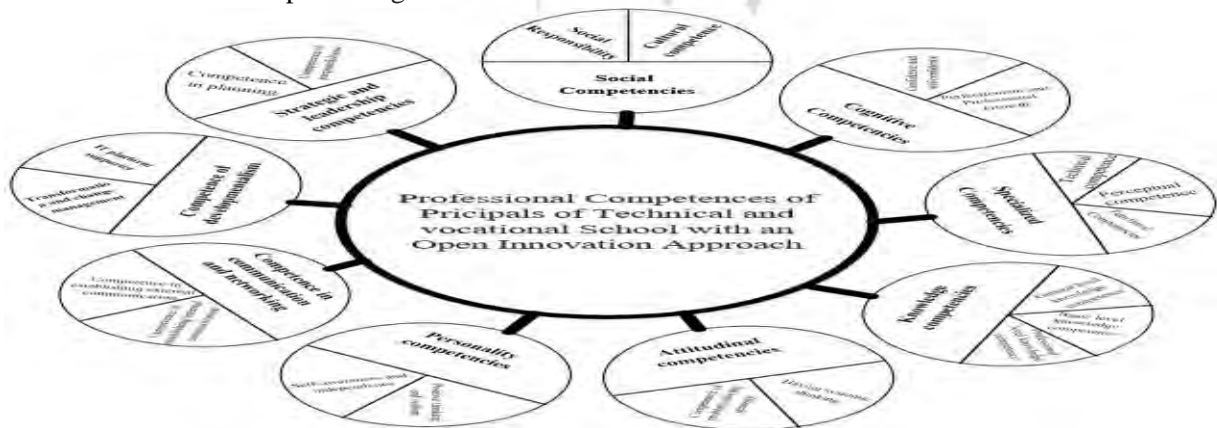

Figure 2. Recognized Professional Competencies of Technical and Vocational School Principals

In order to investigate the similarities and differences between this research and previous researches and to express the new achievements of this research, the concordance or non-concordance of the results of this research have been compared with the results of similar domestic and foreign researches. One of the matched competencies is knowledge, which was studied by Khanifar et al. (2019); Kamrai et al. (2021); Khanifar et al. (2021); Yousefi et al. (1399) and is consistent with this research. Another competency that was identified for principals in implementing open innovation in this study was attitude competencies, which include systemic thinking and problem solving strategy competencies and is consistent with the results of Kamrai et al. (2021); Khanifar et al. (2021) and Yousefi et al. (2020). Communication and networking is another competency which is consistent with the results of Khanifar et al. (2021), Marandi et al. (2016), Nouri Khan Yordi et al. (2020) and Chen and James (2018). Cognitive competencies in this study was also concluded as consistent with the research of Kamrai et al. (2016). Specialized competencies were likewise concluded as consistent with the results of the researches by Khanifar et al. (2021), Kamrai et al. (2020), Nouri Khan Yordi et al. (2020), Yousefi et al. (2020) and Bouchamma, Basque and Caroline (2018). Personality competencies are concluded to be consistent with the results of Bouchamma, Basque and Caroline (2018), Khanifar et al. (2021), Nouri Khan Yordi et al. (2020) and Kamrai et al. (2021). Developmental competence, which includes supporting the context of information technology and transformation and change management for principals and is concluded in this study, is consistent with the results of the researchs by Kamrai et al. (2021); Khanifar et al. (2019) and Sunah Kim (2017). Another competency concluded in this study, social competencies, shows consistency with the results of Marandi et al. (2016) and finally, leadership competencies and strategic competencies are consistent with the results of Marandi et al. (2016), Nouri Khan Yordi et al. (2016) and Khanifar et al. (2021). In this study, the competence of communication and networking with the sub-categories of competence to establish external and internal communication is also identified as one of the main competencies of the directors of technical and vocational schools in order to create open innovation, which is not mentioned in previous research. This competency (main category) has been extracted from the interviews. Besides, previous researches have only identified competencies, while in this research, in addition to identification, the model has also been validated; therefore, the research is not methodologically consistent with previous research.

Principals with these competencies are not practically able to take action without availability of other organizational conditions. For example, no matter how much they advocate technology, their performance will not be visible without budget and equipment. Therefore, it is suggested that, in order to develop and improve the IT infrastructure, issues such as software (computer programs for receiving, processing and producing information), hardware (for processing, storage and retrieval of information) and raw data should be addressed from a technical and engineering point of view. Principals should consider factors in the mission and vision statements such as creating a structure and tasks around the subject of innovation, allocating resources and channels for the production and application of ideas, and creating a culture of changeability. Finally, due to the comprehensiveness of the study of organizational, group, individual, financial and environmental factors affecting the improvement of innovation; generalization and development of the results of this research in other organizations is recommended to other researchers.

Establishing a suitable reward system in the organization is one of the effective factors in increasing effectiveness, risk-taking, entrepreneurship, teamwork and innovative behaviors. The reward system should be purposeful and give feedback and take into account the long-term evaluation of employees. Continuous evaluation with the right criteria of principals' performance are among the measures that motivates principals to work harder. Launching a think tank in a technical and vocational organization will lead to the creation of new ideas in technical and vocational education. Creating network structures based on trust and empathy instead of hierarchical structures, increases the possibility of exchange and transfer of knowledge between researchers, professors, teachers and directors of technical and vocational schools as well as with external partners such as the Ministry of Education and the industry. It is suggested that managers of the technical and vocational training organization develop the skills and abilities and general innovation capacity of their directors and staff by improving human resource development strategies and effective job trainings, before focusing on open innovation as a way to enhance the innovation capacity of their vocational schools. Appreciating the expression of new ideas, supporting innovators and thinkers, as well as applying the suggestions of employees encourage them and strengthen the flow of thought and idea production in the organization. Group collaboration is a fundamental component in establishing an innovative organization. Group activities make the weaknesses in the work process more obvious, which can then be solved by consultation and help of other colleagues, a fact acknowledged by principals of technical and vocational schools.

Ethical considerations

During the implementation of this research and the preparation of the article, all national laws and principles of professional ethics related to the subject of research, including the rights of statistical community, organizations and institutions, as well as authors and writers have been observed. Adherence to the principles of research ethics in the present study was observed and consent forms were consciously completed by all statistical community.

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Conflict of interest

According to the authors of the present article, there was no conflict of interest.

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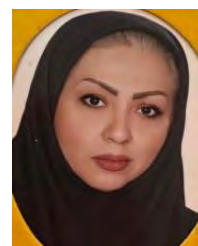
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