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Required competencies for e-learning among science and mathematics supervisors: post-pandemic features of education

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Abstract

Purpose – The aim of this study was to measure the readiness of science and mathematics supervisors to utilize technology and online learning platforms for teachers' plans and professional development, during and after the period of the COVID-19 pandemic.

Design/methodology/approach – To achieve this aim, the researchers developed a questionnaire comprising of 55 items based on the instruments used in pertinent studies. A mixed-methods research design was employed, whereby a quantitative online survey was supplemented by focus group discussions with selected supervisors. Survey data were subjected to one-way analysis of variance and *t*-test, while information obtained via focus groups was coded to identify common themes related to the obstacles and challenges supervisors face.

Findings – When completing the survey, the supervisors approached proficiency using technology; however, focus group discussions revealed misconceptions related to e-leaning and limitations in their abilities to use technology in schools, as well as obstacles imposed by the structure and management of the educational system. *T*

Practical implications – These findings indicate that supervisors need support in acquiring the competencies required for integrating technology in education, and that their support to teacher community needs to be grounded in clear and systematic approaches and best educational practices.

Originality/value – These findings indicate that supervisors need support in acquiring the competencies required for integrating technology in education, and that their support to teacher community needs to be grounded in clear and systematic approaches and best educational practices.

Keywords Post pandemic education, Supervisors, Online learning, e-competencies

Paper type Research paper

Introduction

The recent COVID-19 pandemic has affected educational systems around the world, leading to widespread school and university closures; it has shifted the feature of education and enforced e-leaning into the body of education system globally (Diab-Bahman, 2021). Many

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countries faced many challenges in integrating technology into their education system. The integration of information and communication technologies (ICTs) into the education environment involves multiple factors of an administrative, organizational, professional, and socioeconomic nature (González-Pérez and Ramírez-Montoya, 2022). These factors were more explicit during the last two years when many schools were forced into remote and hybrid mode of learning (Alhouti, 2020). The sudden shift in the education system required many interventions, provisions, and the training to staff and teachers in schools (Diab-Bahman, 2021). In spite of the initial difficulties at the beginning of the pandemic, the incorporation of ICT and e-learning into schools has experienced a shift, both quantitatively and qualitatively (Diab-Bahman, 2021). As a result, the style of communication, teaching, school practices, and school management have been modified based on the new technological trends (Alhouti, 2020).

Regarding teacher training, it is necessary to take into account the design of professional development, and type of training for e-learning because it has specific features and require specific training skills (Alhashem, 2021). Therefore, it is necessary to assess all the changes that came along with e-leaning at different levels, including among supervisors, which implies defining the roles and competencies of them. This is the framework of the present survey.

Background on e-leaning in Kuwait's education system

Teaching in the 21st century requires much more than a set of practical and interpersonal skills. It necessities a mindset shift that needs to be fostered through continuous professional development (González-Pérez and Ramírez-Montoya, 2022). Therefore, educational professionals and teachers must work together to bridge the gap between the education they have, and the education they need. Since the education system in Kuwait is highly centralized and teachers are trained by their supervisors (National Institute of Education Kuwait, 2013), it is essential to ascertain a supervisor's:

(1) Perceptions regarding their ability to integrate technology into science and math education.

(2) Readiness to adopt distance-based curriculum during and post the COVID-19 pandemic period.

(3) Views on the barriers to the more widespread use of technology in the education system of Kuwait.

The shift from traditional to online teaching modes was a challenge for school administrators, supervisors, teachers, parents, and students alike. Nonetheless, this process would have been easier if technology was already widely adopted in the Kuwaiti public school system. At that time, the Ministry of Education (MOE) was not prepared to respond to the circumstances imposed by the pandemic, as its infrastructure was not equipped for such a sudden transition to distance education. Similarly, its technical and administrative cadres were not trained to respond to the crisis, given that all projects that would have provided a solid infrastructure needed for distance education were suspended or canceled years ago, including:

(1) The Educational Channel project, which was suspended in February 2016.

(2) The Educational Portal project, which was suspended at the end of 2018.

(3) The iPad project, which was suspended in 2018.

(4) A project aimed at extending the optical fiber network for schools, which was suspended in 2016. Large parts of the project were completed within a very short period during the COVID-19 pandemic.

These projects failed due to the absence of strategic planning within the MOE, which would provide a unifying framework. For example, the iPad project was withdrawn from schools after only a few months of implementation (Alhouti, 2020). Another technical challenge in Kuwait stems from the lack of e-content that is aligned with the formal curriculum. This issue prompted the development of an e-learning portal, called Siraj that provides e-books as well as limited media content (Kuwait Institute for Scientific Research, 2020). Similarly, even though the Department of Information Systems at MOE delivered and activated Microsoft Teams (MS Teams) accounts for all students, teachers, and supervisors in public-sector schools several years ago, its implementation has been highly problematic (Alrashidi, 2017).

Issues with integrating technology in education still persist, because public education institutions adhere to traditional educational practices (Diab-Bahman, 2021). Moreover, training and professional development remains focused on in-person instruction and content knowledge, whereas technology-related courses, while mandatory, are never related to practical instructional applications within the school context.

As a result of these outdated practices, many teachers are inadequately equipped to use computers, and those that are more skilled lack the necessary resources within their schools (Alrwaished *et al.*, 2017). These issues are partly due to the limited training programs aimed at teachers provided by the MOE (Alrwaished *et al.*, 2017). As a most recent example of systemic failures, prior to the COVID-19 outbreak, the MOE provided online learning as an option, leaving it up to the technical supervisors to provide intensive courses for teachers on how to use technology and teach remotely (Alhouti, 2020).

Supervisors as trainers

Within the MOE, supervision as a field of educational practice with clearly defined roles and responsibilities emerged slowly in response to the institutional, academic, cultural, and professional dynamics that have historically generated a complex schooling agenda (Alrashidi, 2017; National Institute of Education Kuwait, 2013). The job description of educational supervisors is, however, overly broad, and includes too many duties, the main one being monitoring the educational system quality and curriculum effectiveness, along with providing guidance on the teaching methods, content, and teaching techniques. Supervisors also provide a vision and a plan for the professional development of teachers and schools (Alrashidi, 2017; National Institute of Education Kuwait, 2013).

Senior supervisors are in charge of teacher performance, curriculum, and assessment, while also developing plans for their implementation, supervising and working on curriculum development, updating teachers' instruction methods, and mentoring and guiding teachers.

Lastly, the head of supervisors in the district participates in the development of general education policy and planning improvements to the educational process, while providing expertise to the department heads in each academic educational field. This role also involves a follow-up on the professional development and training for teachers, curriculum development, and analysis of and reporting on exam results (Alsaleh, 2020).

As this training is largely subject-related, its content is determined by the relevant supervisor with little or no consultation with teachers. Empirical evidence also suggests that the mode of delivery tends to be formal and lecture-oriented, and rarely entails direct involvement of the participating teachers.

Conceptual framework

The conceptual framework for this study was based on three models: the TPACK (technology, pedagogy, and content knowledge) framework, ICT/computer competence, and support, confidence, beliefs and use frameworks, as shown in Table 1.

Framework	Definition	Research study
TPACK framework	TPACK can be used to represent teachers' unique expertise for technology integration, as it characterizes how they make "intelligent pedagogical uses of technology" (Koehler *et al.*, 2007, p. 741)	Open response questions (1) List the factors that helped you build your e-literacy (2) What are the obstacles that the educational field faces in general and guidance in particular in the field of using technology in education? (3) Is there a possibility of applying distance education during and after the coronavirus pandemic?
ICT/Computer competence	Computer competence is defined as an ability to utilize a wide range of computer applications for various purposes (van Braak *et al.*, 2004)	Survey prompt Determine your level of technological competency for ensuring effective e-learning
Support, confidence, beliefs and use	The conceptual framework pertaining to these factors consists of technology use, the factors shown to affect technology use, and how each factor is related to technology use and other factors (Dogan *et al.*, 2020)	Survey and open response questions

Table 1.
Conceptual framework model

This decision was guided by the fact that content, pedagogy, and knowledge of technology should be the primary focus of education at all levels. TPACK encompasses these elements, which are presumed to be familiar to teachers and continually applied in their classrooms (Mishra and Koehler, 2006). Indeed, teachers are required to possess relevant content knowledge, commonly referred to as pedagogical content knowledge (PCK; Shulman, 1986, 1987), and be able to convey this knowledge in ways suitable for their students' grade level. At the same time, they must adapt and update their technological knowledge to keep up with the evolution of technical and lifestyle developments. Thus, the TPACK framework represents the interrelationships between teachers' PCK, and their understanding of educational technologies, which is essential for the effective use of technology in education (Mishra and Koehler, 2006).

Despite ample body of evidence indicating that integration of technology into curricula at all levels is beneficial, it can be challenging in practice. According to Furner and Kumar (2007), "using an interdisciplinary or integrated curriculum provides opportunities for more relevant, less fragmented, and more stimulating experiences for learners" (p. 186). Still, it is also worth noting that many teachers have omissions or gaps in their own subject content knowledge (Stinson *et al.*, 2009). Thus, asking them to adopt technology in their classrooms may create additional knowledge gaps and challenges (González-Pérez and Ramírez-Montoya, 2022). Alrwaished *et al.* (2017) also recommended including information technology (IT) into core rather than complementary technologies to ensure that, both at the policy level and in practice, technology is treated as an integral aspect of all subject areas.

To fully benefit from the ICT in education, teachers should possess certain skills and should be given opportunities to develop them continuously. Hence, in addition to general understanding of computers and their applications in the educational process, teachers must also be exposed to various ICT tools and platforms that are increasingly used to search for information and communicate with others (Ifinedo *et al.*, 2019). For example, at a minimum, teachers should competently use word processing, presentation, and spreadsheet programs, as well as possess adequate knowledge of databases and graphic applications (Ay *et al.*, 2016).

To ensure that all supervisors possess such skills, it is necessary to demonstrate their relevance to their everyday duties. Indeed, empirical evidence indicates that those that are more competent with using computers tend to have more positive attitudes toward technology, while computer anxiety is negatively related to performance (Chai *et al.*, 2019). In this context, it is important to emphasize that technology allows adoption of a wide variety of teaching methods that meet individual learners' knowledge acquisition preferences.

Although growing evidence of the importance of ICT, the MOE still focuses on training programs that are oriented toward PCK with limited courses related to the aforementioned skills (Alhashem, 2021). At present, the MOE provides three types of training for teachers: two-week training courses for beginner teachers, two-week training courses for promoted department heads, and a training course for curriculum development, evaluations, and assessments (Alsaleh, 2020; National Institute of Education Kuwait, 2013).

Purpose

Although a pandemic is an exceptional occurrence, it has demonstrated the importance of integrating technology into the education system. Taking into account that many supervisors, originally offering traditional training, were in compulsory situation to shift to e-learning practices and training, it is important to identify how the supervisors, used to face-to-face interactions, are affected by their incorporation into online teaching, specifically the changes they face with regard to the new required competencies. Findings yielded by this research will therefore provide insight into the technological competencies of both science and math supervisors throughout Kuwait possess as well as lack, which can be useful when designing training programs for educators for the following points:

(1) Investigate the status of technological competency among science supervisors in Kuwait.

(2) Increase educators' awareness regarding the importance of using technology.

(3) Based on the challenges identified, make suggestions regarding future research and application of ICT in science and mathematics education.

(4) Communicate results to senior stakeholders involved with educational reform and the New Kuwait Vision 2035, while also recommending the inclusion of technology in the system.

Methodology

This research provides an original contribution to the body of evidence regarding technological requirements for distance education. However, as the study was conducted during a pandemic, a mixed-methods approach was employed, whereby both the survey and interviews were conducted online. Moreover, this research design was necessary due to the original nature of this investigation that calls for answers beyond the simple statistical data associated with quantitative approaches and components often employed in qualitative approaches. Qualitative data provides a detailed understanding of a problem, while quantitative data provides a more general understanding of a problem. Each approach has its limitations, and by using both, the strength of each approach ideally negates the limitations of the other. Therefore, the survey conducted with educational supervisors aimed to gather large-scale data from a large number of participants in order to obtain a broad overview of their perceptions regarding technology use in their schools and their ITC aptitudes. These findings were further explored in discussions with a small number of teachers, thus gaining a deeper understanding of these issues.

This approach has become popular in social science research, and scholars in the education field are increasingly combining both qualitative and quantitative methods within a single study (Cara, 2017; Creswell and Plano Clark, 2011) as this strategy provides a better understanding of the research problem (Creswell and Plano Clark, 2011). Cara (2017) defined the mixed-methods design as "a specific design that includes rigorous, systematic, and the planned use of different quantitative and qualitative methods for collecting and/or analyzing data in the same study in order to understand a research problem" (p. 195). Therefore, the use of a comparative mixed-methods research design is suitable for gaining a wide-ranging and in-depth understanding of the supervisors' readiness to use ICT in education.

When conducting mixed-methods research, either concurrent or sequential design can be employed (Cara, 2017; Creswell and Plano Clark, 2011). Concurrent design is used to collect qualitative and quantitative data simultaneously. On the other hand, as a part of sequential design, one type of data is collected before proceeding with the collection of other data types. This second stage can also be either explanatory or exploratory (Cara, 2017). Most importantly, when conducting mixed-methods research, the primary purpose of the quantitative stage (in this case a survey) is to ensure that there is sufficient background information on the topic being examined, while also helping to select participants for the second (qualitative) stage (in this case in-depth interviews).

Instruments

For the quantitative part of this study, a survey was conducted, guided by a 55-item questionnaire comprising of eight sections related to ICT competencies that are needed for any educator to practice online teaching (See Table 2).

Reliability

The survey instrument was tested for reliability through a test-retest method by allowing 28 supervisors to complete it and provide feedback as a part of a pilot study in Table 3 (in Arabic). Reliability statistics were calculated on the eight categories within each domain for the pilot study. The internal consistency reliability (alpha coefficient) score was 0.984 as shown in Table 4.

Based on the information yielded by the pilot study, the survey was modified and several open-ended questions were added. Moreover, to check for content validity, educational technology professors and three experienced senior supervisors reviewed the survey questions, before and after the revisions were made.

Cronbach's alpha value indicates the reliability of surveys requiring responses on a Likert scale. It is particularly relevant when the aim is to measure latent variables—hidden or unobservable variables like a person's conscientiousness, neurosis, or openness—which are very difficult to measure in real life. Thus, Cronbach's alpha indicates whether the chosen test is accurately measuring the variable(s) of interest.

Factor
Factor 1: Computer literacy competencies
Factor 2: Computer skills
Factor 3: Competency for planning an educational situation
Factor 4: Educational program design competencies
Factor 5: Competencies related to the teaching and learning process
Factor 6: Assessment and evaluation competencies
Factor 7: Competencies related to professional development
Factor 8: Competencies related to social, ethical, legal, and humanitarian issues

Table 2.
Survey competencies and related factors

The sample

With assistance from the Department of General Education, the researchers invited 376 science and math supervisors for all three school levels (elementary, middle, and high) in the six school districts and the private sector to participate in the study.

Data analysis and results

In this section, findings yielded by both the survey and subsequent in-depth interviews are presented, focusing on the linkage between the theoretical framework adopted for the study and supervisors' perspectives. The results are interpreted through the TPACK lens, as it indicates the essential skills supervisors must master to effectively train teachers. As one of the aims was to obtain supervisors' perceptions regarding their ability to integrate technology into science and math education, their responses to the ICT competencies' survey were analyzed, and the findings are reported in Table 5.

Factor 1: computer literacy competencies

With respect to computer literacy competencies, there were significant differences in terms of gender, educational stage, major, nationality, and level of technology expertise. First, according to the independent samples t-test, there was a significant difference between males and females in the level of positivity (t-value = −5.737, Sig. (2-tailed) = 0.00), whereby males (M = 4.06) were more positive than females (M = 3.38). Similarly, for the educational stage, ANOVA (f-value: 10.616, Sig.: 0.00) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in the primary stage were less positive than their colleagues focusing on other educational stages regarding acquiring computer literacy competencies. When results were analyzed by major, the t-value = −2.948 and Sig. (2-tailed) = 0.004 (less than 0.05) confirmed a significant difference between math (M = 3.75) and science (M = 3.42) teacher supervisors. Similarly, the t-value of −2.342, Sig. (2-tailed) = 0.02 obtained for nationality indicated a significant difference between Kuwaitis (M = 3.51) and non-Kuwaitis (M = 3.91). Lastly, ANOVA results for the level of technology expertise (f-value = 23.693, Sig. = 0.000) confirmed that there was a significant difference in the level of technology expertise: weak (M = 2.20), average (M = 3.46), and advanced (M = 4.17).

Factor 2: computer skills

The computer skills also differed depending on supervisors' gender, educational stage, major, English proficiency, and level of technology expertise. According to the independent samples

Table 3. Case processing summary

		N	%
Cases	Valid	29	100.0
	Excluded[a]	0	0.0
	Total	29	100.0

Note(s): [a]Listwise deletion based on all variables in the procedure

Table 4. Reliability statistics

Cronbach's alpha	Number of items
0.984	55

Table 5. Means (very low: 1, low: 2, average: 3, high: 4, very high: 5)

		Factor 1 Mean	Factor 2 Mean	Factor 3 Mean	Factor 4 Mean	Factor 5 Mean	Factor 6 Mean	Factor 7 Mean	Factor 8 Mean
Job title	Science supervisors	3.80	4.00	3.80	3.60	3.64	3.60	3.72	3.48
	Math supervisors	3.55	3.75	4.00	3.26	3.32	3.28	3.39	3.15
School District	AL-Ahmedi	3.68	3.80	4.04	3.60	3.56	3.60	3.72	3.35
	Private Edu	3.53	3.67	4.07	2.93	3.00	3.00	3.11	2.76
	AL-Jahra	3.32	3.45	4.14	3.00	3.08	3.00	3.15	3.05
	Hawalli	3.50	3.82	3.97	3.24	3.38	3.35	3.44	3.15
	Al-Asema	4.05	3.90	4.24	3.95	3.96	3.90	4.02	3.55
	AL-Farwaniah	3.51	3.72	3.91	3.15	3.20	3.15	3.25	3.11
	Mubarak Al-Kabeer	3.44	3.85	3.85	3.15	3.22	3.15	3.25	3.12
Gender	Female	3.38	3.62	3.94	3.20	3.26	3.22	3.33	3.07
	Male	4.06	4.15	4.15	3.48	3.52	3.48	3.59	3.41
Stage	Primary	3.17	3.38	3.66	2.78	2.90	2.86	3.00	2.68
	Intermediate	3.65	3.94	4.00	3.35	3.38	3.33	3.46	3.21
	Secondary	3.74	3.88	4.21	3.53	3.56	3.53	3.61	3.43
Major	Math	3.42	3.61	3.84	3.01	3.08	3.05	3.17	2.92
	Science	3.75	3.96	4.22	3.65	3.68	3.64	3.73	3.51
Yrs. Of Experience	Less than 5 years	3.59	3.75	4.07	3.25	3.34	3.32	3.44	3.13
	5 to 10 years	3.58	3.76	4.05	3.49	3.52	3.49	3.55	3.30
	More than 10 years	3.49	3.76	3.87	3.03	3.08	3.03	3.17	3.02
Qualification	Bachelor	3.55	3.73	3.96	3.24	3.30	3.27	3.37	3.13
	Higher level of education	3.61	3.96	4.26	3.48	3.55	3.43	3.57	3.36
Nationality	Kuwaiti	3.51	3.75	3.98	3.23	3.29	3.25	3.37	3.11
	Non-Kuwaiti	3.91	3.83	4.13	3.57	3.60	3.57	3.63	3.52

		Factor 1 Mean	Factor 2 Mean	Factor 3 Mean	Factor 4 Mean	Factor 5 Mean	Factor 6 Mean	Factor 7 Mean	Factor 8 Mean
Tech_Level	Weak	2.20	2.80	3.20	1.40	1.44	1.40	1.44	1.52
	Average	3.46	3.64	3.97	3.16	3.23	3.18	3.29	3.06
	Advanced	4.17	4.39	4.22	4.03	4.02	4.03	4.15	3.84

(*continued*)

		Factor 1 Mean	Factor 2 Mean	Factor 3 Mean	Factor 4 Mean	Factor 5 Mean	Factor 6 Mean	Factor 7 Mean	Factor 8 Mean
PD_Source	Self-learner	3.18	3.53	3.81	2.95	3.01	2.93	3.07	2.88
	Ministry Courses	3.56	3.78	3.67	3.22	3.28	3.22	3.38	3.16
	Outside	3.74	4.00	4.07	3.45	3.45	3.48	3.55	3.21
	Self and Ministry courses	3.50	3.43	4.14	3.00	3.06	3.00	3.10	2.96
	Self and outside	3.69	3.61	3.97	3.17	3.29	3.28	3.41	3.09
	Ministry courses and outside	4.00	3.71	4.00	3.71	3.75	3.71	3.71	3.69
	Self-learner, Ministry courses and outside	3.72	4.08	4.23	3.67	3.72	3.67	3.75	3.55

Table 5.

t-test, there was a significant difference between males and females in the level of positivity (*t*-value = −4.209, Sig. (2-tailed) = 0.00), whereby males ($M = 4.15$) were more positive than females ($M = 3.62$). For the educational stage, ANOVA (*f*-value: 9.217, Sig.: 0.00) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in the primary stage were the least positive regarding acquiring computer skills. When results were analyzed by major, the *t*-value = −3.062 and Sig. (2-tailed) = 0.002 confirmed a significant difference between science ($M = 3.96$) and math ($M = 3.61$) teacher supervisors. Similarly, for the English proficiency, ANOVA (*f*-value: 14.842, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors that are less proficient are less positive toward computers. Lastly, ANOVA results for the level of technology expertise (*f*-value = 18.106, Sig. = 0.000) confirmed that there was a significant difference in the level of technology expertise: weak ($M = 2.80$), average ($M = 3.64$), and advanced ($M = 4.38$). Scheffe's test further showed that each category has different attitude toward the computer skills.

Factor 3: competency for planning an educational situation

For this competency, there were significant differences in terms of educational stage, major, English proficiency, and level of technology expertise. For the educational stage, ANOVA (*f*-value: 10.434, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in the primary stage were the least positive regarding acquiring competencies for planning an educational situation. When results were analyzed by major, the *t*-value = −3.586 and Sig. (2-tailed) = 0.000 confirmed a significant difference between science ($M = 4.22$) and math ($M = 3.84$) teacher supervisors. Similarly, for the English proficiency, ANOVA (*f*-value: 9.353, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors that are less proficient are less positive toward planning an educational situation: weak ($M = 2.57$), average ($M = 3.50$), and advanced ($M = 3.89$). Lastly, ANOVA results for the level of technology expertise (*f*-value = 4.689, Sig. = 0.004) confirmed that there was a significant difference in the level of competency for planning an educational situation.

Factor 4: educational program design competencies

With respect to educational program design competencies, there were significant differences in terms of school district, educational stage, major, years of experience, English proficiency, and level of technology expertise. For the school district, ANOVA (*f*-value: 2.794, Sig.: 0.012) indicated that there is a significant difference between district areas, whereby private education supervisors scored below average, while those from other district areas were above average. Similarly, for the educational stage, ANOVA (*f*-value: 10.630, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in the primary stage were the least positive regarding acquiring educational program design competencies. When results were analyzed by major, the *t*-value = −4.554 and Sig. (2-tailed) = 0.000 confirmed a significant difference between science ($M = 3.65$) and math ($M = 3.01$) teacher supervisors. For the years of experience, ANOVA (*f*-value: 3.606, Sig.: 0.029) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in this role for more than 10 years were less positive about acquiring educational program design competencies. Similarly, for the English proficiency, ANOVA (*f*-value: 9.322, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors that are less proficient are less positive: weak ($M = 2.57$), average ($M = 3.50$), and advanced ($M = 3.89$) Lastly, ANOVA results for the level of technology expertise (*f*-value = 22.664, Sig. = 0.000) confirmed that there was a significant difference in the level of educational program design competencies.

Factor 5: competencies related to the teaching and learning process

For the competencies related to the teaching and learning process, there were significant differences in terms of school district, educational stage, major, years of experience, English proficiency, and level of technology expertise. For the school district, ANOVA (*f*-value: 2.629, Sig.: 0.018) indicated that there is a significant difference between district areas, whereby private education supervisors had an average score, while those from other district areas were above average. For the educational stage, ANOVA (*f*-value: 9.246, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in the primary stage were the least positive regarding acquiring competencies related to the teaching and learning process. When results were analyzed by major, the t-value $= -4.531$ and Sig. (2-tailed) $= 0.000$ confirmed a significant difference between science ($M = 3.68$) and math ($M = 3.08$) teacher supervisors. For the years of experience, ANOVA (*f*-value: 3.838, Sig.: 0.023) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in this role for more than 10 years were less positive about acquiring competencies related to the teaching and learning process. Similarly, for the English proficiency, ANOVA (*f*-value: 9.636, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors that are less proficient are less positive: weak ($M = 2.57$), average ($M = 3.50$), and advanced ($M = 3.89$). Lastly, ANOVA results for the level of technology expertise (f-value $= 24.080$, Sig. $= 0.000$) confirmed that there was a significant difference in the level of competencies related to the teaching and learning process.

Factor 6: assessment and evaluation competencies

For assessment and evaluation competencies, there were significant differences in terms of school district, educational stage, major, years of experience, English proficiency, and level of technology expertise. For the school district, ANOVA (*f*-value: 2.636, Sig.: 0.018) indicated that there is a significant difference between district areas, whereby private education supervisors had an average score, while those from other district areas were above average. For the educational stage, ANOVA (*f*-value: 8.545, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in the primary stage were the least positive regarding acquiring competencies related to assessment and evaluation. When results were analyzed by major, the t-value $= -4.274$ and Sig. (2-tailed) $= 0.000$ confirmed a significant difference between science ($M = 3.64$) and math ($M = 3.05$) teacher supervisors. For the years of experience, ANOVA (*f*-value: 3.865, Sig.: 0.023) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in this role for more than 10 years were less positive about acquiring competencies related to assessment and evaluation. Similarly, for the English proficiency, ANOVA (*f*-value: 9.675, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors that are less proficient are less positive: weak ($M = 2.57$), average ($M = 3.50$), and advanced ($M = 3.89$). Lastly, ANOVA results for the level of technology expertise (f-value $= 23.691$, Sig. $= 0.000$) confirmed that there was a significant difference in the level of competencies related to assessment and evaluation.

Factor 7: competencies related to professional development

For the competencies related to professional development, there were significant differences in terms of school district, educational stage, major, years of experience, English proficiency, and level of technology expertise. For the school district, ANOVA (*f*-value: 3.010, Sig.: 0.008) indicated that there is a significant difference between district areas, whereby Al-Asema district scored high on this factor, while the other district areas were below average. For the educational stage, ANOVA (*f*-value: 8.097, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in the primary stage were the least positive regarding acquiring competencies related to professional development. When results were analyzed by major, the t-value $= -4.338$ and Sig. (2-tailed) $= 0.000$ confirmed a significant difference between science ($M = 3.73$) and math ($M = 3.17$) teacher supervisors. For the years of experience, ANOVA (f-value: 3.046, Sig.: 0.050) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in this role for more than 10 years were the least positive about acquiring competencies related to professional development. Similarly, for the English proficiency, ANOVA (f-value: 10.239, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors that are less proficient are less positive: weak ($M = 2.57$), average ($M = 3.50$), and advanced ($M = 3.89$). Lastly, ANOVA results for the level of technology expertise (f-value $= 29.382$, Sig. $= 0.000$) confirmed that there was a significant difference in the level of competencies related to professional development: weak ($M = 1.44$), average ($M = 3.28$), and advanced ($M = 4.15$).

Factor 8: competencies related to social, ethical, legal, and humanitarian issues

For the competencies related to social, ethical, legal, and humanitarian issues, there were significant differences in terms of gender, educational stage, major, English proficiency, and level of technology expertise. First, according to the independent samples t-test, there was a significant difference between males and females in the level of positivity (t-value $= -2.289$, Sig. (2-tailed) $= 0.023$), whereby males ($M = 3.41$) were more positive than females ($M = 3.07$). For the educational stage, ANOVA (f-value: 13.470, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors working in the primary stage were the least positive regarding acquiring competencies related to social, ethical, legal, and humanitarian issues. When results were analyzed by major, the t-value $= -4.628$, Sig. (2-tailed) $= 0.000$, confirmed a significant difference between science ($M = 3.51$) and math ($M = 3.51$) teacher supervisors. Similarly, for the English proficiency, ANOVA (f-value: 10.812, Sig.: 0.000) indicated that there is a significant difference, whereby Scheffe test showed that supervisors that are less proficient are less positive: weak ($M = 2.57$), average ($M = 3.50$), and advanced ($M = 3.89$). Lastly, ANOVA results for the level of technology expertise (f-value $= 22.473$, Sig. $= 0.000$) confirmed that there was a significant difference in the level of competencies related to social, ethical, legal, and humanitarian issues.

Qualitative results

Due to the COVID-19 restrictions, all focus groups were conducted virtually. The first question inquired into the supervisors' readiness when the COVID-19 pandemic began in terms of the usage of technology. In response, most participants commented on the delays in responding to the crisis due to the ambiguous context in Mach (2020). They also confirmed that they were fully trained to use MS Teams and have trained teachers in acquiring this skill prior to the pandemic. However, no implementation of this technology took place until the crisis enforced the system to reactivate dormant ICT projects. Supervisors working with science teachers were more knowledgeable than their colleagues specializing in math about using technology due to the greater need for extra-curricular activities in these subjects and students' attendance at competitions related to Science, Technology, Engineering, and Math (STEM). Most math supervisors found it difficult incorporating technology into their existing teaching strategies. Supervisors were also invited to share their perspectives regarding the barriers and obstacles associated with the use of technology in the education system of Kuwait. They all concurred that the challenges stemmed primarily from the absence of vision and short-term projects and initiatives. During the discussions, some math as well as science teacher supervisors revealed some misconceptions related to the use of technology. For example, one of the supervisors stated, “Even though we urge teachers to use technology, we need them to prepare their lesson plans and print them so that we track their syllabus on a weekly basis.” None of the supervisors was familiar with all the features of MS Teams, and most were unaware that teachers can save all of their work digitally without having to print the materials and wait for a traditional visit.

In sum, supervisors at all levels expressed that they have an excessive workload and may need additional training, especially on leadership, mentoring, and communication skills related to remote learning. They also noted that those in charge of communication across different departments (such as staff members responsible for curriculum, assessment, and development) should also be part of the team, as supervisors should be supported and enriched consistently. They further expressed that their workload had doubled during COVID-19 pandemic, causing burnout, as representatives of other sectors were not adequately involved in planning or training.

Moreover, during COVID-19, neither the supervisors, nor the school leaders were involved in any of the decisions related to the nature and mechanisms of distance education and learning. This failure to engage specialists that are directly involved in the educational process would have adverse ramifications for the entire educational process, including students, teachers, and parents. As all decisions were made by the higher leadership in the Ministry of Education, technical guidance and study stages were required for implementation, which took time and delayed the entire process. Seeking help from educational specialists would have certainly expedited adoption of online tools and platforms, since they are more knowledgeable about all educational stages and related requirements.

Discussion

The pandemic has changed the way education is received and imparted. The pandemic did not give the MOE much time for planning, as many scenarios must be anticipated and more than one plan must be provided to ensure continuation of education and improve its quality.

It seems that ICT has not yet been integrated into the Kuwaiti education system in a systematic and organized manner. Ample body of evidence indicates that ICT must be integrated with innovative teaching practices that are supported by the school’s vision and strategy, where school leaders and technical supervisors provide a rich learning environment.

The questionnaire was not meant to purely develop theoretical knowledge; however, it was to place a noticeable point on training practices. The questionnaire context required responses which were supposed to facilitate the decision making process. This mixed method approach turned out to be both valuable and productive. The qualitative phase of this study further revealed that science supervisors were better equipped for integrating technology into education compared to their colleagues focusing on mathematics, indicating that additional training is needed to ensure that all supervisors acquire the necessary level of e-competencies. Analyses also uncovered a seemingly inverse relationship between years of experience and confidence in using technology. Similarly, gaps emerged between supervisors from private Arabic schools and those working in public school districts, as private Arabic schools lack the resources and supports needed for integrating technology into their teaching practices. Therefore, their owners need to raise the standards and quality. Limited English proficiency was also identified as another barrier for technology adoption, as some courses are taught in English, and most ICT tools are written in English, and thus, require proficiency in this language.

Discussions during focus groups similarly revealed that the quality and relevance of supervisor-provided training courses and workshops is mixed, that they tend to be theoryoriented, general and generic in orientation, and inadequately target the pedagogical content knowledge needed for the effective teaching of individual subjects and the needs of the teachers involved. Fullan (1991) commented on such isolated training, "Nothing has promised so much and has been so frustratingly wasteful as the thousands of workshops and conferences that led to no significant change in practice when teachers returned to their classrooms" (p. 200). The whole approach runs counter to the research evidence on effective professional development for teachers, as discussed below.

Conclusion and recommendations

The aim of this study was to measure the math and science supervisors' perspective related to ICT competencies during COVID-19 period. While the study findings do not present a blueprint for action, nor were they intended to, it is hoped the analyses and recommendations provided therein will help identify the first steps towards the provision of a roadmap for the ICT professional development of teachers in Kuwait and provide a basis for the formulation of policies on which Teacher Support can be built (Dogan *et al.*, 2020). The reality of educational supervision and development in Kuwait is that supervisors are overworked and have to mentor a large number of teachers. Therefore, they may need additional training in leadership and mentoring to improve their performance. In addition, there is a need for a better communication system with the representatives of curriculum and assessment, and development departments, and among supervisors. Supervisors should be supported and enriched consistently from both departments which will require better communication. On the other hand, initiatives aimed at integrating technology must be based on innovative teaching practices, as well as actively supported by school leaders who perceive technology as a vital tool for deeper engagement in learning (Ifinedo *et al.*, 2019). Research indicates that educational change only takes place when teachers are allowed to own and drive the change. Teachers embody the culture and the purpose of a school, and when properly supported and inspired, they are more capable of transforming the education system with their energy and ideas focused on global e-learning.

Recommendations to Support Education Leadership.

The following recommendations can be offered based on the study findings:

(1) Provide a highly efficient technological infrastructure supplemented by provision of continuous training aimed at teachers' professional skills that will enhance their capabilities to integrate ICTs in learning, instructional management, and organization.

(2) Create an accreditation body that oversees the design and implementation of training programs and the application of high standards for the selection of teachers in teacher training colleges based on robust merit-based selection criteria.

(3) Coordinate with training providers in forecasting the future professional development needs related to the adoption of technology in education.

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