Research in Learning Technology
Vol. 31, 2023

ASSOCIATION FOR LEARNING TECHNOLOGY ALT

ORIGINAL RESEARCH ARTICLE

Analysis of emergency remote teaching in formal education: crosschecking three contemporary techno-pedagogical frameworks

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(Received: 25 December 2022; Accepted: 31 March 2023; Published: 12 May 2023)

During the COVID-19 pandemic outbreak many countries around the world were forced to turn to Emergency Remote Teaching (ERT) and upscale the use of digital technologies for learning, teaching and assessment. The current study analysed field reports from 89 elementary and secondary Hebrew-speaking and Arabic-speaking information and communication technology schools in Israel, representing the cultural, ethnic, and religious diversity of the education system. The qualitative analysis of the collected data was based on three well established contemporary models of technology integration and Digital Competence of Educators (DigCompEdu): the International Society for Technology in Education, Technological Pedagogical Content Knowledge and DigCompEdu. The analysis (n = 872 statements) yielded aspects in the teachers' reports that correspond with the theoretical models, alongside aspects that extend these models to ERT and aspects that were missing from the reports. Finally, based on our findings and previous work we suggested a comprehensive framework for ERT that can be used to design teachers' professional development necessary for effective remote teaching in both emergency and routine times.

Keywords: emergency remote teaching; COVID-19 pandemic; information and communication technology; e-learning; online learning; digital pedagogy

Introduction

Emergency Remote Teaching (ERT) refers to the sudden temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances. In most cases it involves the use of fully remote teaching that would otherwise be delivered face-to-face or in blended or hybrid courses. The primary objective in an emergency crisis is to provide temporary access to instruction (Hodges *et al*. 2020). The outbreak of the COVID-19 pandemic has created one of the most challenging times in the global community (World Health Organization 2020). As part of an effort to limit the spread of the pandemic, over 190 countries worldwide closed their schools and switched to ERT for approximately 1.6 billion students (UNESCO 2020b).

Despite the challenges presented by the transition to ERT, the world has witnessed an important technological transformation. However, there is an important distinction

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Citation: Research in Learning Technology 2023, **31**: 2982 - http://dx.doi.org/10.25304/rlt.v31.2982

between ERT and online learning, and even though policy makers and education officials mistakenly refer to these terms interchangeably (Hodges *et al*. 2020), high quality online instruction is not something that can be launched overnight. Thus, the purpose of the present study was to analyse ERT during this unique and unprecedented worldwide pandemic based on contemporary techno-pedagogical frameworks in order to propose a comprehensive framework for ERT.

Frameworks for technological development in context teacher education

Research indicates that the development of technology-based competencies, appropriate pedagogical techniques, and teaching strategies is pivotal for effective remote learning (Munoz-Najar *et al*. 2021; Rivera *et al*. 2021). While much research on the development of technology-based competencies during COVID-19 has been accumulated over the past 2 years (Avidov-Ungar *et al.* 2023; Lien *et al.* 2022; Shamir-Inbal and Blau 2021; Valeeva and Kalimullin 2021; Zhou and Li 2020), only a handful of studies, however, attempted to analyse ERT on the basis of theoretical models such as Technological Pedagogical Content Knowledge (TPACK) (DeCoito and Estaiteyeh 2022) or the Digital Competence of Educators (DigCompEdu) Standards for Educators (Dias-Trindade *et al.* 2021). In the present study we adopted three comprehensive conceptual frameworks that address techno-pedagogical development of teachers in routine times and examined their applicability to ERT: the TPACK model (Koehler and Mishra 2009), the International Society for Technology in Education Standards for Educators (ISTE 2017), and the European framework for the DigCompEdu (2017).

The TPACK

The model suggested by Koehler and Mishra (2009) asserts that effective teaching with technology practices depends on content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). The three core components of knowledge constructs are strongly interconnected and combine in various ways within the TPACK framework. Technological pedagogical knowledge (TPK) describes teachers' understanding of how particular technologies can change both the teaching and learning experiences by introducing new pedagogical affordances and constraints. Technological content knowledge (TCK) involves understanding how the subject matter can be communicated via different technological tools and considering which specific tool might be best suited for specific subject matters or classrooms.

The ISTE standards for educators

The ISTE Standards conceptualise seven key standards and best practices for educators that focus on using technology to empower student learning experience and support teachers' technological and pedagogical competencies in the digital age. (1) The *learner* standard views educators as lifelong learners seeking evidence-based practices that leverage technology to improve student learning. (2) The *leader* standard encourages educators to seek out opportunities for leadership by engaging with education

Citation: Research in Learning Technology 2023, **31**: 2982 - http://dx.doi.org/10.25304/rlt.v31.2982

stakeholders, looking for ways to capitalise on resources in order to provide students with equitable access to educational technology, digital content, and learning opportunities, as well as modelling others in the adoption of new digital resources and tools for learning. (3) The *citizen* standard states the importance of educating students to use technology positively and socially and to contribute to and responsibly participate in the digital world. (4) The *collaborator* standard encourages professional growth through meaningful collaboration and interactions with colleagues, as well as co-learning with students to discover and use new digital resources and technology. (5) The *designer* standard refers to the ability to design authentic, learner-centred activities and learning environments and to apply instructional design principles that foster independent and personalised learning. (6) The *facilitator* standard encourages educators to foster opportunities and the culture of effective use of technology and learning strategies in digital platforms. Finally, (7) the *analyst* standard highlights the importance of understanding and using data to guide instruction and support students in achieving their learning goals.

The European framework for the DigCompEdu

The DigCompEdu (Redecker 2017) framework aims to capture and describe six different areas of digital capability that are essential for educating in the 21st century: (1) *Professional engagement*, which refers to the use of digital technologies for communication, collaboration, and professional development. (2) *Digital resources*, which refers to sourcing, creating, and sharing digital resources. (3) *Teaching and learning,* which refers to managing and orchestrating the use of digital tools in teaching and learning. (4) *Assessment*, which refers to using digital tools and strategies to enhance formative and summative assessment through a diversity of assessment formats and approaches. (5) *Empowering learners,* which refers to using digital technologies to enhance inclusion, personalisation, and learners' active engagement. (6) *Facilitating learners' digital competence,* which refers to enabling learners to creatively and responsibly use digital technologies for information, communication, content creation, well-being, and problem-solving.

Research goals and questions

This study aims to analyse teachers' reports of the transition to ERT based on three well established contemporary models of technology integration and DigCompEdu, the ISTE, TPACK and DigCompEdu, in order to propose a comprehensive framework for ERT. The following research questions were explored: (1) Which aspects of ISTE, TPACK, and DigCompEdu knowledge and skills relating to the integration of technology during ERT were reported? (2) Which aspects emerging from the data are beyond the ISTE, TPACK, and DigCompEdu models?

Method

Participants

In the current study, we analysed 89 fully detailed written reports from schools across the State of Israel. The reports represent the perspectives of schools' information and communication technology (ICT) coordinators, teachers, and

principals from various K-12 levels (kindergartens, n = 5, 5.68%, elementary schools, n = 45, 51.14%, and secondary schools, n = 38, 43.18%) and also the cultural, ethnic, and religious diversity of sectors in the Israeli education system: regular and special education, including Hebrew-speaking schools (secular, religious, and ultra-orthodox) and Arabic-speaking schools (Arab, Druze, and Bedouin). All of the schools had participated in the national ICT program for several years and thus, were quite experienced in technology-enhanced learning in classroom setting.

Instruments and procedure

The study was approved by the Institutional Ethics Committee. During the lockdown from March 2020 to June 2020, the Ministry of Education (MoE) issued a call to all the regional ICT coordinators to collect field reports that would describe challenges and successes, how the rapid curriculum transformation was established, and the educational continuity was maintained. The schools provided, through ICT coordinators and school principals, in-depth and detailed information about special projects which were carried out during this period, and some schools shared learning outcomes from these projects on the portal. The original data obtained from participants was in Hebrew and the themes and representative quotes in the Results section were translated into English by the researchers.

All reports were analysed by content analysis based on the Thematic Analysis approach (Nowell *et al*. 2017), utilising axial coding, selective coding, and establishing hierarchies between the categories. At the initial coding stage, as many codes as possible were generated inductively from each section of the dataset and labelled as similar to the data as possible (Charmaz 2006).

The major themes that emerged from the data were: (1) aspects in the teachers' reports that correspond with the theoretical models, (2) aspects in the teachers' reports that extend these models to ERT, and (3) aspects from the theoretical models that were missing from the reports. Once categories began to develop in the intermediate phase of coding, relationships between the categories were identified and basic information was transformed into more abstract concepts. The data was analysed according to the competencies definitions from the theoretical models. Some new categories that were identified from the data, extended these models to ERT, alongside aspects from the theoretical models that were missing from the reports. Following several iterations, final categories and subcategories were determined. In the last phase of advanced coding, the categories became abstract and represent the participants' stories reduced into conceptual terms. These interrelated concepts represent the relationships between the core category of each research question and more detailed subcategories (Corbin and Strauss 2007), see Tables 1 and 2 in the Results. Finally, based on this conceptualisation, a theoretical model of the phenomenon (Birks and Mills 2015) was suggested and explored in the last research question (see Figure 1).

Top-down and bottom-up data coding patterns from 25% of the reports were established independently by three researchers. Disagreements between them were resolved through discussion. The coding of the remaining reports was conducted based on the established coding.

Citation: Research in Learning Technology 2023, **31**: 2982 - http://dx.doi.org/10.25304/rlt.v31.2982

Table 1. Theoretical analysis of remote teaching according to the ISTE, TPACK, and DigCompEdu models (n = 872).

Theme	% of the statements	Representative quotes
Phase 1: Teachers' acquisition of technological knowledge (n = 242, 27.75%)		
Educators as learners (ISTE); DigCompEdu Area 1: Professional Engagement; Technological knowledge (TPACK: TK)	n = 104, 42.97%	'Teacher development was conducted every other week via Zoom in the format of two sessions: one session for learning how to use digital tools (based on a teachers' needs survey) and another for teaching how to use these tools effectively.' (School 41)
Educators as collaborators (ISTE);	n = 137, 57.03%	'We practiced peer learning for the purpose of training the teachers for distance learning – the teachers were divided into learning pairs – one teaches while the other watches and supports. Gradually the staff developed independent remote teaching skills.' (School 51)
Phase 2: Remote/Online Teaching – Techno-pedagogical application (n = 280, 32.1%)		
Educators as designers (ISTE); Technological Content Knowledge (TPACK: TCK); Techno-pedagogical knowledge (TPACK: TPK); DigCompEdu Area 2: Digital Resources; DigCompEdu Area 3: Teaching and Learning Managing	n = 180, 64.29%	'For teaching new material, teachers prepared narrated presentations with links to supplementary materials and assignments, similar to a digital course.' (School 1) 'To spark the students' interest, I prepared an experiment in science studies that they could follow easily via Zoom. It was a great success. I was excited to see the enthusiasm in their eyes – they were totally engaged. I think that the careful design of the lesson is what made the difference.' (School 37)
Educators as facilitators (ISTE); Techno-pedagogical knowledge (TPACK: TPK); DigCompEdu Area 5: Empowering Learners' Use of digital technologies	n = 91, 32.5%	'The teacher incorporated differential learning by dividing the students into breakout rooms via Zoom, which allowed the teacher to take the role of a facilitator who moves between rooms and provides a differential response to address the differences between the learners.' (School 55)
Educators as analysts (ISTE); Techno-pedagogical knowledge (TPACK: TPK); DigCompEdu Area 4: Assessment	n = 9, 3.2%	'Data regarding the learning progress of each student was collected in the Google classroom in order to create an individual program that addressed diversity and existing needs.' (School 47)
Students' digital citizenship (ISTE); Learners' Digital Competence (DigCompEdu, area 6);		–
Educators as leaders (ISTE)		–

ISTE, International Society for Technology in Education; TPACK, Technological Pedagogical Content Knowledge; DigCompEdu, Digital Competence of Educators; TCK, Technological content knowledge; TPK, Technological pedagogical knowledge.

Table 2. Aspects that expand the ISTE, TPACK and DigCompEdu models (n = 872).

Theme	% of the statements	Representative quotes
Reorganisation of educational framework to ERT) n = 98, 11.24%)		
Adjusting the schedule	n = 75, 76.53%	'With the outbreak of the crisis, we conducted rapid adjustments that would allow us to manage the distance learning processes. From the organizational perspective, we prepared an online version of the school schedule and learning modes (synchronous, asynchronous, or their combination – blended learning). We divided the online channels according to subject matter.' (School 55)
Bridging the digital gap (equality)	n = 9, 9.18%	'Teachers listed students who did not have proper means for distance learning. The school provided laptops to assist these students.' (School 19) 'Teachers encouraged knowledgeable students to guide their peers on how to submit assignments on Microsoft Teams.' (School 61)
Providing access to virtual learning platforms	n = 14, 14.29%	'We decided to manage the remote learning via Microsoft 365. To this end, all 1000 students and 170 teachers were connected to the system. Students and teachers had to download the platform to their personal computers and were given a username and password to access their accounts.' (School 46)
Supporting social emotional needs (n = 252, 28.9%)		
Strengthening the relationships among teaching staff	n = 35, 13.89%	'The principal gave us the feeling that she believed in our abilities. She trusted us to succeed and be meaningful to our students during the pandemic. The sense of belonging has grown stronger during this time. There has been considerable sharing on social networks, and the teachers all felt that we were in the same boat and together would overcome the crisis.' (School 37)
Emotional support for students and families	n = 102, 56.03%	'Emphasis is placed on communication with students through all channels; teachers respond to students and support them both academically and emotionally on WhatsApp, which is always available.' (School 5) 'The school counselor and psychologist conducted anxiety workshops for parents and students to allow an emotional dialogue through which the children could express their concerns and receive coping strategies during the lockdown.' (School 12)
Extracurricular projects, initiatives, and recreational activities	n = 115, 45.63%	'The student council, in collaboration with the social studies teachers, the innovation team, and the ICT coordinator, launched "Corona Live" to broadcast special events and holidays in response to student needs that arose from the days of lockdown or quarantine. It was a multidisciplinary project (social studies, history, geography, computers, entrepreneurship, social education, etc.) and included students, teachers, parents, and special guests. This was broadcasted to the general public.' (School 36) 'This year the parents' council turned our annual *Parents as Teachers* event into a virtual conference that was held throughout the week and consisted of diverse lectures and workshops.' (School 43)

ISTE, International Society for Technology in Education; TPACK, Technological Pedagogical Content Knowledge; DigCompEdu, Digital Competence of Educators; ERT, Emergency Remote Teaching; ICT, information and communication technology.

Citation: Research in Learning Technology 2023, **31**: 2982 - http://dx.doi.org/10.25304/rlt.v31.2982

Results

Aspects of educators' TK and skills addressed by the ISTE, TPACK, and DigCompEdu frameworks

Similar to Perla *et al*. 2018 and DeSantis (2016), analysing the data we found that there is some overlapping of educator competencies between the three theoretical models described by the TPACK, ISTE, and DigCompEdu models (Table 1).

As can be seen in Table 1, phase 1 consisted of teachers' acquisition of TK (n = 242, 27.75%). In this category we found an overlapping between the three models: *educators as learners* (ISTE), *professional engagement* (DigCompEdu, Area 1), and *technological knowledge* (TPACK: TK). All these dimensions relate to the acquisition of fundamental TK and skills in how to use new technologies to teach. The need to learn synchronous and asynchronous digital tools was paramount for communicating and collaborating with colleagues as well as for teaching remotely. The second category refers to *educators as collaborators* (ISTE). Teachers had opportunities to work together with fellow teachers, supporting each other and sharing experiences specifically related to gaining TK.

Phase 2 in Table 1 refers to remote/online teaching – techno-pedagogical application (n = 280, 32.1%). The first subcategory corresponded with each of the three models: *educators as designers* (ISTE); *Technological Content Knowledge* (TPACK: TCK) and *Techno-pedagogical knowledge* (TPACK: TPK); *Digital Resources* (DigCompEdu, Area 2); *Teaching and Learning Managing* (DigCompEdu, Area 3). All of the above digital skills are integrated to build the teacher's comprehensive techno-pedagogical skill. The techno-pedagogical design process of instruction and learning consists of selecting the proper technological tools to achieve the learning goals, manage the learning process, and incorporate and provide the right digital resources. Therefore, together all of these competencies provide a comprehensive coverage of the digital skills that teachers should master in their teaching. The second subcategory refers to the overlap between *educators as facilitators* (ISTE), *techno-pedagogical knowledge* (TPACK: TPK), and *empowering learners' use of digital technologies* (DigCompEdu, Area 5). Through fostering techno-pedagogical approaches to learning, educators promoted independent and collaborative work, student learning strategies in digital platforms, and other digital skills. The third category refers to the overlapping of *educators as analysts* (ISTE), *assessment* (DigCompEdu, Area 4), and *techno-pedagogical knowledge* (TPACK: TPK). A proper techno-pedagogical design should incorporate the right assessment methods and the use of student learning behaviour and achievement data to support instructional decision-making.

Aspects of ERT that expand the ISTE, TPACK, and DigCompEdu models

As can be seen in Table 2, two major aspects emerged from the data analysis and elaborate the existing theoretical frameworks of technological development: *reorganisation of the educational framework to ERT* (n = 98, 11.24%) and *supporting social emotional needs* (n = 252, 28.9%). In terms of reorganisation of educational framework to ERT, we found the following subcategories: adjusting the schedule, bridging the digital gap (equality), and providing access to virtual learning platforms. In terms of supporting social emotional needs, we found the following subcategories: strengthening the relationships among staff, emotional support for students and families, and extracurricular projects, initiatives and recreational activities.

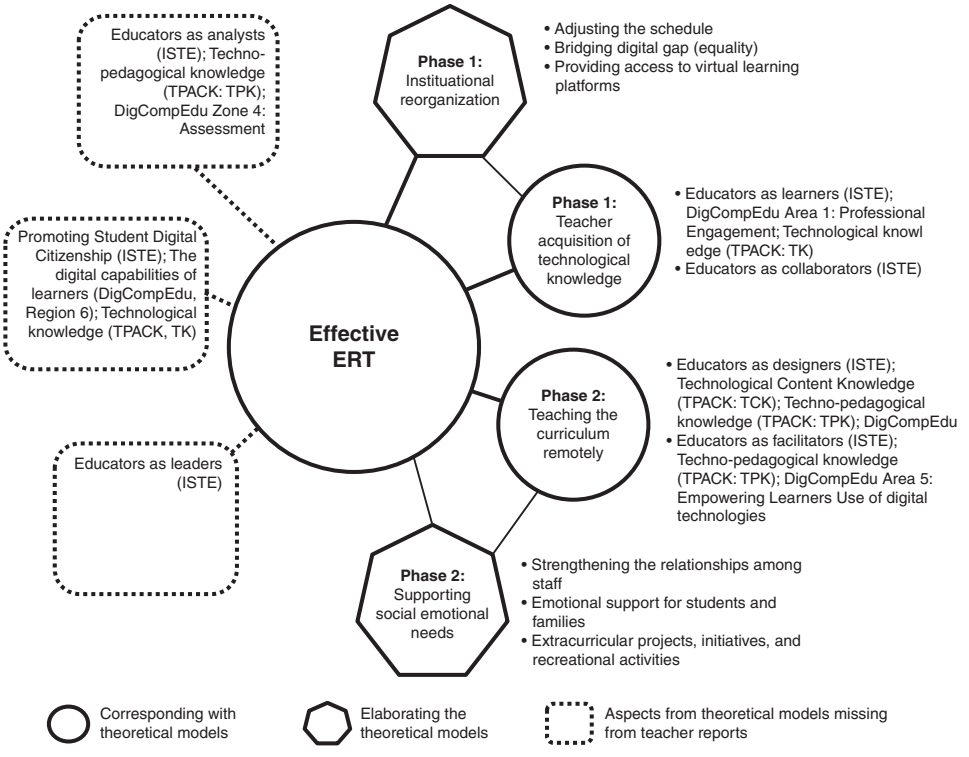

Figure 1. Comprehensive framework of effective ERT based on the ISTE, TPACK, and DigCompEdu models. ERT, Emergency Remote Teaching; ISTE, International Society for Technology in Education; TPACK, Technological Pedagogical Content Knowledge; DigCompEdu, Digital Competence of Educators.

Discussion

With the closure of the education system during the COVID-19 pandemic, schools were required to provide students with remote education routines that would replace the traditional face-to-face instruction (Manca and Meluzzi 2020). The current study analysed theoretically how ICT-integrated schools, who often used technology for teaching and learning, coped with this sudden transition to ERT. The analysis was conducted on the basis of three well established contemporary models of technology integration and DigCompEdu (the ISTE, TPACK, and DigCompEdu), in order to propose a theoretically based, comprehensive framework for ERT that can be applicable in emergency times.

Figure 1 illustrates the theoretical analysis and presents aspects in the teachers' reports that correspond with the theoretical models and domains that extend these models to ERT. We also identified domains from the theoretical models that were missing from the reports and should be the focus of teachers' professional development in order to improve their practice and to develop and apply the skills and knowledge necessary for effective remote teaching.

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Phase 1: Reorganisation and teacher acquisition of TK

The first phase in initiating the online educational framework consisted of reorganising and acquiring TK and skills. In terms of reorganisation, schools needed to plan and provide an online version of school programs consisting of schedule adjustments, curriculum adaptation, learning modes (synchronous, asynchronous, blended learning), and suitable learning platforms. These findings correspond with previous findings regarding the global shift to remote online learning (Lien *et al.* 2022; Valeeva and Kalimullin 2021; Zhou and Li 2020).

Because all distance learning planning should be guided first and foremost by concern for equality and inclusion (Miao *et al*. 2020), similar to reports from other countries (Cerna *et al.* 2020), equality issues were raised and addressed in the present study. Our findings revealed that teachers mapped the technological infrastructure and internet access available at their students' homes and assisted those who did not have proper technology means for remote learning. This included taking steps to increase the accessibility of teaching materials for students with low digital literacy who were facing technology know-how obstacles beyond the lack of necessary equipment and internet access. For instance, teachers encouraged students with TK to aid students who were less technology-oriented in their nature.

In terms of teacher acquisition of TK, school principals and ICT coordinators held weekly meetings to provide the teaching staff with technology training. According to global reports, only a few teachers were able to conduct the transition to ERT quickly and effectively, even those who were well experienced in the use of educational technologies (World Bank Group 2020). Previous research shows that teachers felt unprepared with the sudden move to online teaching and struggled with supporting students in engaging in remote learning, with developing new skills, with transitioning their lessons to a remote format, to use new platforms, applications, and teaching tools, and how to adjust their teaching strategies and adapt their pedagogy in effective ways (Avidov-Ungar *et al.* 2023; Bond 2021; Leech *et al*. 2020; Shamir-Inbal and Blau 2021). In this context, Hodges *et al*. (2020) stressed that merely going online is not enough to meet the criteria for effective distance learning – a goal which requires thoughtful instructional design and systematic planning.

Phase 2: Remote online teaching and supporting social emotional needs

The two pillars of the ERT education framework, due to the suspension of classroom instruction, were the *remote online teaching* and *supporting social emotional needs*. In terms of *remote online teaching,* we found an emphasis on two subcategories (i.e. design and facilitate), similar to Miao *et al*. (2020) who argue that when delivery technologies are in place, teachers are in the frontline to design and facilitate learning activities, monitor and evaluate students' home-based distance learning processes, adjust their learning management accordingly, and assess students' achievement of learning outcomes. We will elaborate on these two subcategories in the following paragraphs. Teachers referred to assessment to a lower extent (see the section entitled 'Aspects from the theoretical models that were missing from the reports').

The *design and facilitate* subcategories are vital components of digital teaching and thus represented in all three digital models: *educators as designers* (ISTE); *Technological Content Knowledge* (TPACK: TCK); *Techno-pedagogical knowledge*

(TPACK: TPK); *Digital Resources* (DigCompEdu, Area 2); *Teaching and Learning Managing* (DigCompEdu, Area 3); *Educators as facilitators* (ISTE); *Techno-pedagogical knowledge* (TPACK: TPK); and *Empowering learners' use of digital technologies* (DigCompEdu, Area 5). All these domains relate together to the thoughtful process of defining, designing, and executing optimal remote learning and teaching experiences that engage students and are driven by student needs and interests. Teachers found videoconferencing tools helpful, because they enable content and assignment delivery, feedback, and vital communication (Chimelis 2020). According to Lowenthal *et al*. (2020), live synchronous videoconferencing best approximates the traditional classroom approach to teaching. Instructors can quickly clarify problems, stimulate social learning, and, in this way, reduce the feeling of isolation.

Effective online learning is a by-product of cautious instructional design and planning, and numerous considerations, such as identifying the content, types of interaction, learners' characteristics, social and cognitive aspects, learner support, all have an impact on the quality of the instruction (Hodges *et al*. 2020). Thus, many resources were allocated to *socio-emotional support* to alleviate the mental burden experienced by the students, their families, and teachers alike during the closure (Fegert *et al*. 2020; Wango *et al.* 2020). Bozkurt *et al*. (2020) described the pedagogy of care which emerges during times of anxiety and trauma. Accordingly, in times of crisis educators allocate resources to address their students' vulnerabilities, allowing them to be more attuned to their individual needs. As for the teachers, the mutual efforts to close technological and pedagogical gaps through weekly school organised sessions contributed to the relationships among staff and brought teachers together.

Aspects from the theoretical models that were missing from the reports

We also identified digital capabilities that barely appeared in the reports, such as educators as analysts (ISTE) and assessment (DigCompEdu Zone 4). Overall, the assessment category was represented less in teachers' reports (n = 31) and, of these statements, teachers mostly referred to traditional evaluation processes such as checking homework and classroom assignments (n = 22). They rarely referred to the use of digital tools and digital learning data to conduct their instruction modes and provide personalised learning as described in both ISTE and DigCompEdu (n = 9). Our findings are supported by previous research showing that while rapidly transitioning to online teaching, teachers replicated their face-to-face teacher-led traditional teaching and learning into the online environment with digital tools without making instructional adjustments to the online setting (Shamir-Inbal and Blau 2021).

One important component that was completely lacking from teacher reports was *promoting students' digital citizenship* (ISTE) or *Facilitating Learners' Digital Competence* (DigCompEdu, area 6). The *citizen* standard (ISTE) states the importance of educating students to use technology positively and socially, contributing to and responsibly participating in the digital world. The definition of DigCompEdu refers to enabling learners to creatively and responsibly use digital technologies for information, communication, content creation, well-being and problem-solving. These two dimensions are connected, since using digital technologies safely and responsibly as well as using digital technologies for communication, collaboration, and civic participation, lead to smart digital citizenship behaviour. Although teachers were briefed on online safety and internet security to protect children's privacy and allow for the

Citation: Research in Learning Technology 2023, **31**: 2982 - http://dx.doi.org/10.25304/rlt.v31.2982

proper operation of distance learning, there were no references to teaching students safe online citizenship. These areas should be developed in teacher training and professional development courses to develop the skills and knowledge necessary for effective remote teaching.

Another aspect that was missing from teacher reports was *educators as leaders* (ISTE). The *leader* standard encourages educators to seek out opportunities for leadership by engaging with education stakeholders, looking for ways to capitalise on resources in order to provide students with equal access to educational technology, digital content, and learning opportunities, as well as modelling others in the adoption of new digital resources and tools for learning. Aside from providing students with equal access to educational technology, which was a threshold condition for distance learning, the reports did not reflect leadership and seeking collaboration with stakeholders in education or resource mobilisation. It should be taken into account that the teachers themselves also experienced an emotional burden and anxiety from the pandemic, as they and their families were exposed to COVID-19 just like the rest of the population, so it is understandable that they did not engage in activities beyond what was needed for their teaching.

Conclusions

While most of the previous reports on ERT have focused mainly on the lack of technological infrastructure (Alvarez 2020; Cullinane and Montacute 2020; Sen and Tucker 2020; UNESCO 2020a), the current study focused on schools that were already technologically equipped for the transition. These settings enable to identify techno-pedagogical characteristics associated with effective ERT and explore the promise of the pandemic to upscale the use of educational technologies for learning, teaching and assessment. In accordance with Hodges *et al*. (2020), who differentiated between ERT and quality online learning, our data suggests that, after initially adjusting school schedules to synchronous, asynchronous, or blended lessons, these schools were able to grow from technical issues to techno-pedagogical teaching and learning, while addressing the social emotional needs of both students and teachers. As one school so beautifully articulated: '*The Covid-19 crisis has brought not only challenges, but also opportunities that should not be ignored, but rather promoted and learned from later on*' (School 70).

Adopting three well established contemporary models of technology integration and DigCompEdu, the ISTE, TPACK and DigCompEdu, to analyse teacher reports has led to the identification of aspects that correspond with the theoretical models, aspects that extend these models and adapt them to ERT. Some aspects from the theoretical models that were missing from the reports should be the focus of teachers' professional development in order to improve their practice and develop and apply the skills and knowledge necessary for effective remote teaching. Consistent with previous studies (Avidov-Ungar *et al.* 2023; Hodges *et al*. 2020; Kasperski *et al*. 2022; Munoz-Najar *et al*. 2021; Porat *et al*. 2018; Rivera *et al*. 2021; Shamir-Inbal and Blau 2021), we call upon education policy makers to provide extensive teacher training in technology and pedagogy to support high quality online teaching. Teacher training should address digital competencies such as analyst/assessment, students' digital citizenship (ISTE and DigCompEdu), and digital leadership (ISTE).

Limitations and future directions

The main limitation of this study is its self-report methodology. It would be worthwhile for future studies to triangulate school reporting with observations of the actual behaviour of teachers and students during online lessons in order to improve the credibility of the qualitative findings (Jonson *et al.* 2020). In addition, the schools participating in this study previously took part in the national ICT program. As such, the reports reflect fewer technological challenges and shed more light on the pedagogical aspects and practices of schools experienced in technology-enhanced learning. Lastly, the unit of analysis in this study was the school, and thus, we did not distinguish between the ERT of younger and older students. The results of the Future of School's survey (2020) indicated that younger students had more difficulty switching to ERT than older students. Therefore, future studies may choose a different unit of analysis in order to conduct quantitative comparisons of the findings in various age groups.

Disclosure statement

The authors declare that they have no conflict of interest.

Data availability statement

These data were derived from the following resources [in Hebrew] available on the public domain: Israeli Ministry of Education portal https://pop.education.gov.il/online-learning/teachers-reported/

Contribution statement

All the authors contributed to conceptualisation of this paper and to the data analysis. The first author contributed to writing the paper draft, while other authors contributed to its editing. All authors read and approved the final manuscript.

Acknowledgements

The authors are thankful to Ms. Orit Avdiel for her help in initial data coding.

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