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Professional Development Needs and Challenges Faced by K-12 Teachers in Delivering Effective Online Education in the United Arab Emirates

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Abstract. During the COVID-19 outbreak, online mode of education, schooling from home and the absence of any fully operational educational facilities became the new norm of the education sector, mainly when the pandemic reached its peak. The transition to online teaching for the K-12 teachers in the United Arab Emirates (UAE) was made seamless. The Ministry of Education (MoE) extended its full support to schools, nationwide. For the transition to be sustainably effective, there was the need to examine the professional development needs of the K-12 teachers and the possible challenges that they may confront. This study, therefore, explored the challenges of adopting online education and professional development (PD) needs of K-12 teachers in the UAE. The study employed a descriptive research design using a well-developed and validated survey to collect quantitative and qualitative data involving 1,110 teachers and focusing on their shared and subjective views. Data analyses were done using a variety of descriptive statistics for the closed-ended questions and thematic coding of the open-ended questions. The

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results reveal significant differences between the surveyed teachers' as they recognized their needs, the application of emerging trends in online education, and perceived challenges due to the teacher's grade levels (educational level). The study suggests the need to customize professional development training for K-12 teachers based on their grade levels, exposing them to cutting-edge technologies and other mentoring schemes, as a method of preparing them to combat the challenges.

Keywords: online education; professional development needs and challenges, public school teachers, online pedagogical trends, UAE

1. Introduction

One of the pillars of the National Agenda in accordance with the UAE Vision 2021, is providing world class and state of the art educational systems. The UAE strategic vision l is to enable their students rank among the best in the world in reading, mathematics, science, and Arabic language proficiency. The role of a teacher, whether it is in a face-to-face or online teaching environment, is undoubtedly to create an immense impact on the learners. Several studies during the pandemic revealed the role of a teacher as acting as a motivator in creating a positive impact on students' learning abilities (Aderibigbe, Dias, & Abraham, 2021; UNESCO, 2020). The creativity and innovativeness toward adopting innovative teaching and learning methods for coping in different educational landscapes demand that the teachers remain lifelong learners open to the concept of their professional development (PD).

In the COVID-19 era, online education seems to be the only viable option to cope with such unforeseen events. However, the transition to online teaching requires specialized skills, which need to be learned and practiced, thereby strengthening the proficiency of the teachers to be able to incorporate the new educational technologies. As the literature indicates, successful online education requires special skills such as creating creative and innovative e-content, timely and appropriate planning, and the capability to use the technology (Adnan, 2017; Nachimuthu, 2012). The transition to online education in schools and higher education institutions due to COVID-19 posed several challenges for teachers and students worldwide. Philippakos et al. (2022) discusses challenges related to online instruction, including student participation, engagement, and motivation, lack of resources, and limited access to professional development. The article highlights the importance of teacher preparation programs to adequately prepare teachers to effectively deliver instruction online and select appropriate tools for their learners. The impact of prior training and experience with online instruction on teachers' efficacy and readiness to provide remote instruction is also discussed. These challenges and the need for teachers' PD skills during and after the pandemic have been noted in the literature, including in studies conducted in the UAE (Kamble et al., 2021). Therefore, it is crucial for educational planners and stakeholders in the UAE to develop strategies that address these challenges and enhance teachers' PD skills in online education.

The literature review had shown evidences that the effort for a smooth transition to online teaching and learning modes have been noticeable in the UAE. To cite a

few examples, the Mohammed Bin Rashid Smart Learning Program (MBRSLP) focused on providing the latest technology for creating smart learning environments in the UAE schools. It also provides resources, including smart interactive whiteboards, tablets for students, and access to high-speed 4G networks (Gokulan, 2014). Buckner et al. (2016) also found that teachers in the UAE have high participation rates in their PD activities. Enhancing teachers' PD skills and reducing challenges in online education during pandemics require research-driven and evidence-based practices.

Against this juncture it is imperative to mention that this research explored the K-12 teachers' PD needs and the challenges faced while delivering online classes during COVID-19 in the UAE context. The authors contend that this study provides insights for developing a framework to address teachers' PD needs and challenges that have the possibility to hinder their effective online teaching in emergencies. The study also complements the existing body of literature and knowledge globally on issues surrounding online education and teachers' PD needs during a pandemic.

2. Objectives of the Study

With the help of this study, the researchers aimed to gain an in-depth understanding of the PD needs of K–12 teachers and the challenges they may face in online education settings. The objectives of the study are:

1. Identify the PD needs of K–12 teachers in the UAE context.
2. Explore the extent to which the K–12 teachers in the UAE are familiar with the emerging trends and applications in online education.
3. Examine the challenges teachers may face when adopting online education models in the UAE's K–12 settings.
4. Determine the extent to which the K-12 teachers' educational levels impact their PD needs, familiarity with emerging trends in online education and challenges they may face in online education.

3. Research Questions

With the evolution of innovative teaching techniques, and platforms due to the COVID-19 pandemic, the concept of PD needs special attention. Efforts should be exerted to train teachers in acquiring the required technological skills, as the COVID 19 has exacerbated the gaps in the teaching and learning methods and that of PD needs of teachers. This study was conducted to answers to the following questions:

1. What are teachers' professional needs required to deliver effective online education in the UAE's K–12 contexts?
2. To what extent are the teachers in the UAE's K–12 settings familiar with the contemporary trends in online education?
3. What challenges hinder the effective adoption of online education by the K-12 teachers in the UAE?
4. Are there any significant differences between teachers' perceptions of their PD needs based on their educational level (grade level)?

4. Significance

Although teachers in the UAE are generally exposed to PD workshops organized by schools, educational zones, and sometimes by the Ministry of Education, these workshops need to be regularly revised in line with the changing needs and contexts of teachers and their students. Thus, efforts need to be intensified in unravelling the different needs of teachers and providing a variety of training opportunities for teachers in line with their needs and teaching contexts. For the programs to be effective, program planners ought to contextualize the information clarifying the specific needs of the teachers. This study provides information on which training conducted by the program planners can customize development initiatives for public school teachers in the UAE.

As the educational landscape evolves, teachers need to be supported to keep pace with innovative technologies that would lead to success in technological integration, conforming to technological models such as Technological Pedagogical Content Knowledge, (TPACK), Substitution, Augmentation, Modification (SAM), and Analyze Learners, State Objectives, Select Methods, Utilize Media and Materials, Require Learner Participation, and Evaluate and Revise, (ASSURE). This endeavour is crucial as blended and online learning and teaching have become integral parts of the educational system and have gained paramount importance. This study also offers training planners the insights and information for organizing development training to adequately assist teachers with the technology and pedagogical skills needed in such an environment.

5. Literature Review

Online education refers to teaching and learning using the internet, enabling that all teaching materials are provided to students online (Kisanjara, 2020; Yusuf & Jihan, 2020). The shift from traditional teaching to online learning is challenging for teachers and curriculum designers alike; however, it could even result in an opportunity that teachers may benefit from (Ortiz, 2020). Needless to say, it is also recognized as a teaching model that promotes dynamic learning approaches (Yusuf & Jihan, 2020) and has gained the attention of many institutions due to its numerous advantages (Dwiyogo & Radjah, 2020; Limperos et al., 2015). As a pedagogical approach, online education is growing at a fast rate at the K–12 levels (Barbour & Harrison, 2016; LaFrance & Beck, 2014). Despite such rapid growth the success of the online mode of teaching depends on the teachers' skills to use this approach efficiently and effectively (Yusuf & Jihan, 2020).

Teachers are thus required to master their skills through PD activities, including workshops and independent learning (Sulisworo et al., 2016; Zhou et al., 2020). There are numerous PD programs that are helping teachers to prepare for their jobs. Successful components of PD programs may additionally enhance teachers' competencies since they have become imperative for online learning (Candice, 2019). Online learning can only be achieved when the teacher can: '(a) convey knowledge with limited face-to-face contact, (b) design and develop course content in a technology-based environment, (c) deliver content in a way that will engage students, and (d) use assessment measures to ensure that students are enable to master the content' (Archambault & Kennedy, 2018, p.221).

As online education continues to grow, so are the rewarding opportunities for continuing PD for K–12 online teachers (Farmer & West, 2019). Teachers' acceptance of and readiness to adopt ICT in classroom practices has shown a gradual increase (Alawani, 2019; Ghavifekr et al., 2013). Despite this, teachers' effective use of ICT may be severely impaired if they are not provided with adequate PD training and support (Alawani, 2019; Almekhlafi & Almeqdadi, 2010; Aubusson et al., 2009). According to Barbour, Miron and Huerta (2017) teachers' effective preparation for online teaching is the only solution to ensure an effective online delivery mode of instruction. This is because research evidence studied in the literature review indicated that students in a virtual setting tend to underperform compared to their counterparts in the face-to-face mode. Based on Philippakos et al.'s (2022) findings, there is a widespread perception that online classes do not measure up to the face-to-face classroom experience. However, the authors suggest that this perception can be overcome by comprehending the inherent nuances between the two environments. The technology provides both a platform and an opportunity for learning activities to take place in an online environment to achieve the same learning objectives. As such, it is possible for students to perform well in a virtual setting if the necessary support and resources are provided.

Researchers have proposed strategies to succeed in online teaching. Hertz (2020) proposed the Hertz Quality Teaching Attributes teaching model, it guides teachers to use an entire set of different tools and not to think about it merely as a change of medium of instruction. Tertiary courses using learning management systems tend to be teacher-centred and lecture-based (Vercellotti, 2018). To avoid this in online classes, Awasthi (2020) suggested initiating more than one online channel to communicate with students might be a solution to such an issue. He further suggested that teachers and students should dress formally as they would in conventional classes. Teachers might use a Bluetooth headset and mic to give the students an impression of being active and energetic. The importance of building positive relationships with students comes into play when teaching online. Students may be given a break after every 30 or 40 minutes to engage in a conversation about their well-being, helping them feel relaxed and thereby building a positive relationship with them (Awasthi, 2020; Hertz, 2020).

Borup et al. (2014) suggested six elements to improve student outcomes in online learning. These elements include designing and organizing learning activities, facilitating discourse with students, parents and other teachers, providing students with one-on-one instruction, nurturing a safe and caring learning environment, motivating students to engage in learning activities, and monitoring student behaviour and learning as a close-knit cohort.

Barbour and Harrison (2016) mentioned teachers' perceptions of the K–12 online learning and that the K–12 school administrators and other stakeholders do not have sufficient knowledge or are themselves prepared to support the K–12 online learning. Teachers, showed enthusiasm about developing the skills required for implementing online teaching. Husain, Natasya and Basri (2019) found that the teachers believed that online education assisted them and their students in developing ICT competencies. Drawing on their study, they suggested conducting continuous training to increase their ICT competencies including

skills to conduct successful and effective synchronous and asynchronous sessions once the pandemic is over. With the increased demand on adopting and applying Artificial Intelligence (AI) and intelligent tutoring systems in the educational and in the training contexts, teachers and faculty may face challenges if they are not prepared or trained professionally and effectively (Abdelaziz, 2019; Abdelaziz & Al Zehmi, 2020).

As teachers may not possess adequate knowledge, skills, and confidence to use the available technologies effectively or efficiently to support technological integration into the learning environment, PD activities becomes crucial and essential (El Fadil, 2015; Ferdig & Kennedy, 2014; Somera, 2018). Essentially, teachers' PD needs should be met by focusing on their ability to know why, where, when, and how technology tools can be used to achieve teaching objectives and facilitate students' learning (Gu et al., 2012; UNESCO, 2002).

6. Methods

Research Design

The study employed a descriptive research design as it helped in exploring an existing condition and situation of individuals within a specific context (Creswell, 2014). Specifically, this research design assisted in exploring K-12 teachers' shared and subjective understanding of the issues related to their professional development needs and the challenges experienced by them during COVID-19.

Research Instruments

The research team adopted a multi-rating scale questionnaire to collect information for addressing the research questions in the study. The questionnaire consisted of four parts, with the first section devoted to the demographic data of the participants and consisted of five main items. In the second section of the survey (Professional Needs Assessment), a four-point Likert scale was used to assess the felt need of the participants. Response choices were: 1= No need at all, 2= Low level of need, 3= Moderate level of need, 4= Highly needed, 5= Extremely high need. In the third section of the survey, participants were given a list of challenges that may or may not apply to them. They were asked to select the challenges that apply to them. This section was followed by an open-ended question to give the participants to add other challenges, if any. In the fourth section of the survey (Emerged Digital Learning Trends), a four-point Likert scale was sued to assess the awareness level of the participants. Response choices were: 1= Not familiar, 2= Familiar but I have not tried it, 3= Familiar but I need support to Adopt it, and 4= Familiar and Adopt it. The distributed survey has been showcased in Appendix A.

Population and Sample

The study targeted all schools that had migrated to an online mode of education due to the spread of COVID-19. According to the UAE Ministry of Education (MoE), the total number of public school teachers in 2020 was 21,153, representing 619 schools (MoE, 2020). The study targeted a sample of 1400 teachers. Purposive and random sampling techniques were used to reach out to teachers with relevant experience. All teachers were offered the chance to participate and share their thoughts on the issues under exploration. A total of 1,110 public school teachers

responded and completed the survey. Table 1 shows the demographic characteristics of the participants.

Table 1. Participants' Demographic Characteristics and Size (n = 1110)

Variable	Sample Size
Gender	N
Male	421
Female	689
Level of Education	
Pre-school (kindergarten)	114
Elementary Education	231
Primary Education	291
Secondary education	474
Field of Specialisation	
Math	187
Science	212
Art	35
Drama	7
Arabic	186
Islamic Studies	61
Social studies	54
English	108
Business studies	10
Other	250
Years of experience	
Fewer than 5 years	175
Between 6 and 10 years	207
Between 11 and 15 years	226
Between 16 and 20 years	200
More than 20 years	302
Qualifications	
Bachelor	396
Bachelor's in education	311
Postgraduate Diploma in Education/Teaching	97
Master's degree in Education	97
Master's degree in other fields	138
PhD or Ed.D in Education	25
Other Degree	46

As can be seen from Table 1, most participants were female (62%). The number of participants from secondary education was higher than that of participants from other grade levels. Science education teachers represented approximately 20% of the sample. It is evident in the table, that participants were from all streams. Similarly, participants had varied years of teaching experience extending from 5 to 20 years. Regarding the education qualification of participants, 36% had BA degrees, while 2% had doctoral degrees.

Data Collection

An electronic version of the questionnaire was sent to all the public-school teachers in the UAE through the MoE using its teachers' management information

system platform. The MoE portal was used due to its potential to help reach out and collect data from as many teachers as possible. However, teachers were not mandated or forced to participate in the study and other ethical factors were considered, as clarified below.

Reliability and Ethical Considerations

The research instrument (questionnaire) was validated through an iterative and collaborative process of reviewing and revising the questionnaire's contents among the researchers. In doing this, the first author crafted the initial draft and then shared it with the other authors, who read and provided feedback to validate the questionnaire items. To establish the content reliability, the survey was distributed to a random sample consisting of 141 public school teachers. The Cronbach's Alpha was 0.929, which indicates that the survey is reliable and has the required consistency to accurately collect data.

All procedures involved in this study were conducted following scientific organizations' ethical practices and approved by both the MoE and the Institutional Research Ethics Committee of Hamdan Bin Mohammed Smart University (Ethical Clearance Code). The participants' consent to participate and confidentiality in the data collection process were recorded.

Data Analysis

As mentioned earlier, 1,110 K-12 teachers responded to the survey. Partial responses were included for only the questions answered, with no further treatment of missing values. Of the two possible open-response questions, question one was answered by 860 respondents, yielding 573 responses after initial data cleaning. The data cleaning criteria were: exclude the survey with missing response to a survey item in the dataset, and through review of any data entry errors. The second open-response question was answered by 685 respondents, generating 351 responses after the initial cleaning.

After cleaning and sorting responses by question, the researchers conducted a range of descriptive and inferential statistical analyses using the SPSS. Tables of frequencies and percentages were used to present categorical variables; means, independent sample t-test, One-way ANOVA were used to test for the differences between pairs of categorical variables. Qualitative coding of themes was conducted based on the responses to the two open-ended questions, following an inductive process (Corbin & Strauss, 1990; Saldana, 2015). The following stages were followed: open coding, axial coding and selective coding to ground the major patterns and themes addressing other PD needs felt and perceived by the public-school teachers to deliver and assess effective online education in the UAE K–12 educational contexts.

7. Findings

Findings related to question 1

To answer question 1 'What are the teachers' PD needs to deliver effective online education in the UAE K–12 contexts?', the researchers computed the frequencies, percentages, means and weighted means for each item included in section two in the survey. As shown in Table 2, the respondents indicated a range of PD needs for public school teachers to deliver and assess effective online education in the UAE's K–12 educational contexts.

Table 2. Percentages and Means of The UAE Teachers' Professional Development Needs

#	Items	Rating Scale*					Mean	Means Weight
		No need at all (1)	Low need (2)	Moderate need (3)	High need (4)	Extremely high need (5)		
1	Design and manage the interactive learning environment to encourage learners' engagement	5.2%	15.1%	32.4%	31.8%	15.4%	3.37	67.4%
2	Use next-generation online learning pedagogy	7.0%	13.5%	33.5%	30.0%	16.3%	3.36	67.2%
3	Design and manage the online collaborative learning environment	7.1%	15.3%	33.1%	30.3%	14.2%	3.29	65.8%
4	Use online assessment tools with immediate built-in feedback feature	9.7%	16.0%	30.0%	27.7%	16.7%	3.26	65.2%
5	Use cloud computing and open learning spaces to manage learner's files and projects	10.0%	16.0%	29.3%	30.0%	15.0%	3.24	64.8%
6	Design and manage effective online assessments and activities	10.6%	14.4%	31.6%	27.8%	15.5%	3.23	64.6%
7	Encompass state-of-the-art online learning platform and Learning and Content Management Systems (LCMS)	9.3%	17.2%	31.2%	26.0%	16.3%	3.23	64.5%
8	Design and deliver e-content in small micro-objects	8.6%	15.8%	34.1%	28.0%	13.6%	3.22	64.4%
9	Create and manage personalized learning environment	8.0%	16.5%	36.2%	26.3%	13.0%	3.20	64.0%
10	Create and manage digital teaching portfolio	11.6%	16.7%	30.4%	24.6%	16.7%	3.18	63.6%
11	Integrate open educational resources	9.6%	17.3%	33.3%	25.7%	14.1%	3.17	63.4%
12	Integrate new innovative mobile technologies into classroom teaching	8.1%	18.7%	36.7%	22.2%	14.2%	3.16	63.2%

#	Items	Rating Scale*					Mean	Means Weight
		No need at all (1)	Low need (2)	Moderate need (3)	High need (4)	Extremely high need (5)		
13	Use social media networks to promote learning	18.4%	20.0%	27.8%	20.0%	13.8%	2.91	58.2%

To effectively identify the critical PD needs for the K-12 school teachers in the UAE, and to deliver effective online education and transfer to a distance learning model, the researchers suggested a hypothesized cut-off point of 60% for the weighted means. If the weighted mean for each item in Table 2 is equal to or greater than 60%, then the PD need is critical. More than 50% of the surveyed participants feel they need to be trained in how to master this competency. According to the weighted mean values for each item shown in Table 2, 12 critical PD needs are considered essential by the public-school teachers in this study.

To complete the answer to research question 1, the researchers performed qualitative coding of themes based on the responses to the first open-ended question attached to section 2 in the survey. This open-ended question states 'Please use this space to tell us about any other PD needs you feel are important for you, that we did not mention in the above list'. This question was answered by 860 respondents (77% of the sample size), yielding 573 responses. The subthemes (patterns) and major themes yielded from this analysis are presented in Table 3.

Table 3. The Patterns and Major Themes of the Open-Ended Question #1 (Other Professional Development Needs)

Patterns, *How to…*	Major themes	Professional development tracks
Use differentiated online learning strategies	Differentiated and personalised e-learning design and strategy	Effective e-learning pedagogy
Develop responsive learning objects that address learning styles		
Personalize the online learning experience		
Use online learning platforms for learners with special needs		
Manage online learning classroom and online learners' behaviour	Managing online classroom and collaboration	
Manage online collaborative and distributed problem-solving		
Motivate and encourage parents' involvement in online learning		
Develop educational gamification and animation in specific subject areas	Utilization and integration of interactive technology application in teaching and learning	Effective e-content design and learning technologies
Use online instructional tools and resources such as Nearpod or Wordwall, Edushare		
Use AI educational applications		
Use Blender software for creating animations		
Use augmented reality in content-specific areas/subjects		
Design experiential learning for content-specific online pedagogy	Design interactive and experiential e-content/lesson	
Integrate online field trips and virtual labs in the daily lessons		
Create a step-by-step video bank (objects) on guided instruction		
Develop agile e-content/lesson		

Collect and analyze online assessment evidence	Design and effective online assessment	Effective online assessment strategies
Use learning analytics to track and improve students' discussion quality and quantity		
Design online test- and assessment-based standards		
Use/implement online students' progress tracker		

Findings related to question 2

To answer question 2, 'To what extent are the teachers in the UAE's K–12 familiar with the contemporary trends in online education?, the researchers computed the frequencies and percentages for each item included in Section four in the survey. Section 4 has 18 items addressing the most frequently mentioned online and digital learning trends in relation to the literature that was reviewed of the last three years. It outlined the important training needs and tracks for teachers and faculty in schools and higher education institutions worldwide. The frequencies and percentages of the UAE public school teachers' level of familiarity with online and digital learning trends are as shown in Table 4.

Table 4. Percentages of Adoption and Non-Adoption of the Online and Digital Learning Trends

#	Digital Learning Trends, Techniques and Tools	Rating Scale*				Total Percentage of Not adopted
		Not adopted			Adopted	
		not familiar	familiar but have not tried it	familiar, but I need support and training to adopt it	familiar and adopt it	
1	Hybrid (blended) courses (with over 50% delivered online and in-person)	4.5%	13.1%	27.1%	55.3%	44.7%)
2	Augmented reality (AR)	11.7%	16.1%	34.1%	38.1%	61.9%
3	Virtual reality (VR)	6.0%	15.0%	35.1%	43.9%	56.1%
4	Experiential e-learning	6.1%	7.7%	30.6%	55.6%	44.4%
5	Avatar-based coaching	17.6%	12.0%	36.4%	34.1%	65.9%
6	Agile design for e-lessons	16.2%	9.6%	33.7%	39.7%	60.3%
7	Adaptive electronic testing and Assessment	7.7%	10.5%	33.6%	51.4%	48.6%
8	Intelligent tutoring systems (ITS)	14.3%	7.7%	35.6%	43.3%	56.7%
9	Automated pedagogical agents (APA)	20.8%	9.2%	36.7%	33.3%	66.7%
10	Multi-tasks learning objects	10.1%	8.6%	30.0%	51.4%	48.6%
11	Machine learning	25.0%	13.3%	34.2%	25.4%	74.6%
12	Learning analytics	15.7%	12.4%	36.8%	35.1%	64.9%
13	Seamless learning	20.7%	11.7%	31.0%	36.7%	63.3%
14	Crowd learning	21.0%	12.6%	33.9%	32.5%	67.5%
15	Learning by making/design	26.5%	16.4%	35.2%	21.9%	78.1%
16	Create an e-learning profile and aptitudes inventory	20.1%	13.6%	38.0%	28.3%	71.7%

17	Infographic presentation design software	19.6%	14.6%	38.6%	27.2%	72.8%
18	Online learning communities	4.9%	7.7%	23.3%	61.0%	39%

*The rating scale for this section is as follows: 4 = Not familiar at all, 3 = Familiar but have not tried it, 2 =Familiar but I need support to adopt it, 1 = Familiar and adopt it

For effective analysis based on the available data and responses collected for question 2, the researchers did the following:

1. Combined the first three points in the scale: Not familiar, Familiar, but I have not tried it, and Familiar, but I still need support and training to adopt it to address the trends that are not adopted (non-adoption) by the public-school teachers in the UAE.
2. Compute participants' response frequencies and percentages on each item.
3. Suggest a hypothesized cut-off point of 60%.
4. Compare the percentage of familiarity and adoption with the combined percentages of non-adoption. If the total percentage of non-adoption is equal to or greater than 60%, then the contemporary trends of online and digital learning are critical since more than 50% of the surveyed participants infer that they need to be trained in it.
5. Identify and prioritize the trends that the majority of public-school teachers in the UAE are not adopting.

According to the data presented in Table 4, one can conclude that out of the 18 critical trends of online and digital learning; there are 11 trends that the UAE public schools' teachers are neither familiar with nor adopting into teaching and learning. Thus, they feel that they need to be trained in how to master them. These 11 trends are: Learning by Making/Design (78%), Machine Learning (74.6%), Infographic Presentation Design Software (72.8%), Creating an e-Learning Profile and Aptitude Inventories (71.7%), Crowd Learning (67.5%), Automated Pedagogical Agents (APA) (66.7%), Avatar-based Coaching (65.9%), Learning Analytics (64.9%), Seamless Learning (63.3%), Augmented Reality (AR) (61.9%) and Agile Design for e-Lessons (60.3%).

Findings related to question 3

To answer question 3, 'What challenges hinder the effective adoption of online Education by public sector teachers in the UAE?', the researchers computed the frequencies and percentages for each item included in section three in the survey. The frequencies and percentages of the challenges of adopting online and digital learning perceived by the UAE public school teachers are shown in Table 5.

Table 5. Frequencies and Percentages of Challenges That Hinder the Effective Adoption of Online Education

	Challenges	**Yes, Applies to Me**		**No, It Does Not Apply to Me**	
		N	**%**	**N**	**%**
1	Getting students to complete assignments	752	68%	358	32%
2	Getting students to complete the online activities on time	742	67%	368	33%

3	Ensuring that students understand what it takes to succeed online	711	64%	399	36%
4	Structuring learning activities that foster student–student interaction	705	63%	405	37%
5	Keeping students engaged throughout the online course	695	63%	415	37%
6	Identifying and supporting struggling students	693	62%	417	38%
7	Gathering feedback from students to improve the learning experience	675	61%	435	39%
8	Using specific strategies to create an instructor presence in the course	670	60%	440	40%
9	Structuring my course for best online experience	652	59%	458	41%
10	Familiarity with effective pedagogy for online teaching	627	56%	483	44%
11	Giving students constructive feedback in a timely manner	623	56%	487	44%
12	Developing an online lesson or course can be complicated	610	55%	500	45%
13	Inadequate time to learn about online teaching and assessment	546	49%	564	51%

To effectively identify the critical challenges that hinder the effective adoption of online education perceived by the public school teachers in the UAE, the researchers suggested a hypothesized cut-off point of 60% of the participants. If the challenge is seen by at least 60% of participants, it addresses a critical issue.

According to the data presented in Table 5, one can conclude that eight major challenges were perceived by the majority of the public-school teachers in the UAE that inhibited them from the effective adoption of online education.

To complete the answer to research question #3, the researchers performed qualitative coding of themes based on the responses to the second open-ended question attached to section 3 in the survey. This open-ended question states 'Please use this space to tell us about any other challenges you think you are facing, that we did not mention in the above list', was answered by 685 respondents (62% of the sample size), yielding 351 responses after initial data cleaning. The subthemes (patterns) and major themes yielded by this analysis are presented in Table 6.

Table 6. The Subthemes and Major Themes of the Open-Ended Question #2 (Other Challenges and Barriers)

Subthemes (Patterns), How to…	Major Themes/Challenges
Increase students' engagement in online sessions	Students' and Parents' Motivation and Engagement
Increase students' parents' interaction	
Motivate learners to complete activities and assignments on time	
Promote Parents/Teachers/Learners' presence	
Manage time of online sessions	Time and Online Classroom Management
Use behaviour management strategies during the online lesson	
Strike a balance between work and life for well-being	
Monitor the learning of individual learners during the lesson	
Apply micro teamwork and collaboration during the time frame of a session	
Deal with learners' individual needs	
Support online learners when they face interaction problem	Online Learning Support
Promote self-paced learning skills among online learners	
Overcome isolation and student attendance issues	
Interact with special needs learners (with learning disabilities)	
Reduce learning load	
Ensure authentication of exam and work done remotely	Online Learning Assessment and Authenticity
Collect evidence about students' performance	
Measure online learning effectiveness	
Give individual constructive feedback to students whose parents are doing the work for them	
Apply student self and peer assessment	
Prepare interactive lesson	e-Content Pedagogical Design
Redesign and align the curriculum for effective online learning	
Use specific strategies for effective online learning	
Search for and integrate professional and subject-specific open educational resources that support teachers and learners	
Overcome language barriers in online learning environments	Technical and Language Challenges and Barriers
Solve technical and platform access limitations and problems	

Findings related to question 4

To answer question 4, 'Are there any significant differences between the teachers' perceptions of their PD needs based on their educational level (grade level)?' the researchers conducted a one-way ANOVA test. The researchers limited the analysis to one demographic characteristic, which is the level of education (grade level) among the teachers, since this variable has not been completely addressed in the previous literature.

Table 7. One-Way ANOVA Investigating the Relationship Between Grade Level and PD Needs, DL Trends and Perceived Challenges Among Public School Teachers

Dep. Variable	Ind. Variable: Grade Level	Descriptive Statistics			One-way ANOVA Test Results				
		N	Mean	Std.	Sum of Squares	df.	Mean Square	F Value	P
Teachers' PD needs	Pre-school (Kindergarten	114	40.904	11.195	Between Group = 1728.408	3	576.136	3.644	0.012
	Elementary Education (Cycle 1)	231	42.680	12.499	Residuals = 174854.731	1106	158.097		
	Primary Education (Cycle 2)	291	43.447	11.978					
	Secondary Education	474	40.612	13.259					
Familiarity with Emerging Trends	Pre-school (Kindergarten	114	39.105	14.066	Between Group = 1498.514	3	499.505	2.993	0.030
	Elementary Education (Cycle 1)	231	36.926	14.152	Residuals = 184592.229	1106	166.901		
	Primary Education (Cycle 2)	291	35.175	12.183					
	Secondary Education	474	35.719	12.434					
Perceived Challenges	Pre-school (Kindergarten	114	16.895	4.027	Between-Groups = 362.282	3	120.761	6.132	< .001
	Elementary Education (Cycle 1)	231	18.030	4.454	Residuals = 21781.852	1106	19.694		
	Primary Education (Cycle 2)	291	17.852	4.465					
	Secondary Education	474	18.719	4.506					

Table 7 demonstrates the results of a one-way ANOVA test to identify the differences between the UAE public schools' teachers according to their grade level (Pre-school (Kindergarten), Elementary Education, Primary Education, and Secondary Education). The independent variable was the grade level with four categories. The dependent variables were: Teachers' PD needs level, familiarity

with emerging trends and applications of online education and perceived challenges hindering effective adoption of the online education mode in the UAE public schools.

This analysis revealed a significant effect for participants' grade level on their PD needs level, $F(3, 1106) = 3.644$; $p = 0.012$. The Tukey HSD (Post Hoc) test showed that teachers in Primary Education (Cycle 2) scored significantly higher than teachers in Secondary Education ($p = 0.013$). There were no significant differences between teachers in the Pre-school (Kindergarten), teachers in the Elementary Education (Cycle 1), and teachers in the Secondary Education.

This analysis also revealed a significant effect for participants' grade level on their familiarity with emerging trends and applications of online education, $F(3, 1106) = 2.993$; $p = 0.030$. The Tukey HSD (Post Hoc) test showed that teachers in the pre-school (Kindergarten) scored significantly higher than teachers in the primary education (Cycle 2) ($p = 0.031$). There were no significant differences between teachers in the pre-school (Kindergarten), teachers in elementary education (Cycle 1) and secondary education.

This analysis also revealed a significant effect for participants' grade level on their perceived challenges hindering effective adoption of online education, $F(3, 1106) = 6.132$; $p < 0.001$. The Tukey HSD (Post Hoc) test showed that teachers in the secondary education scored significantly higher than teachers in pre-school (Kindergarten) ($p < 0.001$) and teachers in the primary education (Cycle 2), (p 0.044). There were no significant differences between pre-school teachers (Kindergarten) and teachers in the elementary education (Cycle 1).

8. Discussion

The analysis of quantitative data related to question 1 revealed that 12 critical PD needs were considered vital by the K–12 public school teachers in this study. The highly ranked PD needs identified by 65% of the public-school teachers for effective delivery of online education are: 1) design and manage interactive learning environments to support learners' online engagement; 2) use next-generation online pedagogy; 3) design and manage online collaborative learning; 4) use online assessment tools and 5) use cloud computing and open learning spaces to manage learners' files and projects. This finding is in line with the generated themes from the first open-ended question. Most of the surveyed teachers who answered this question felt they need professional and practical training on the following: Managing the online classroom and collaboration; Designing and managing effective online assessment; Designing interactive and experiential e-content/lessons and utilizing personalized e-learning design and strategy. These findings reinforce the need for PD endeavours for teachers in technology-enabled teaching and learning contexts (El Fadil, 2015; Ferdig & Kennedy, 2014; Somera, 2018). For effective and customized PD activities, one can conclude that over two-thirds of respondents in this study identified 'promoting learners' engagement through interactive online learning space, smart and personalized pedagogy, online assessment techniques, and online collaborative learning strategies' as areas in which they want PD. These results were consistent with other studies emphasizing that online teachers in the context of K–12 schools must be able to design and develop content in a technology-enabled learning

environment (Archambault & Kennedy, 2018; Awasthi, 2020; Somera, 2018; and Sulisworo et al., 2016). Beyond this, they must also be able to deliver content through dynamic pedagogies and approaches that promote students' engagement, use assessment measures to ensure that students master content, while utilizing more than one online channel to communicate with students and their parents (Archambault & Kennedy, 2018; Awasthi, 2020; Somera, 2018; and Sulisworo et al., 2016). Thus, stakeholders like MoE who are leading the workshops, and other agencies need to consider designing training programs capable of assisting teachers to develop the skills identified in this research. As situations change, PD facilitators will need to regularly explore teachers' needs to ensure adequate and contextually relevant training and that the required support are provided to them.

The quantitative data analysis related to question 2 revealed that more than 60% of the surveyed teachers are not adopting some of the new trends in online learning. They identified the following as critical and challenging trends: Making/Design (78%), Machine Learning (74.6%), Infographic Presentation Design Software (72.8%), Creating an e-Learning Profile and Aptitudes Inventory (71.7%), Crowd Learning (67.5%), Automated Pedagogical Agents (APA) (66.7%), Avatar-based Coaching (65.9%), Learning Analytics (64.9%), Seamless Learning (63.3%), Augmented Reality (AR) (61.9%) and Agile Design for e-Lessons (60.3%). This result was found to be surprising since most of the trends mentioned above needs extra infrastructure and smart technology solutions such as advanced virtual labs, and big data analysis software. At the same time K-12 teachers who are not pursuing postgraduate degrees and collaborative research with university researchers may not be familiar with the trends or consider them relevant to their context. These are new areas for further training as critical competencies for online teachers regardless of contexts. These results were consistent with other studies (Barbour et al., 2017; Hertz, 2020; Husain et al., 2019; Nachimuthu, 2012). They emphasised that the quality of online teaching needs more research to understand evidence-based practices that require the use of an entirely different set of tools and an innovative medium of online instruction and tutoring so that students achieve the experiences they deserve. These new trends are causing huge disruptions in learning design and technology. They are also creating a new line of competencies and PD learning opportunities for the teachers and faculty members (Farmer & West, 2019).

The analysis of the quantitative data related to question 3 revealed that over 60% of public school teachers in the UAE are facing critical challenges in adopting online and distance learning strategies, especially in the following areas: Getting students to complete assignments (68%); Getting students to complete the online activities on time (67%); Ensuring that students understand what it takes to succeed online (64%); Structuring learning activities that foster student–student interaction (63%); Keeping students engaged throughout the online course (63%); Identifying and supporting struggling students (62%); Gathering feedback from students to improve the learning experience (61%) and using specific strategies to create an instructor presence in the course (60%). This finding is in line with the themes generated from the second open-ended question. Most of the surveyed teachers who answered this question felt they are facing challenges in promoting

students' and parents' motivation and engagement; managing large online classrooms; providing online support; ensuring online assessment authenticity; designing effective online learning pedagogy and; overcoming technical and language barriers. These findings are not entirely unique to the UAE context as scholars reported similar challenging situations in other systems (Awasthi, 2020; Borup et al., 2014; Compton, 2009; Hertz, 2020; Husain et al., 2019). Thus, PD training provided for the K-12 teachers in this context can enhance teachers' preparation for changes to facilitation mode, online education to reduce their challenges (Barbour, et al., 2017).

The results of the current study reveal that there were significant differences between the surveyed teachers' recognized needs, the application of emerging trends in online education and perceived challenges due to their grade levels (educational level). Concerning the perceived needs, primary education teachers (Cycle 2) scored significantly higher than teachers in secondary education). Therefore, teachers in primary education need more training than their colleagues in secondary education. Meanwhile, teachers in pre-school (Kindergarten) scored significantly higher than teachers in primary education (Cycle 2) about the lack of application of emerging online learning trends. Therefore, kindergarten teachers are less likely to apply new online education trends. The findings re-echo the view that moving from traditional to online education and embracing the new trends can be challenging even though it offers new and innovative learning opportunities (Ortiz, 2020). Failure to recognize the variation in teachers' preference and ability by PD planners may result in an ineffective training as the success of online education depends on the skills of the teachers' (Yusuf & Jihan, 2020).

9. Conclusion, Recommendations and Future Studies

The COVID-19 crisis has had and will have a long-term impact on society, schools, and higher education systems. In reducing the adverse effects of the pandemic on the teaching and learning process, this study sought to identify the K-12 teachers' PD needs and perceived challenges in online education. The results from this study suggest that the UAE K-12 teachers need additional professional and guided training in multiple areas to best support their students in this online learning and digital transformation era. In particular, the student engagement and motivation on which effective online pedagogical design and assessment is needed.

Given that most the UAE public school teachers received training during the school lockdown period, yet they faced the challenges mentioned above. They felt that there are still sets of emerging and critical training needs among 60% of the target population. Therefore, a professional training policy and ecosystem supporting contemporary skills development are highly recommended and needed so that no teacher or school is left behind.

While this study indicates that the pre-school (Kindergarten) teachers are facing challenges in adopting online learning pedagogy and assessment more than their colleagues in primary and secondary education, considerable attention and training priority should be given to this cohort by identifying and applying

mentorship training programs based on the personalized training and at the same time measure its impact on improving the practices in the field.

Since the data collected were limited to public school teachers in the UAE, the results may not be the same in the private school context. The survey could, therefore, be administered to the private school sector to determine whether different contexts lead to different results, given that the findings in this study rely on self-reported data. Respondents may have forgotten some of the rigorous training they received earlier. Future research may investigate the alignment between teachers' reported challenges and those observed by the school principal, their line manager or independent observers. Future studies could also focus on how to plan, design, develop, implement and evaluate technological trend-oriented PD programs for public school teachers in the UAE context.

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Appendix 1

Professional Development Needs of the UAE Teachers for the Transition to Online and Distance Education

https://forms.gle/sokRqDmVNfHDupdQ6

Dear Participant,

At Hamdan Bin Mohammed Smart University, as part of our research-driven culture, a team of dedicated researchers has come together to conduct institutional research. The objective of this research is to explore the professional development needs of the UAE teachers in order to effectively implement the shift to online and distance education. In order to achieve this objective, we would need to collect information focusing on your professional development needs to help you with a smooth transition to online teaching and learning.

The results of this survey will be confidentially used for research purposes only. If you would like to have a copy of this research results, please let us know and communicate with the research principal investigator

Section one

Please select from the following what applies on you:

Gender:

- Male
- Female

Educational Level:

- Pre-school (kindergarten)
- Elementary Education
- Primary Education
- Secondary education

Major (Field of Specialization):

- Math
- Science
- Art
- Drama
- Arabic
- Islamic Studies
- Social studies
- English
- Modern Languages
- Business studies
- Other (Please specify :……..…)

Years of experience:

- Less than 5 years
- Between 6 and 10 years
- Between 11 and 15 years
- Between 16 and 20 years
- More than 20 years

Qualifications

- Bachelor
- Bachelor in education
- Post Graduate Diploma in Education/Teaching
- Master Degree in education
- Master degree in other fields
- PhD or Ed.D in Education
- Other Degree (Please specify…)

Section Two

Reflecting on your own professional development needs, please indicate the extent to which you have the below needs. The rating scale for this section is: 1 = No needed at all, 2 = Low level of need, 3 = Moderate level of need, 4 = Highly Needed, and 5= Extremely needed

#	Items	Rating scale			
		No needed at all	**Low level of need**	**Moderate level of need**	**Highly needed**
1	Integrate new innovative technologies (mobile devices, virtual/augmented reality, mobile apps, gamification, etc.) into classroom teaching				
2	Create and manage personalized learning environment to support your learners				
3	Design and manage Online Collaborative Learning environment to support your learners				
4	Encompass state-of-the-art online learning platform (e.g., Learning Management system)				
5	Design and manage Immersive Learning Environment (such as simulations, role play, virtual and augmented reality) to support your learners' online engagement				
6	Design and deliver e-content in small micro segments				
7	Use social networks to communicate effectively with your students and their families				
8	Create your own digital content for teaching and learning purposes (videos, presentation, etc.)				
9	Use online assessment tools with immediate built-in feedback feature				

10	Design and manage online effective assessments and activities to assess your learners' performance and progress.				
11	Use cloud computing to store your learners' files and projects				
12	Use next generation online pedagogy (e.g., intelligent pedagogy, distributed pedagogy, engaging pedagogy, agile pedagogy, and situated pedagogy)				
13	Search, allocate and use Open Educational Resources (OER)				

Open ended

Please use this space and tell us about any other professional development needs you feel as important for you and we did not mention in the above list……

Section 3

Challenges

The following are a list of challenges that may or may not apply on you, please select the challenges you are facing.

Challenges
▪ Getting students to complete the course online activities ▪ Getting students to complete assignments ▪ Keeping students engaged throughout the online course ▪ Identify and support struggling students ▪ Familiarity with effective pedagogy for online teaching ▪ Inadequate time to learn about online teaching and assessment ▪ Developing an online lesson or course can be complicated ▪ Structuring my course for best online experience ▪ Structuring learning activities that foster student-student interaction ▪ Giving students constructive feedback in a timely manner ▪ Gathering feedback from students to improve the learning experience ▪ Using specific strategies to create an instructor presence in the course ▪ Ensuring that students understand what it takes to succeed online

Open ended
Please use this space and tell us about any other challenges you think that you are facing we did not mention in the above list……

Section 4

Emerging Digital Learning Trends

The following are a list of emerged trends and applications in Digital Learning that can support the shift to online and distance learning in your school. Please answer the following questions as appropriate and applicable to you. The rating scale for this section is: 1 = Not familiar at all, 2 = Familiar but have not tried, 3 =Familiar but I need support to Adopt it, 4 = Familiar and Adopt it.

Topological Trend, techniques, and tools	Not familiar	Familiar but have not tried	Familiar but I need support to Adopt it	Familiar and Adopt it
Hybrid (Blended) Courses (with over 50% delivered online and in-person)				
Augmented Reality (AR)				
Virtual Reality (VR)				
Experiential e-Learning				
eAvatar-based Coaching				
Agile Design of e-courses				
Adaptive Electronic Testing and Assessment				
Intelligent Tutoring Systems (ITS)				
Automated/Animated Pedagogical Agents (APA)				
Multi-tasks Learning Objects				
Machine Learning				
Learning Analytics				
Seamless Learning				
Crowd Learning				
Learning by Making/Design				
eLearning Aptitude Profiles				
Infographic presentation software.				
Online Learning Agency				