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Identifying the Factors Affecting High School Technological Competency-Based Curriculum: A Qualitative Study

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Abstract

Purpose: The aim of the present study was to identify the factors affecting the high school technological competency-based curriculum.

Methodology: This was an applied study in terms of purpose and qualitative in terms of methodology. The research population included the documents and experts of the technological competency-based curriculum in Tehran during 2018. Of these, twelve were selected as a sample according to the principle of theoretical saturation and purposive sampling. The research instrument included a semi-structured interview whose validity was confirmed by the triangulation method and its reliability was estimated 0.85 by calculating interrater agreement coefficient. Data analysis was carried out using open, axial and selective coding methods in MAXQDA software.

Findings: The results showed that the factors affecting the high school technological competency-based curriculum consisted of 66 concepts, 15 components and 6 dimensions. The dimensions included network infrastructure status (with two components of access and quality), communication and interaction tools (two components of simultaneous and simultaneous tools), non-technical competencies and technical skills (with three components of knowledge, skills and attitude), training facilitation strategies (three components of participation modeling, management and supervision), training strategies to increase trust (with three components of trust, honesty and appreciation) and management (with two components of time management and support).

Conclusion: According to the research results, the components and dimensions identified for the factors affecting the high school technological competency-based curriculum, it is essential to have plans to improve it by promoting concepts, components and dimensions.

Keywords: Curriculum, Technological competency, High school

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Introduction

Today, new technologies, especially information and communication technology (ICT) have affected almost all aspects of human life, and accordingly, the education system has been no exception. This impact has been so great that some have called it the ICT revolution (Barbu & Militaru, 2019). Therefore, ICT is one of the most important and prominent achievements of human society (Cruthaka & Pinngern, 2016), which directly and indirectly affects a large part of human life activities, and, therefore, the present age is called the information society (Siegert, Schlegel & Bauernhansl, 2020). The most important activity to improve and nurture school manpower is possible through teacher training. Therefore, it is necessary to pay attention to programs to promote the professional competencies of teachers, especially technological competencies in line with global developments in the ICT age (Laskowski, 2018). The unemployed rate college graduates show the inappropriate relationship of curricula with industry and jobs and potential capabilities in industry. Moreover, lack of necessary expertise in industry indicates lack of necessary skills in individuals, which leads to cost loss and reduced effectiveness in the business and industry sector (Noori & et al, 2019). After carefully studying the missions of education and studying its short-term and long-term plans, it can be inferred that the integration and use of ICTs in teachers' educational activities is one of the important missions for which experts have adopted implement appropriate strategies (Kimm, Kim, Baek & Chen, 2020).

In the national curriculum and the Fundamental Reform Document of Education (FRDE), strengthening and reviving competencies appropriate to the needs of the labor market has been proposed as one of the points of reform and as a key approach in the field of learning in general education. In other words, one of the goals of the National Curriculum Document of Iran is to acquire practical skills for efficient and productive life and to acquire technological competencies in the relevant sciences in order to enter jobs and professions in various sectors of economics and social life (Noori, Yarmohammadiyan & Nadi, 2019). Terminologically, competency is defined as deserving and sufficient, acceptable, capable and ready to enter a job and profession (Shyr, 2017). Acceding to Oxford Dictionary, this term means the power, ability and capacity to perform a task (Bolukbas & Guneri, 2018). Competency emphasizes the basic traits and characteristics of a person that can be a person's motivation, behavior, skills and perception of the social role or a set of knowledge used in doing things and activities (Baek & Sung, 2020). Technological competencies are basic functional skills, critical thinking, constructive behaviors at work, and a set of procedures for using technology, learning ability, teamwork, and interpersonal skills (Al-Furaih & Al-Awidi, 2020). Technological competency is an important principle and indicator for advancing the goals of the education system, which discusses how teachers are prepared to use ICT (Gunes, Gokcek & Bacanak, 2010). Teachers take steps to increase students' motivation, learning and thinking levels by using technology, technological tools and learning their usage (Ajuwon, Meeks, Griffin-Shirley & Okungu, 2016). Moreover, teachers with technological competency use information technology as a tool to build knowledge that engages students and teachers in the teaching and learning process (Yilmaz, Karabulut, Ucar & Ucar, 2021).

There are few researches on technological competency and there has been no research on the high school technological competency-based curriculum, however, the most important relevant researches are as follows: Habibi-Azar, Keyhan & Talebi (2020) concluded in their study that the technological competency of Iranian teachers includes five components of creating motivation, desire and interest in teachers (seven subcomponents: choosing the right teacher, changing the attitude towards the teaching profession, paying attention to time of courses, classifying teachers based on prior knowledge, creating a sense of need, changing the position of teachers and changing the level of received teachers' salaries), planning (five sub-components: determining the right teacher, determining the right place, determining the right time, determining the curriculum and teacher leveling), starting the learning process (six sub-components of hardware training, facilitating access to educational resources, information literacy training, problem solving training, software training and support), implementation of the learning process (four sub-components of initial-service training courses, in-service training courses, specialized school courses and out-of-organization training courses) and institutionalization of technological competency (three sub-components: institutionalization of

follow-up training and learning courses, institutionalization of cooperation between teachers and problem-solving training).

Tahmasebizadeh, Rahimidoost & Khalifeh (2020) concluded in a study that the technological competencies of elementary school teachers included three components: the competencies of integrating technology in education, the competencies of identifying, selecting and using technological tools, and the competencies of orientating towards technology use.

Noori et al. (2019) concluded that technological competencies consist of five comprehensive themes, including technical competencies (two themes organizing technology literacy and professional and meta-professional skills), meta-competencies (two themes organizing thinking, innovation and ideation skills), basic empowerments or abilities (two themes of organizing physical abilities and mental abilities), labor market competencies (with two themes= organizing social adaptation and professional ethics) and strategic competencies (two themes of organizing organizational competencies and managerial competencies).

Bagherzadeh, Keshtiaray & Assareh (2018) investigated engineering education curriculum and emphasized on technological education which consisted of 64 concepts, 28 sub-categories, and four main categories, including personal technological environment, technological social environment, technological industrial environment and technological education.

Ozdemir (2017) introduced the basic technology skills of teachers in applied skills including set up, maintenance, troubleshooting, word processor, network, media communication, spreadsheets, database and social, legal and ethical issues.

Almerich, Orellana, Suarez-Rodriguez & Diaz-Garcia (2016) divided teachers' approaches to achieving technological competency into three categories. The first category includes models provided by organizations and can be used in all organizations. The second category includes models that include technological knowledge, pedagogy, and content. The third category refers to models provided for teachers to achieve technological competency.

Dai & Liang (2012) concluded that the most important key competencies include problem-solving skills, computer skills, strategic thinking (conceptual, analytical, compositional, coping, objectivity, creativity, and language learning skills).

One of the most important elements of education is the curriculum, which must be appropriate and in line with the relevant goals, tasks and developments in order to be able to play its role effectively. The educational systems should train individuals to enter the labor market in such way that they create the necessary competencies in the general and specialized fields. This goal will not be achieved unless the curricula are designed in a way that create and strengthen these competencies. Considering that research on technological competencies has been conducted in educational systems, it is still unclear what technological skills and competencies high school teachers should be equipped with, on the one hand; and conducting this research could help high school teachers improve their technological competencies and help officials and their planners to design curricula to improve their technological competencies, on the one hand; the present study aimed to identify the factors affecting the high school technological competency-based curriculum.

Methodology

This was an applied study in terms of purpose and qualitative in terms of implementation method. The research population included the documents and experts of the technological competency-based curriculum, including university professors and senior managers of the education system of Tehran in 2018, 12 of whom were selected as a sample according to the principle of theoretical saturation and using purposive sampling. The purposive sampling method was used in order to select people who can provide maximum assistance to the researcher to identify the factors affecting the technological competency-based curriculum. Inclusion criteria included having at least a master's degree, at least 10 years of work experience, teaching experience in the educational system, publishing a book or article in the field of technological competency-based curriculum and willingness and satisfaction to participate in the study.

The researchers first investigated the documents related to the technological competency-based curriculum. They then designed a number of main interview questions with the help of professors (Table 1). Then,

samples, i.e. the relevant experts, were selected, and the time and place of the interview was coordinated with them. They were also assured of ethical considerations. They were also told that in addition to recording the key points of the interviews, all interviews would be recorded for re-examination and no information would be lost. The average duration of the individual interview was about 40 to 45 minutes. At the end of the interview, the interviewees were thanked and coordinated with them on how to report the results of the present study.

Table1. The main interview questions to identify the factors affecting the high school technological competency-based curriculum

Row	Questions
1	What is the infrastructure required for a high school technological competency-based curriculum?
2	What is the role of education administrators and planners in the technology competency curriculum in high school?
3	What are the problems and challenges for having a high school technological competency-based curriculum?
4	What steps should be taken to implement a high school technological competency-based curriculum?
5	What indices are effective in the high school technological competency-based curriculum l?
6	What components are involved in a high school technological competency-based curriculum?
7	What dimensions are effective in the high school technological competency-based curriculum?
8	What is the role of high school technological competency-based curriculum in improving the quality of the education system?

The instrument used in the present study included a review of technological competency-based curriculum documents and semi-structured interviews with experts. The interviews were conducted individually at a predetermined time and place. Moreover, in addition to taking notes of their key points, all interviews were recorded. The validity of the interviews was assessed using the appropriate triangulation method. Triangulation methods include data source triangulation (using multiple data sources in a study or research), researcher triangulation (using more than one researcher to collect, analyze, and interpret data) and theoretical triangulation (using multiple perspectives to interpret data). The validity of triangulation was assessed by examining the interview questions with the help of two experts and theories, information sources and documents were assessed at the same time. The reliability of the interviews was assessed by calculating interrater the agreement coefficient (α=0.85), which indicated a good and excellent reliability.

Data obtained from reviewing documents and interviews were analyzed by open, axial and selective coding methods in MAXQDA software.

Results

Demographic information of experts, including university professors and senior managers of the education system, by sex, education, position and work experience, were presented in Table 2.

Table2. Demographic information of experts by sex, education, position and work experience

Variable	Levels	Frequency	Percentage
Sex	Male	9	%75
	Female	3	%25
Education	M.A	4	%33.33
	Ph.D.	8	%67.66
Position	University professor	7	%33.58
	Senior Managers of Education	5	%67.41
Work experience	11-15 years	1	%33.8
	16-20 years	3	%25
	21-25 years	2	%67.16
	26-30 years	6	%50

As can be observed in Table 2, most of the experts were male (75%) with a Ph.D. (66.67%), a university professor (58.33%) and 26-30 years of work experience (50%).
Table 3 shows the results of open, axial and selective coding used to identify the factors affecting the high school technological competency-based curriculum.

Table3. Results of open, axial and selective coding to identify the factors affecting the high school technological competency-based curriculum

Selected code	Axial code	Open source
Network infrastructure status	Access	1. Internet access in different time conditions, 2. Ability to use the website via cellphones and 3. Ability to join the website and get information
	Quality	1. The possibility of easy use of the virtual education system, 2. The inserting relevant links on the website of educational centers, 3. The multimedia content of the educational website and 4. Coverage of various specialized topics in the educational website
Communication and interaction tools	Simultaneous tools	1. Audio conferencing, 2. Video conferencing, 3. Instant messaging and 4. Chat
	Non-simultaneous tools	1. Weblog, 2. Email, 3. Word processor, 4. Audio processor and 5. image processor
Non-technical competencies and technical skills	Knowledge	1. How to work with some technological devices such as computers safely and familiarity with the signs on home appliances
	Skill	1. Team work, 2. Communication, 3. Organization, 4. Resource management, 5. Safety at work and 6. Ability to set

		up, operate, use and repair technology tools and equipment
	Attitude	1. Paying attention to safety before work and 2. The importance of proper use of technology with human physics
Training facilitation strategies	Participation modeling	1. Supporting learners, 2. Creating appropriate communication patterns by the instructor, 3. Availability of the instructor, 4. Playing the role of a learner and inducing this role in others, 5. Modeling the form and manner of interactions by the teacher to learners, 6. Encouraging learners to introduce themselves in personal profiles, 7. Facilitating interactions between people, and 8. Providing an opportunity for people to get to know each other.
	Management	1. Ensuring that the learner is e-learning before the start of the course, 2. Having a teaching assistant, 3. Clearly expressing the teacher's expectations of the learners at the beginning of the course, 4. Assigning authority to the learners, and 5. Selecting and grouping learners by the teacher
	Supervision	1. The teacher's involvement under critical situations to resolve differences, 2. Preventing learners from dominating the discussion, 3. Thinking of measures to reduce the additional burden of information, and 4. Putting the learner in the direction of learning goals.
Educational strategies to increase trust	Trust	1. Creating an atmosphere for people to trust each other, 2. Ensuring learners' information security, 3. Commitment to common goals, 4. Paying attention to cultural differences while providing education, and 5. Reflecting before responding
	Honesty	1. Explaining etiquette in the network in the first course, 2. Developing e-learning rules and

		regulations with the participation of learners, 3. Promoting honesty in writing and 4. Paying attention to the authenticity of sources and writings
	Appreciation	1. Appreciating others for their opinions, 2. Encouraging others to participate, 3. Paying respect for innovative ideas, and 4. Referring to opinions of other people during courses
Management	Time management	1. Providing lesson content in small pieces, 2. Giving learners enough time to complete assignments and participate in class, 3. Providing a timetable to learners for more communication, 4. Providing suggestions on how to make the best use of time, 5. Paying attention to the time differences of learners and 6. Holding classes at appropriate times
	Support	1. Paying attention to learners 'time intervals in different geographical areas, 2. Paying attention to learners' different learning styles, 3. Paying attention to individual cognitive, social and cultural differences, 4. Timely assistance when students face technical problems and 5. Flexibility when students feel the need to change class hours

As can be observed in Table 3, the factors affecting the high school technological competency-based curriculum l consisted of 66 concepts, 15 components and 6 dimensions. The dimensions include the network infrastructure status (two subcomponents of access and quality), communication and interaction tools (two subcomponents of simultaneous and non- simultaneous tools), non-technical competencies and technical skills (three subcomponents of knowledge, skills and attitude), training facilitation strategies (three subcomponents of modeling participation, management and supervision), training strategies to increase trust (three subcomponents of trust, honesty and appreciation) and management (two subcomponents of time management and support).

Conclusion

Technological competencies can play an important role in the quality of education and learning. Therefore, the present study aimed to identify the factors affecting the high school technological competency-based curriculum. The results of the present study showed that the factors affecting the high school technological competency-based curriculum consisted of 66 concepts, 15 components and 6 dimensions. The dimensions includes the network infrastructure status (two components of access and quality), communication and

interaction tools (two components of simultaneous and non-simultaneous tools), non-technical competencies and technical skills (three components of knowledge, skills and attitude), training facilitation strategies (three components of modeling of participation, management and supervision), training strategies to increase trust (three components of trust, honesty and appreciation) and management (two components of time management and support). These results are consistent with the results of studies by Habibi-Azar & Talebi (2020), Tahmasebizadeh & et al. (2020), Noori & et al. (2019), Bagherzadeh & et al. (2018), Ozdemir (2017), Almerich & et al. (2016) and Dai & Liang (2012).

With regard to the network infrastructure status (two components of access and quality), it should be mentioned that before implementing any project and program for technology-based training, training centers should be equipped with the latest hardware facilities and up-to-date equipment. Therefore, in order to establish a technology-based education system in schools, it is necessary to develop ICT skills, quantitative and qualitative development of the technology infrastructure and strengthening of the Internet network infrastructure. Therefore, access to the Internet at different times, use of the website via cellphones, membership in the website, and access to information as concepts of easy access and use of the virtual education system, the existence of relevant links on the website, multimedia nature of the website and coverage of various specialized topics on the website as quality concepts can play an effective role in the technological competency-based curriculum. Also, with regard to communication and interaction tools (two components of simultaneous and non-simultaneous tools), it can be said that one of the effective factors for achieving the technological competency-based curriculum is the use of appropriate tools that can be divided into two general parts of simultaneous and non-simultaneous tools. Therefore, voice conferencing, video conferencing, instant messaging and chatting as simultaneous tool concepts and weblog, email, word processor, audio processor, and image processor as non- simultaneous tool concepts can enhance technological competency-based curriculum by improving communication and interaction tools.

With regard to non-technical competencies and technical skills (two components of knowledge, skills and attitude), it should be said that non-technical and technical or specialized competencies and skills are an important factor in the technological competency-based curriculum that should be paid special attention by officials and planners. Because, proper use of some technological devices such as computer and familiarity with home appliances and devices as a concept of knowledge, teamwork, communication, organization, resource management, safety at work and the ability to set up, operate, use and repair technology tools, as concepts of skills, and attention to safety even before work and the importance of proper use of technology according to human physics, as concepts of attitude, can play an effective role in the technological competency-based curriculum through non-technical competencies and technical skills. Also, with regard to training facilitation strategies (three components of modeling of participation, management and supervision), it can be said that these strategies play an effective role in modulating and accelerating the achievement of educational goals based on ICT. Therefore, supporting learners, creating appropriate communication patterns, access to the instructor, playing the role of the role of a learner by instructor and inducing such a role to others, modeling the form and manner of interaction by the teacher for learners, encouraging learners to introduce themselves, facilitating interactions between people and creating opportunities for familiarity with others, as concepts of participation modeling, ensuring e-learning before the start of the course, using the instructor, expressing the teacher's clear expectations of learners at the beginning of the course, assigning authority to learners and selecting and grouping learners by the teacher, as concepts of management and teacher intervention under critical situations to resolve differences and prevent their escalation, preventing some learners from dominating the discussion, thinking and designing measures and strategies to reduce the additional burden of information, and putting the learner in the path of educational goals and learning, as supervision concepts can enhance technological competency-based curriculum by improving training facilitation strategies.

With regard to educational strategies to increase trust (three components of trust, honesty and appreciation), it should be mentioned that the strategies used to increase trust through encouragement and relaxation can play an effective role in teaching and learning and improving their quality. Therefore, creating a trust-based atmosphere, ensuring learners' information security, commitment to common goals, paying attention to

cultural differences during teaching and learning, and reflecting before responding to issues, as concepts of trust, presenting etiquette in the network at the start of the training course, formulating e-learning rules and regulations with the participation and cooperation of learners, promoting honesty in writing, and paying attention to the authenticity of sources and writings, as concepts of honesty, and appreciation of others' opinions, encouraging others to participate, respecting original, serious and innovative ideas, and referring to the opinions of others during participatory discussion, as concepts of appreciation, can play an effective role in the technological competency-based curriculum through educational strategies to increase trust. Also, with regard to the management dimension (two components of time management and support), it can be said that management plays a fundamental role in improving quality in any field and technological competency-based curriculum is no exception and proper management can improve it. Since, providing lesson content in small pieces and sizes, giving learners enough time to do homework and participate in the class, providing a timetable to learners for more communication, providing suggestions for the best use of time, paying attention to learning time differences and holding classes at appropriate times, as concepts of time management, and paying attention to time intervals of learners in different geographical areas, paying attention to different learning styles of learners, paying attention to individual cognitive, social and cultural differences, timely assistance when learners face technical problems and challenges, and flexibility when learners need to change class hours, as support concepts, can improve technological competency planning by improving management.

Overall, it can be said that many factors affect the success and failure of the technological competency-based curriculum, some such as network infrastructure are a concern for developing countries and some are a common concern of all countries. Therefore, it is necessary to provide appropriate conditions such as creating a strong infrastructure, developing the necessary educational standards for evaluating teachers and students, building a proper culture and changing the cultural attitude of society in education, investment and participation of public and private sectors in this field. Therefore, strengthening educational skills and strategies and support is necessary to establish a technology-based education system. Moreover, it is necessary to take into account items such things as the virtual in-service education system, creating retraining conditions for virtual education courses for teachers, and developing specific rules for electronic activities, development of a successful evaluation system for technology-based education on an ongoing basis and computer skills training opportunities up to an advanced level for educators and students.

One of the limitations of the present research is the few number of previous research on the technological competency-based curriculum, which prevented the possibility of extensive comparison of the results of the present study. Therefore, researchers need to investigate other aspects of the technological competency-based curriculum and compare the results with the results of the present study. Another limitation is that the present study was a qualitative research and only attempted to identify the factors affecting the technological competency-based curriculum and the effectiveness of these factors has not been investigated. Therefore, it is needed to design a curriculum and evaluate its effectiveness in future research based on results of the present research and even in combination with other research. The last limitation was the use of document reviews and interviews and the lack of appropriate conditions for observing class activities. Therefore, if the conditions are right, it is suggested to observe classroom activities and interview the people present in the classrooms to identify the factors influencing the technological competency-based curriculum in future studies. According to the results of the present study and the concepts, components and dimensions identified for the factors affecting the high school technological competency-based curriculum, it is essential to plan to improve it by promoting the concepts, components and dimensions. For example, one of the dimensions included the network infrastructure status and that the current the Covid-19 pandemic showed that although the technology-based education has been emphasized for about a decade, Iran's ICT infrastructure is not still in good condition. Therefore, professionals and planners need to spend adequate budgets to improve the network infrastructure status and teach teachers and students how to use it. Another practical suggestion is implement empowerment and strengthening professional programs in order to make the educational system, schools and teachers more familiar with new technologies through technology growth centers, identification of new sciences and modern scientific map of the world and the need for these

sciences according to special privileges included in regulations and circulars. The last practical suggestion is to develop a technology competency curriculum and technology education in a way that includes its comprehensive concepts including various aspects of technology education, technology nature, professional competence, thought processes, individual and social needs. For this purpose, it is necessary to take advantage of all the opportunities of the education system and even beyond it. To this end, we must train technology and technological competency and thus to fund resources and equipment by utilizing all available capacities of the society and opportunities outside the school and educational system such as industry and trade partnership and research and technology departments of other organizations.

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