Developing Digital Literacies in Teacher Education: A Collaborative Enquiry Examining Teacher Educators' Experiences of Teaching Online During the Pandemic

Teacher Education Advancement Network Journal

Issue 15(1) pages 1-17

Helen Coker, Tara Harper, Louise Campbell, Sharon Tonners-Saunders, Lina Waghorn, Derek Robertson
University of Dundee

Abstract:
The digital pivot of 2020-21, which moved teacher education online, created a catalyst for teacher educators to develop their digital literacies. This paper reports on a Collaborative Inquiry which sought to examine the factors which influenced teacher educators' digital skills during this time. Additionally, this paper aims to address the need for research on digital technology in teacher education, as previous studies have reported that some student-teachers feel ill prepared to engage with digital technology in their practice. In seeking to examine the factors which influence the development of teacher educators' engagement with digital technology, this research adds to knowledge and understanding in this area, informing professional learning provision for teacher educators with digital technologies.

The Technology Pedagogy and Content Knowledge (TPACK) model was used to examine the ways in which teacher educators were influenced in their practice and what impact this had on their experience. Analysis highlighted how the positioning of teacher educators within the framework influenced their experience of teaching online. The lived experiences of teacher educators when using technology for teaching online moved beyond their understanding of content, pedagogy, and technology, and highlighted the importance of context. Relationships, wellbeing, and emotional factors influenced engagement with digital technology as it mediated social practices. The findings add to knowledge and understanding of teacher educators' engagement with digital technology and have implications for professional development.

Key words
Teacher-education; Online learning; TPACK

Introduction
In 2019 Caena and Redecker suggested that '*the digital revolution [had] not yet been matched by mainstream transformations of education systems*' (Caena and Redecker, 2019, p. 357). In teacher education, digital skills inputs were often developed by a few enthusiasts on the staff (Ottestad et al., 2014) and the digital skills and competencies of teacher educators were often reported to be low (Gudmundsdottir and Hatlevik, 2018, Lund *et al.*, 2014). In the academic year 2020-2021, periods of lockdown led teacher educators, alongside their colleagues in schools, to move their teaching online. The Covid-19 pandemic, which acted as a catalyst for digital development in schools (Lindfors *et al.*, 2021), prompted digital development in teacher education too. The digital literacies, skills and capacities, developed by teaching online are arguably very important for teacher educators, who are tasked with preparing student-teachers to work in 'digitally-infused' education systems (Starkey, 2020). Digital literacies, skills and competencies will be a key element of Initial Teacher Education (ITE)

Citation
Coker, H., Harper, T., Campbell, L., Tonners-Saunders, S., Waghorn, L. and Robertson, D. (2024) 'Developing Digital Literacies in Teacher Education: A Collaborative Enquiry Examining Teacher Educators' Experiences of Teaching Online During the Pandemic', *TEAN journal*, 15(1) pp. 1-17.

programmes, post-pandemic, as digital technology continues to be prevalent in schools and ubiquitous in society. In this study, we examined the experiences of teacher educators during the academic year 2020-21, with the aim of understanding the factors which influenced the development of digital literacies, skills, and capacities. The participants of this research study were based at a Scottish university and many of them had limited experience of teaching online before the pandemic.

Digital Literacies, Skills and Capacities in Teacher Education

Digital literacies, skills and capacities have been widely acclaimed as key aspects of education in the 21st century, with many education policies, curricula and frameworks internationally seeking to include these within children and young peoples' school experience (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2020; European Commission, 2019; Scottish Government, 2016). Digital literacy is a core cognitive foundation, in the Organisation for Economic Co-operation and Development's (OECD) Learning Compass 2030, which:

> *defines the knowledge, skills, attitudes and values that learners need to fulfil their potential and contribute to the well-being of their communities and the planet*
>
> (OECD, 2015, no page).

Digital technology has the potential to 'change the work of education' (Starkey, 2020). The development of digital technologies and the ubiquity of digital devices and software in the developed world (Jandrić, 2017) have created a world which is interconnected and interdependent (Mansilla and Jackson, 2013), a world in which the skills required to actively participate include digital capabilities. Future practice in education, being reflective of wider society, will include the digital domain, and student-teachers need to be prepared to engage with digital tools (Brevik *et al.*, 2019). Engaging with digital technology as part of their professional practice will be an integral aspect of new teachers' professional competence (Kelentrić, Helland and Arstorp, 2017). It is therefore a key consideration for teacher education.

The intersection where teaching skills and digital technologies meet is a complex site for exploration (Lawrence and Tar, 2018; Player-Koro, 2012) and one that offers challenges for teacher educators seeking to build on this in addition to the range of pedagogical skills and dispositions associated with learning to be a teacher (Fisher, 2000). However, the affordances of digital technologies for teaching are widely recognised as having huge potential for enhancing teaching and learning experiences, as well as other aspects of school life (Lawrence and Tar, 2018; Selwyn *et al.*, 2016; Starkey and Yates, 2021). Three stages of digital integration of technologies for schools have been theorised: introduction, integration and infusion (Starkey, 2020). Each of these stages articulates a progression from the previous, with the final stage, infusion, indicating the ubiquity of technology across every aspect of school life (Starkey and Yates, 2021). The question of how best to prepare teachers for schools with infused technology remains a source of debate. Internationally, there have been a range of attempts to create supportive structures to enable this.

Some recent models for developing teachers' digital competence include the Norwegian Professional Digital Competence Framework for Teachers (Kelentrić, Helland and Arstorp, 2017), the European Framework for the Digital Competence of Educators known as DigCompEdu (Punie and Redecker, 2017) and the International Society for Technology in Education (ISTE) Standards for Educators (Crompton, 2017). In Scotland, in response to government calls to ensure pre-service teachers are well prepared for effective engagement with digital pedagogies (Scottish Government, 2016), teacher education institutions have collaborated to create a National Framework for Digital Literacies in Initial Teacher Education (Scottish Council of Deans of Education, no date). This appears to be a rare attempt to target teacher educators' practice rather than that of teachers themselves. The extent to which these and similar frameworks have effected change and progress is a matter for ongoing research.

A widely used approach to theorising and measuring how teacher education can and does support the development of digitally enhanced teaching skills is the technology, pedagogy and content knowledge (TPACK) model (Mishra, 2019), which builds on Shulman's (1986) ideas about pedagogical content knowledge (PCK):

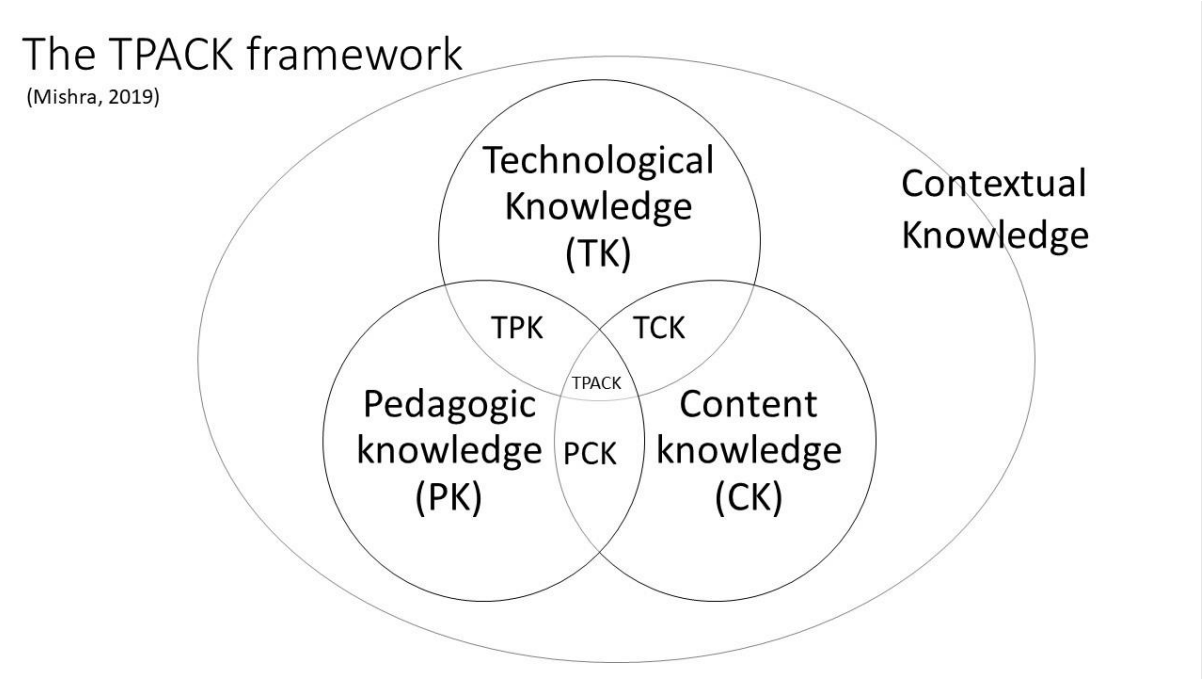

Figure 1. The TPACK framework.

Shulman's premise is that effective teaching requires not only subject content knowledge but knowledge about pedagogy relating to it (Shulman, 1986). Koehler and Mishra's (2008) TPACK model argues for the integration of technological knowledge alongside these requirements, as part of effective teaching:

> *[TPACK] encompasses understanding the representations of concepts using technologies; pedagogical techniques that apply technologies in constructive ways to teach content in differentiated ways according to students' learning needs; knowledge of what makes concepts difficult or easy to learn and how technology can help redress conceptual challenges; knowledge of students' prior content-related understanding and epistemological assumptions; and knowledge of how technologies can be used to build on existing understanding to develop new epistemologies or strengthen old ones*
>
> (Koehler and Mishra, 2008, p.3).

These can be seen as emergent forms of knowledge for teachers (Koehler and Mishra, 2009); ones that enable them to engage with their learners' needs responsively. They also reflect the contextual factors that impact day-to-day practice (Mishra, 2019) unlike Puentadura's (2006) Substitution Augmentation Modification Redefinition (SAMR) model, in which context is essentially absent (Hamilton, Rosenberg & Akcaoglu, 2016) or the Florida Center for Instructional Technology's Technology Integration Matrix (TIM; 2019), which foregrounds the intentional work of planning for technology's integration. Emergent and contextual factors were critical aspects of the present study and so TPACK was recognised as being an effective model for the task.

It has been argued that the TPACK model is well-suited to use in teacher education and teacher professional development programmes because it enables pre-service and practising teachers to track their learning or practice across core areas (Cabero and Barroso, 2016). Given the articulation of digital literacy as a core requirement within Professional Standards for teachers in Scotland (General

Teaching Council for Scotland, 2021), this tracking of learning is an important benefit. However, it has been argued that other factors can present challenges for professional learning in relation to TPACK, including 'technostress' (Özgür, 2020, p.1), the organisational climate within which teachers operate once they leave teacher preparation programmes (Andyani et al., 2020) and prior understandings and dispositions (Phillips, 2016). These are some of the challenges not only for teachers but also for teacher educators, who have a key role to play in developing student teachers' digital literacies. As such, this research focused on the experiences of a group of teacher educators working in a Scottish University during the year 2020-21, as they negotiated the 'new normal' of online teaching and supported the development of digital literacy in their students.

The Research Context

In Scotland, Initial Teacher Education (ITE) is based in universities where teacher educators work in Education departments, employed as higher education lecturers. Students can choose from undergraduate, or postgraduate pathways, each comprising of university study and school placements, culminating in initial registration with the General Teaching Council for Scotland (GTCS). The participants of this research study were ITE lecturers based in university with a large cohort of student teachers: over 200 Professional Graduate Diploma in Education (PGDE) students, studying a one-year programme in Primary or Secondary Education; and over 200 undergraduate students, studying a four-year programme in Primary Education. The programmes were well established for face-to-face delivery and led by an experienced team of staff. Participants in this research taught on these programmes, four of whom already had some experience of teaching online.

A Collaborative Enquiry

This research study was enacted through a Collaborative Enquiry (Kaser and Halbert, 2014). As detailed in the methodology section below, this is congruent with the professional context of the research team, themselves teacher educators who, like the research participants, had moved their teaching online during the academic year 2020-21.

Methods and Methodology

The Collaborative Enquiry was enacted through a qualitative research study, taking an inquiry stance and utilising the 'Spiral of Inquiry' (Kaser and Halbert, 2014), a framework for collaborative inquiry from Canada. It places learners at the centre and begins by asking:

- *What is going on for learners?*
- *How do we know?*
- *Why does it matter?*

This stance provided a way to deeply understand practice (Timperley, Kaser and Halbert, 2014), and was an effective method for exploring the 'real-life context of practice' (Hall and Wall, 2019, p. 12). From an epistemological perspective, knowledge was seen as socially constructed (Wenger, 1999) and situated within peoples' lived experiences (Riveros, Newton and Burgess, 2012). The study focused on the potential transformation of teacher educators' practice, in relation to digital skills and competences, following the 2020-21 Covid-19 pandemic.

In the context of this research, teacher educators were the learners, and the research began by seeking to understand their perceptions and experiences. Two reflective discussions with the research team formed the first stage of the research process, enabling the team to 'scan' (Kaser and Halbert, 2014) and take a wide perspective on the learning of teacher educators. In these discussions, experiences and reflections were shared which highlighted some key concepts: resilience, agency, problem solving, the use of (and confidence with) digital tools, trust, reluctance, and emotions. From this starting point the research study was developed. The research questions posed were:

- How has teaching online during the academic year 2020-2021, affected teacher educators' confidence and/or competence with digital technology?

- What factors have influenced this?

- In what ways have teacher educators' experiences of teaching online influenced their pedagogy and practice?

An invitation to participate in the study was posted on the Teacher Education Microsoft Team and e-mailed to the staff team. Twelve participants came forward to take part in the study. After University Ethics approval was gained for the study, group interviews were carried out using Microsoft Teams, because Teams was a familiar context for both researchers and participants as it was being used for staff meetings and communications whilst working from home during Covid-19 restrictions. These group interviews provided the participants with time to share their experiences with each other and stimulate 'in-depth exploration' (Stewart, Shamdasani and Rook, 2009, p. 590). Each interview had two interviewers and two or three interviewees all of whom worked as teacher educators in the University context. The eventual eleven participants had a variety of experience, subject specialisms, and seniority, with two participants working in managerial roles. The interview groups were purposefully organised, acknowledging the influence of group dynamics (Stewart, Shamdasani and Rook, 2009) and to ensure, as much as possible, a positive social dynamic where participants felt confident to share their experiences and co-construct their response (Morgan *et al.*, 2013). To ensure consistency across all four group interviews, the interviewers used an interview script in which the questions were designed to stimulate discussion between the interviewees. To allow participants to discuss their responses without intervention from the interviewers, the interviewers' cameras were switched off after each question was posed. Participants were asked to respect the confidentiality of other participants in the interviews and not share the discussion.

Following the interviews, and before the transcripts were shared with the research team, the transcripts for each interview were anonymised for confidentiality by removing the names and identifiers of individuals, and the data was stored securely. This enabled the research team to focus on what had been said rather than who said it. Four members of the research team coded the transcriptions using first cycle descriptive coding (Saldaña, 2021). The first cycle coding was compiled in Nvivo, generating 310 codes. Second cycle code mapping (Saldaña, 2021), by one researcher, then organised the 310 codes, grouping them into coherent themes. Through the process of code mapping, three main themes, seven subthemes and a series of categories emerged, as shown in Figure 2.

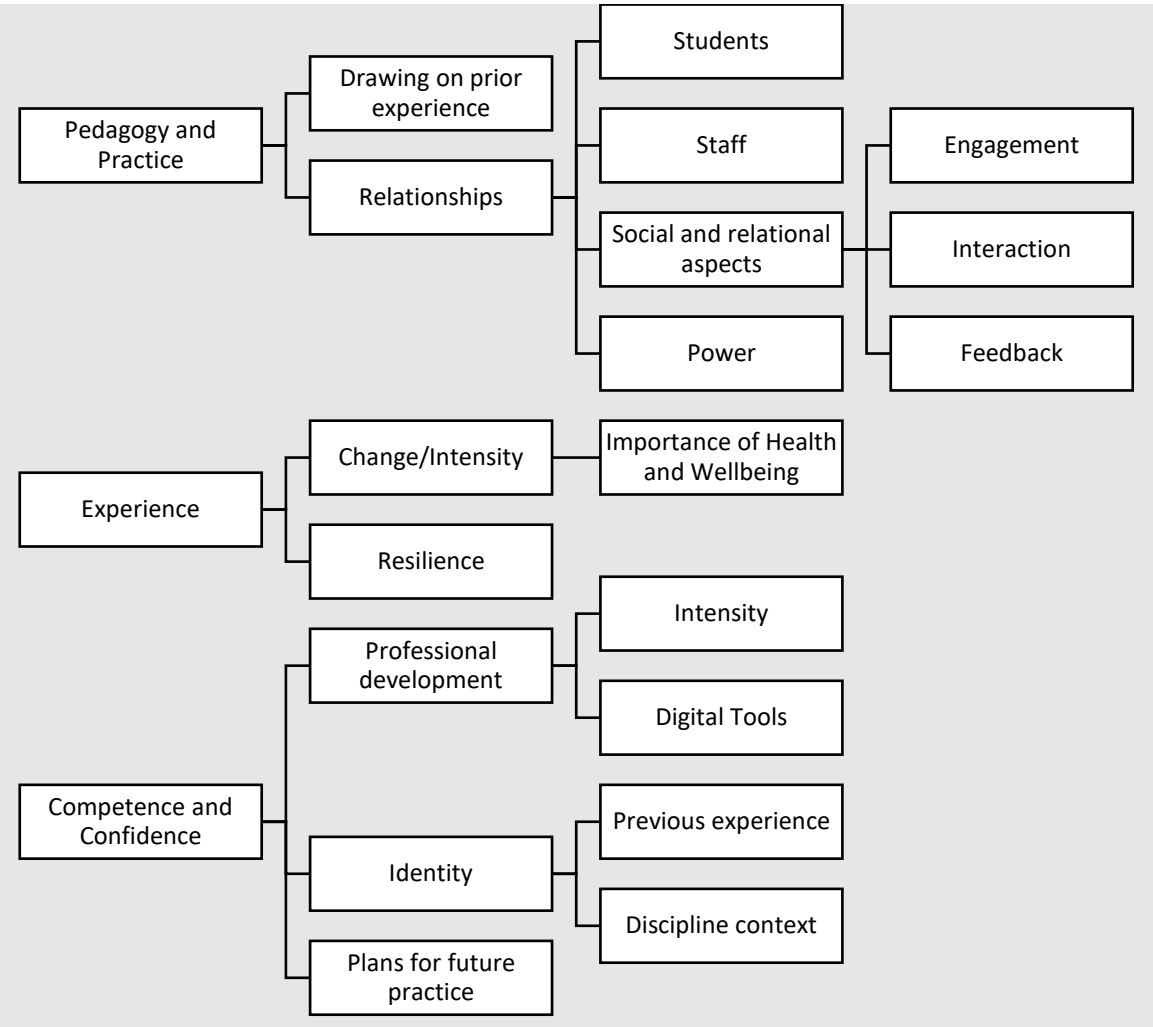

Figure 2. Themes, Subthemes and Categories.

Following the code mapping the researchers returned to the original scripts to refine and develop the themes and codes and check for outliers or anomalies.

Results

What emerged from the data analysis was a sense of the holistic nature of the experience of teaching online during Covid-19. Beyond simply a set of skills or capacities the digital modality influenced the practices and social interactions of teacher educators' daily lives. The positioning of teacher educators in relation to their previous experience with digital tools influenced their engagement with the training offered. The health and wellbeing 'buffer' offered by spatial boundaries (moving between locations) was lost. While geographic boundaries were broached, temporal boundaries were challenged by an underlying assumption of efficiency.

Results are organised by the three key themes that emerged from the qualitative coding process.

Theme One: Pedagogy and Practice

A key theme that emerged in relation to teacher educators' pedagogy and practice was relationships. Teacher educators who had experienced teaching online before the pandemic drew on their previous experience with this delivery type, and the move to online provided an opportunity to develop their skills with digital tools for teaching. For teacher educators for whom face-to-face teaching on campus was the norm, the switch to online marked a change: interactions with students were now mediated

through digital platforms and this resulted in changes to the relational aspects of pedagogy. Student engagement, interactions and feedback were identified as impacting on the teacher educators' experience. The social and relational aspects of teaching were impacted:

> *I think prior to lockdown, rapport was something I didn't even really even think about. It was always something that was really important to me but I didn't have to put too much effort into thinking about how to build rapport with students. And face to face I thought that was quite easy. Then, in lockdown, it was much more difficult*
>
> (Participant B).

Engaging students became more challenging:

> *…sometimes there would be tumbleweed. They wouldn't be there, and it became excruciating because I thought well their names are there…*
>
> (Participant E).

Teacher educators recounted the cues they would have relied on in a classroom environment that were lost online:

> *You could be walking around a group and you know, just hear something in the discussion and you want to tease that out*
>
> (Participant H).

> *I think one of the key things as I was delivering it that I noticed was how much I obviously relied on that those sort of passive interactions that happened between you and your learners that you would pick up and body language and tone. You know in the in the atmosphere, in the room and you know I would notice that in lots of ways. When I was teaching online. Well, it was harder without that feedback to think, is this going over their head, is it too fast and too slow?*
>
> (Participant D).

Online interactions lost the paraverbal and non-verbal cues of face-to-face interactions when students did not put their cameras on or interact:

> *I find that really difficult to get conversation going with them … none of them would put on their cameras …*
>
> (Participant G).

> *I don't like it when the students … won't put their cameras on because I just find that really, I don't know. Well, we all know what that's like, it just feels too impersonal. I, but again, I suspect some people are sitting there thinking, well, I don't have my makeup on or whatever…*
>
> (Participant I).

Feedback from the students was no longer instant and engagement was challenging:

> *You can use hand signals and all sorts of stuff to engage them. And I was trying to do that online and it was a complete disaster. Because of the time lapse… it just doesn't work*
>
> (Participant K).

Teacher educators with experience teaching online reflected on the different groups of learners and the challenges of engaging them:

> *I suppose one of the challenges in undergrad is engagement, is trying to engage them meaningfully, and I think a lot of it's about the insecurities and … also their own expectations*
> (Participant C).

All the above transcript extracts highlight the central role that face-to-face interactions play in the context of teacher education:

> *This is about building a community, building belonging, and teaching is face to face and therefore a lot of it is about our, you know, our discussion and our negotiation*
> (Participant A).

Collegial relationships and professional dialogue were also mediated by digital platforms during periods of lockdown. Some staff experienced feelings of isolation because the day-to-day campus-based interactions were lost: '*…sitting at this computer in our roles, has just been absolutely tiresome...*' (*Participant B*). However, for other staff, the digital spaces – and their 'newness' – resulted in more collegial discussion as staff negotiated new pedagogies and practices. In Interview 4 'sitting at the computer' mediated connection rather than isolation:

> *I don't think in the last year, year and a half I've spoken so much about my teaching and what I'm doing with students...*
> (Participant I).

> *…have more of those discussions with colleagues, I suppose too, become less of … an echo chamber, because I had to have discussions with colleagues and folk and students about, you know what I'm doing and why I'm doing it and how I'm doing it*
> (Participant K).

In Interview 3, the potential to challenge geographic boundaries was an affordance which enabled interaction:

> *This year in terms of professional development and network and that I just wouldn't have been able to do because it would have been geographically based and it wouldn't have been open to me and I wouldn't be able to do it. And I've loved that, and that is really exciting moving forward*
> (Participant E).

Collegial relationships, like other aspects of digital practice, were experienced in different ways by different staff members and tensions were observed as digital platforms afforded both isolation and connection.

Theme Two: Digital skills and Digital Tools

Digital practices experienced in different ways by teacher educators were partly because of the varying degrees of knowledge and competence of using online digital tools for teaching and learning pre-Covid-19. This was acknowledged by one teacher educator who felt that there were only a few members of staff who had a high level of digital expertise:

Many of us started at the same level last September. Apart from certain folks that you know, like people that teach in the distance learning programmes and people that are interested in technology

(Participant J).

A teacher educator, who had experience of online teaching, was excited about the prospect of the campus programmes shifting to online due to understanding '*what online learning is about*' (*Participant D*). Even with this prior knowledge, experienced teacher educators still found that they had to familiarise themselves with new digital tools. The desire to incorporate more interaction to enable students to have a voice was highlighted, and tools that were embedded in the video conferencing applications such as breakout rooms and the chat function, or additional tools such as Padlet and Mentimeter, were utilised as a result.

Once teacher educators had mastered the technical skills, they were then able to enjoy using the technology as it became a part of their teaching toolkit rather. Repetition of using the technology to become competent and confident was discussed, agreeing that time is a crucial factor in developing digital skills:

…it's not just about learning something, but it's about becoming confident, becoming you know expert in it, becoming, you know that normally you know you've got a bit more time, a bit more capacity to be able to do that

(Participant K).

Finding time to embed digital practices and learn how to use new digital tools could be a challenge (Interview 3). Although there were opportunities to attend training sessions, the teacher educators in Interview 3 found it difficult to allocate time in their workloads to attend these. For some, an important factor was focusing more on the content rather than the technology:

I think for me, keeping my focus on. On my subject area, rather than being dictated to by the digital element because I felt there was so much support, so many tools that were available that we were getting exposed to, encouraged to look at, that I felt I was becoming overwhelmed at all of that and after thinking about it I thought no go back to the bit that you know best which is your own context, your own subject area

(Participant I).

Alongside developing their knowledge of digital tools, teacher educators were also aware of students' digital skills, and access, and how this impacted on the learning experience:

…I suppose this is the digital side is recognizing that the digital can sometimes take a bit more time as people (students) are trying to figure out a new button to click or they're using a Mac and I'm not. So, what does it look like for them?

(Participant F).

A challenge that was shared by many interviewees was that students did not have the same experience due to hardware issues, connectivity not always being stable or broadband speeds differing. This resulted in teacher educators having to adapt which technology to use based on the learners' needs rather than pedagogical considerations; for example, sharing links to videos for students to watch individually rather than playing a video synchronously where the quality might differ:

,,,trying to adapt my practice to the technology that we had. […] and it just sort of didn't work for some people. I think it depended on their broadband. Because it would sort of stop and start and the same with sort of video content would be a similar issue, so I had to kind of think around. So my work around for that was to put sort of video links in the chat for them to go and watch things

(Participant G).

Teacher educators developed new digital competences and practices which many can now see the potential of using when they return to campus-based teaching and learning.

Theme Three: The Experience of Teaching Online

With the rapid flip to teaching online, and accounting for the introduction of and need to use digital skills and tools, a key theme that emerged from the experience of teaching online was the impact of the pace of change. As with all improvements, change is required, but the speed with which the change to teaching online happened was reported as intense and as leading to feelings of pressure and stress.

Not only did teacher educators feel the weight of expectation to engage in new learning to improve their own digital knowledge and skills, but additionally they wanted to ensure that they were providing their students with a good learning experience:

…it's that balance of … we don't want to overload people with time and all of that, but at the same time you go ... What is the best practice? Because part of being university is not just, for them, it's not just the coming and sitting in a class, it's everything else that happens.

(*Participant A*).

Reflecting on their experiences in the past year, some teacher educators, whilst acknowledging the stress and pressure involved in the rapid change to working in a digital environment, were able to reflect on the affordances of working in this way:

I find that incredibly inspiring I think the blended approach has got all the different potentials … in terms of family life and finance and all the bits that we enjoyed by not having commutes

(Participant H).

I started to stress less about it because I was almost, you know it's just part and parcel of, and I suppose you know you can see that with students as well …, I think initially where they would come on and you know they were all sort of sitting dressed and as things sort of went, progressed a bit more, you know, the cameras come on and they're sitting there in their dressing gowns

(Participant J).

I mean, it's a whole year we have all done our job sitting at our computer and not stepping across the door, and I think that's amazing. It's not ideal, but it's amazing that we've done it

(Participant K).

Additionally, there has been a shift from worrying about the 'newness' of everything to a realisation that one needs to concentrate on what is going to make things different and better, even in the online environment:

If we were using Mentimeter to post something and not to panic if there were only five posts. But to give them just a little bit more time and then the communication would come along...

(Participant F).

managing my time by just focusing on what I needed to do digitally to teach my subject.…
(Participant I).

While it is unlikely that teacher education will remain wholly online, the need to be digitally literate and to infuse technology into what is taught, and how it is taught, will remain high on the agenda for all in education.

Resulting from the three identified themes above, and how they articulate with the TPACK framework, we have used the TPACK framework to highlight the factors that influence teacher educators' engagement with and use of digital technology in the following discussion.

Discussion

Prior to Covid-19, the starting point for many of the participants in the current study was a solid understanding and expertise in their subject content knowledge (SCK) and pedagogical content knowledge (PCK), which were occasionally supported by an integration of technology (Starkey, 2020). Lockdown necessitated a greater focus on and engagement with technological knowledge, technological content knowledge, and especially technological pedagogical knowledge (Koehler and Mishra, 2008). For the teacher educators in this study, who had taught face-to-face, this meant they had to learn how to use technology themselves, how to develop materials that were appropriate for an online learning environment and had to identify the best tools to use to effectively support learning and teaching online.

If, as Mishra and Koehler (2006) suggest, introducing technology can overwhelm even experienced practitioners, this, coupled with the speed with which teaching had to be converted into the online environment, compounded the feelings of stress and pressure. As exemplified by the TPACK framework, looking beyond content and pedagogical knowledge (PCK) to technological, content, and pedagogy knowledge (TPACK) to infuse technology in the learning and teaching environment is important. The teacher educators in this study had to look at their content differently and re-evaluate their pedagogical practices in response to the affordances of technology alongside their own learning and upskilling. Whilst these teacher educators could draw on their experience and expertise in learning and teaching face-to-face, they could no longer rely on this expertise, and their PCK did not necessarily translate to the online environment. This meant, in several cases, a change from being an expert face-to-face practitioner to being a novice online practitioner, which gave rise to feelings of not knowing what they were doing, feeling overwhelmed, and led initially to a lack of confidence (Northcote *et al.*, 2015). Lynch (2017) argues for a focus on philosophical and ontological approaches to be developed in relation to teaching with technology. The work required for these teacher educators to teach online, and their engagement with their content and pedagogic knowledge as they navigated digital tools and platforms, could be observed as philosophical and ontological action. The process was much more complex than simply acquiring a set of technology skills, compounding Lynch's suggestion that future work should take more philosophical and ontological approaches.

A key aspect, which is not obvious initially in the TPACK framework, is the influence of contextual knowledge (Mishra, 2019). Whilst these teacher educators had to work hard to integrate and infuse technology into their pedagogical practices, their understanding of the context, although not necessarily the online teaching context but the context of their learners, the influence of relationships, and the needs and expectations of the profession, was an area on which they built in the online environment. These teacher educators were aware of the challenges their students faced working online during this time and worked to alleviate this. Drawing on their pedagogic knowledge they looked to a range of digital tools to facilitate learning for their students. However, to develop technological knowledge takes time, something which they felt they lacked. A lack of time is identified as a barrier to professional development for online teaching (Ní Shé *et al.*, 2020), and a complicated

factor which requires attention (Barbera, Gros and Kirschner, 2012). In this study, the teacher educators were torn between time to attend training in technology and time to translate their content and pedagogical knowledge into the new digital context of practice. This highlights that separating technology from content and pedagogy when providing professional learning opportunities is problematic.

Relationships were observed as a central pedagogical tenet for the teacher educators in this study. Teaching in schools (and in the teacher education context of this research study) generally happens in a face-to-face context. The shift online during periods of lockdown moved both teachers and teacher educators into a new digital context, which did not have the same affordances as the physical contexts in which they were comfortable. The practices of teaching changed online, as the non-verbal and para-verbal cues of the physical environment were muted or lost (Slagter van Tyron and Bishop, 2009). Interactions, engagement, and feedback provide in-time pedagogical content knowledge (PCK) as they enable teacher educators to gauge student-teachers' current understanding and enable the teacher educators to respond accordingly. Without the ability to wander around the class or interact naturally with student-teachers, teacher educators had less access to pedagogic content knowledge and knowledge of their learners (Koehler and Mishra, 2009) than they would have in a face-to-face environment. While digital tools have been developed to capture this type of information (Kreijns *et al.*, 2004), an elevated level of technology knowledge is required to utilise them effectively. In this study, the interaction between the domains of the TPACK framework (see Figure 3), and the overlaps between the different domains, were highlighted as key areas for consideration.

The teacher-educators in this study were not all new to teaching online. For those with technological skills or experience, teaching online during lockdown provided opportunities for development, using digital tools to enable interaction and support student voice, thereby demonstrating engagement with pedagogical (PK) and technological knowledge (TK). For these teacher educators developing practice was observed as engagement with the mutually constituting nature of pedagogical knowledge and technological knowledge (TPK). The overlap of the TPACK framework provided a space for active engagement. Comments made by the teacher-educators with less experience teaching online suggested that their focus was on content knowledge and technological knowledge, at times worrying that the technology may lead the content. This reflects ongoing discourses in technology enhanced learning, in which the 'shiny light' of new technology may detract attention from the 'real' teaching. Darling-Hammond, Hyler and Gardner (2017) assert that effective professional development needs to be content focused and active. For the teacher educators with lower technological knowledge (and focused on content and technology), the TCK was a less active space, a situation compounded by the focus of professional learning provision being on technological knowledge, thus foregrounding TK rather than TCK. These teacher educators had high levels of content knowledge (CK), so the focus on technological knowledge (TK) positioned them as receivers of the inputs, and therefore less active than those engaged in the TPK overlap. This research suggests that effective professional development needs to consider the overlaps of the TPACK framework, as these are where the 'active' parts of professional learning happen, albeit in different ways depending on one's positioning in terms of the three knowledge domains. Future research could develop understanding of the mutually constituting elements of the TPACK framework, and the varying trajectories of teacher-educators as they engage with technology more frequently in their practice.

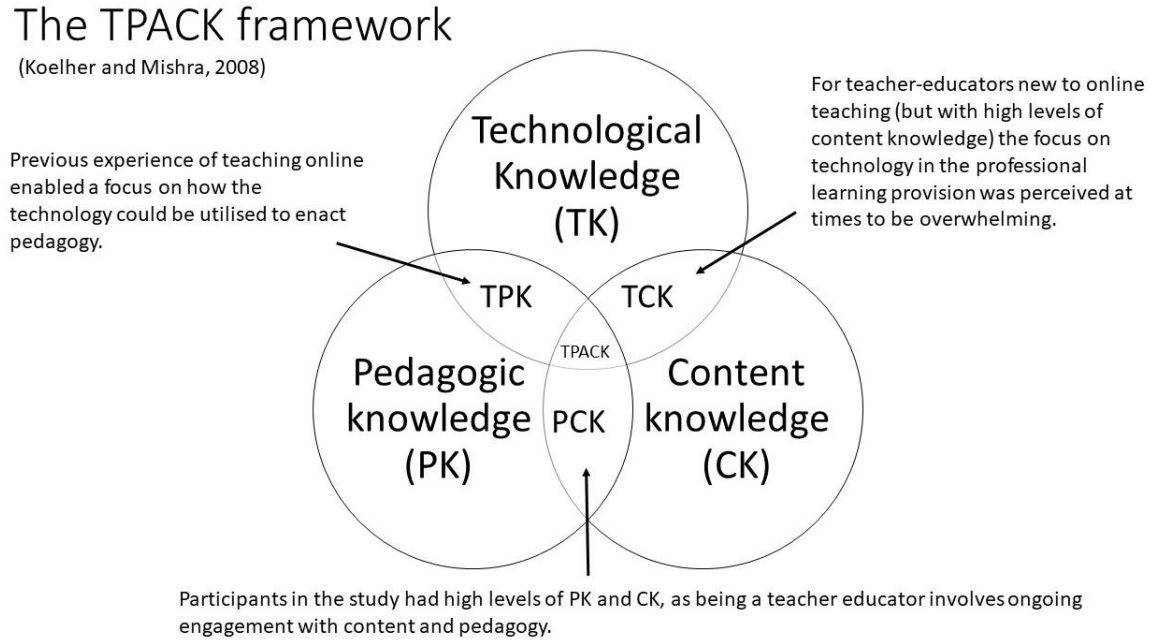

Figure 3. Applying the TPACK framework to our findings.

As well as supporting students and facilitating their learning, the teacher educators in this study worked collegially with colleagues and engaged in their own professional development but experienced both isolation and connection through their online collegial engagements. Online platforms removed geographic boundaries, enabling access to wider networks, and connections to geographically distributed groups of professional peers. Changes to the delivery of teaching, and working conditions, led to more collegial discussions about their teaching for some participants while for others they resulted in a sense of isolation. Social practices of professional networking and collegial interactions were influenced by the new digital context of practice and, although digital tools were able to remove geographic boundaries, new boundaries – affective and social interactions being diminished – were created through the nature of online working. Beyond accessing online platforms or using digital tools to develop knowledge and understanding (as presented in the TPACK framework), working online influenced the day-to-day social practices and experiences for these teacher educators.

Digital technology has been conceptualised as a cultural tool (Engeness, 2021) with the potential to redefine classroom roles and structures (Virmani and Williamson, 2016). This study suggests that when interactions – teaching or collegial – are mediated through digital tools the nature of the practice changes (Baroud and Dharamshi, 2020). If teacher educators are to prepare student-teachers for a digitally infused education system (Starkey, 2020) '*communication, interaction and dialogue*' (Gardner-McTaggart and Palmer, 2018, p. 272) are key considerations. Moving beyond the knowledge required to teach online, consideration of the experience of working online is required.

Conclusion and Implications for Practice

The findings of this collaborative enquiry confirm Mishra's (2019) contention that context matters. Teacher educators' practice is situated in place and time and therefore context is important. The rapid change and the newness of both tools and practices were factors which influenced the development of teacher educators' digital literacies, skills, and capacities, so additionally the context of practice should be a key consideration when designing professional learning.

A second consideration for professional learning is the mutually constituting nature of content, pedagogical, and technological knowledge (Koehler and Mishra, 2009). Teacher educators in this study brought a high level of pedagogic and content knowledge with them. The intersections between these and technological knowledge were the spaces in which learning happened. Engaging with technological pedagogical knowledge (TPK) and technological content knowledge (TCK) (Koehler and Mishra, 2009) would support teacher educators to draw on their professional skillset to develop pedagogically sound use of digital technology.

Social competencies (Bullock, 2016) and emotions are important as well. The findings suggest that we need to consider the holistic nature of practice, beyond knowledge. Digital tools increasingly mediate social practices, and in doing so change the nature of our interactions with one another, impacting relationships and wellbeing. Future research could examine the relational aspects of teacher educators' use of digital technologies or examine the impact on wellbeing.

The move online due to the Covid-19 pandemic was, hopefully, an anomaly and will not be repeated. Digital technology continues to be embedded in society, and education, and therefore it matters for teacher education. Student-teachers should feel prepared in terms of their digital literacies, skills, and technologies. Teacher educators have upskilled and developed confidence in the digital domain but to continue this trajectory, and engage with the ever-changing nature of digital technology, we need to consider it as embedded within our practice, rather than distinct, or sitting alongside it (Knox, 2019). Beyond teacher educators' knowledge, we need to consider the mediating role of digital technology on social practices (Baroud and Dharamshi, 2020), and (with that in mind) the role of teacher education in preparing student-teachers to thrive in a digitally infused education system (Starkey, 2020).

References

Andyani, H., Setyosari, P., Wiyono, B. and Djatmika, E. (2020) 'Does Technological Pedagogical Content Knowledge Impact on the Use of ICT In Pedagogy?', *International Journal of Emerging Technologies in Learning (iJET), 15*(3), pp. 126-139. Kassel, Germany: International Journal of Emerging Technology in Learning. Available at: https://www.learntechlib.org/p/217025/ (Accessed: April 2021).

Australian Curriculum, Assessment and Reporting Authority (ACARA) (2020) *Digital Technologies in focus*. Available at: https://www.australiancurriculum.edu.au/resources/digital-technologies-in-focus/ (Accessed: April 2021).

Barbera, E., Gros, B. and Kirschner, P. (2012) 'Temporal issues in e-learning research: A literature review', *British journal of educational technology,* 43**,** pp. E53-E55.

Baroud, J. and Dharamshi, P. (2020) 'A Collaborative Self Study of Critical Digital Pedagogies in Teacher Education', *Studying teacher education*, 16, pp. 164-182.

Brevik, L. M., Gudmundsdottir, G. B., Lund, A. and Strømme, T. A. (2019) 'Transformative agency in teacher education: Fostering professional digital competence'*, Teaching and Teacher Education*, 86, no page.

Bullock, S. (2016) Digital technologies in teacher education: From mythologies to making, in *Building bridges.* Brill Sense. pp. 1-16.

Caena, F. and Redecker, C. (2019) 'Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu)', *European Journal of Education*, 54, pp. 356-369.

Cabero, J. and Barroso, J. (2016) 'ICT teacher training: a view of the TPACK model / *Formación del profesorado en TIC: una visión del modelo TPACK*', *Culture and Education*, 28(3), pp. 633-663.

Crompton, H. (2017) *ISTE Standards for Educators*. International Society for Technology in Education.

Darling-Hammond, L., Hyler, M.E. and Gardner, M., (2017) *Effective Teacher Professional Development*. Palo alto, CA: Learning Policy Institute. Available at:

https://learningpolicyinstitute.org/media/477/download?inline&file=Effective_Teacher_Professional_Development_BRIEF.pdf (Accessed: April 2021).
Engeness, I. (2021) 'Developing teachers' digital identity: towards the pedagogic design principles of digital environments to enhance students' learning in the 21st century', *European Journal of Teacher Education*, 44(1), pp. 96-114.
European Commission (2019) *Digital Education at School in Europe*. Eurydice report. Luxembourg: Publications Office of the European Union.
Fisher, M. (2000) 'Computer skills of initial teacher education students', *Journal of Information Technology for Teacher Education*, 9(1), pp. 109-123.
Florida Center for Instructional Technology (2019) *Technology Integration Matrix*. Available at: https://fcit.usf.edu/matrix/matrix/ (Accessed: 26 October 2022).
Gardner-McTaggart, A. and Palmer, N. (2018) 'Global citizenship education, technology, and being', *Globalisation, societies and education*, 16, pp. 268-281.
General Teaching Council for Scotland (2021) *The Standard for Provisional Registration: Mandatory Requirements for Registration with the General Teaching Council for Scotland*. Edinburgh: GTC Scotland. Available at: https://www.gtcs.org.uk/wp-content/uploads/2021/09/standard-for-provisional-registration.pdf (Accessed: 26 October 2022).
Gudmunsdottir, G. B. and Hatlevik, O. E. (2018) 'Newly qualified teachers' professional digital competence: implications for teacher education', *European journal of teacher education*, 41, pp. 214-231.
Hall, E. and Wall, K. (2019) *Research Methods for Understanding Professional Learning*. London: Bloomsbury Publishing.
Hamilton, E.R., Rosenberg, J.M. & Akcaoglu, M. (2016) 'The Substitution Augmentation Modification Redefinition (SAMR) Model: A Critical Review and Suggestions for its Use', *TechTrends,* 60, pp.433–441.
Jandrić, P. (2017) *Learning in the Age of Digital Reason.* Rotterdam: Sense Publishers.
Kaser, L. and Halbert, J. (2014) 'Creating and Sustaining Inquiry Spaces For Teacher Learning and System Transformation', *European Journal of Education Research, Development and Policy*, 49(2), pp. 206-217. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/ejed.12079 (Accessed: April 2021).
Kelentrić, M., Helland, K. and Arstorp, A. T. (2017) *Professional Digital Competence Framework for Teachers*. Available at: https://www.udir.no/contentassets/081d3aef2e4747b096387aba163691e4/pfdk-framework.pdf (Accessed: December 2021).
Knox, J. (2019) 'What Does the 'Postdigital' Mean for Education? Three Critical Perspectives on the Digital, with Implications for Educational Research and Practice', *Postdigital Science and Education*, 1, pp. 357-370.
Koehler, J. and Mishra, P. (2008) Introducing technological pedagogical knowledge, in American Association of Colleges of Teacher Education (AACTE) (eds.) *The handbook of technological pedagogical content knowledge for educators*. New York: Routledge for the American Association of Colleges of Teacher Education. Routledge: Taylor and Francis Group. pp. 3–28.
Koehler, M. and Mishra, P. (2009) 'What is technological pedagogical content knowledge (TPACK)?', *Contemporary issues in technology and teacher education*, 9, pp. 60-70.
Kreijns, K., Kirschner, P. A., Jochems, W. and Van Buuren, H. (2004) 'Determining sociability, social space and social presence in (a)synchronous collaborative groups', *Cyber Psychology and Behaviour*, 7(2), pp. 155-172.
Lawrence, J.E. and Tar, U.A. (2018) 'Factors that influence teachers' adoption and integration of ICT in teaching/learning process', *Educational Media International*, 55(1), pp. 79-105.
Lindfors, M., Pettersson, F. and Olofsson, A. D. (2021) 'Conditions for professional digital competence: the teacher educators' view', *Education Inquiry*, 12(4), pp. 390-409.

Lund, A., Furberg, A., Bakken, J. and Engelien, K. (2014) 'What Does Professional Digital Competence Mean in Teacher Education?', *Nordic journal of digital literacy*, 9, pp. 280-298.

Lynch, J., (2017) Theorising teacher practice with technology: Implications for teacher education research, in Peters, M.A., Cowie, B., and Menter, I. (2017) *A companion to research in teacher education.* Singapore: Springer. pp. 741-752.

Mansilla, V. and Jackson, A. (2013) Educating for Global Competence: Learning Redefined for an Interconnected World, in Jacobs, H. (ed.) *Mastering Global Literacy, Contemporary Perspectives*. New York: Solution Tree.

Mishra, P. (2019) 'Considering Contextual Knowledge: The TPACK Diagram Gets an Upgrade', *Journal of Digital Learning in Teacher Education*, 35(2), pp. 76-78.

Mishra, P. and Koehler, M. (2006) 'Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge', *Teachers College Record,* 108(6) pp. 1017-1054. Available at: https://journals.sagepub.com/doi/epdf/10.1111/j.1467-9620.2006.00684.x (Accessed: April 2021).

Morgan, D, L, Ataie, J, Carder, P and Hoffman, K. (2013) 'Introducing Dyadic Interviews as a Method for Collecting Qualitative Data' *Qualitative Health Research*, vol. 23 (9), pp. 1276-1284

Ní Shé, C., Farrell, O., Brunton, J., Costello, E., Donlon, E., Trevakis, S. and Eccles, S. (2019) *Teaching online is different: critical perspectives from the literature*. Available at: https://doras.dcu.ie/23890/1/13758_Text_V3.pdf (Accessed: 21 April 2021).

Northcote, M., Gosselin, P., Reynaud, K., Kilgour, P. and Anderson, M. (2015) 'Navigating learning journeys of online teachers: Threshold concepts and self-efficacy', *Issues in educational research,* 25(3)**,** pp. 319-344.

Organisation for Economic Co-operation and Development (OECD) (2015) *The OECD Learning Compass 2030*. Available at: https://www.oecd.org/education/2030-project/teaching-and-learning/learning/ (Accessed: 27 April 2021).

Ottestad, G., Kelentric, M. and Gudmundsdottir, G. (2014) 'Professional Digital Competence in Teacher Education', *Nordic Journal of Digital Literacy*, 9(4), pp. 243-249.

Özgür, H. (2020) 'Relationships between teachers' technostress, technological content knowledge (TPACK), school support and demographic variables: A structural equation modelling', *Computers in Human Behavior*, 112, p.106468.

Puentedura, R. (2006) 'Transformation, technology, and education', *Hippasus blog, 2006*. Available at: http://hippasus.com/resources/tte/ (Accessed: 26 October 2022).

Phillips, M. (2016) 'Re-contextualising TPACK: exploring teachers' (non-)use of digital technologies', *Technology, Pedagogy and Education*, 25(5), pp. 555-571.

Player-Koro, C. (2012) 'Factors Influencing Teachers' Use of ICT in Education', *Education Inquiry*, 3(1), pp. 93-108.

Punie, Y. (ed.) and Redecker, C. (2017) *European Framework for the Digital Competence of Educators: DigCompEdu*, EUR 28775 EN, Luxembourg: Publications Office of the European Union. Available at: https://op.europa.eu/en/publication-detail/-/publication/fcc33b68-d581-11e7-a5b9-01aa75ed71a1/language-en (Accessed: 21 April 2021).

Riveros, A., Newton, P. and Burgess, D. (2012) 'A situated account of teacher agency and learning: Critical reflections on professional learning communities', *Canadian Journal of Education*, 35 (1), pp. 202-216.

Saldaña, J. (2021) *The coding manual for qualitative researchers*. London: SAGE.

Scottish Council of Deans of Education (No Date) *The National Framework for Digital Literacies in Initial Teacher Education*. Available at: http://www.scde.ac.uk/wp-content/uploads/2016/08/SCDE-National-Framework_B-151020.pdf (Accessed: 27 April 2021).

Scottish Government (2016) *Enhancing Learning and Teaching Through the Use of Digital Technology: A Digital Learning and Teaching Strategy for Scotland*. Available at: http://www.gov.scot/Publications/2016/09/9494/0 (Accessed: 27 April 2021).

Selwyn, N., Nemorin, S., Bulfin, S. and Johnson, N. (2016) Toward a Digital Sociology of School, in Daniels, J., Gregory, K. and McMillan Cottom, T. (eds.) *Digital Sociologies*. Bristol UK: Policy Press. pp. 147–162.

Shulman, L.S. (1986) 'Those who understand: knowledge growth in teaching', *Educational Researcher*, 15(2), pp. 4-14.

Slagter van Tyron and Bishop (2009) 'Theoretical foundations for enhancing social connectedness in online learning environments' *Distance Education*, 30(3), pp. 291-315

Starkey, L. (2020) 'A Review of Research Exploring Teacher Preparation for the Digital Age', *Cambridge Journal of Education*, 50(1), pp. 37–56.

Starkey, L. and Yates, A. (2021) 'Do digital competence frameworks align with preparing beginning teachers for digitally infused contexts? An evaluation from a New Zealand perspective', *European Journal of Teacher Education*. Available at: https://doi.org/10.1080/02619768.2021.1975109, pp. 1-17.

Stewart, D. W., Shamdasani, P. N., and Rook, D. W. (2009) Group depth interviews: focus group research, in Bickman, L. and Rog, D. J. *The SAGE handbook of applied social research methods* London: SAGE Publications. pp. 589-616.

Timperley, H., Kaser, L. and Halbert, J. (2014) 'A framework for transforming learning in schools: Innovation and the spiral of inquiry', *Centre for Strategic Education*, Seminar series paper 234, April 2014.

Virmani, R. and Williamson, P. (2016) Lessons for Teacher Educators about Learning to Teach with Technology, in Kosnik, C., White, S., Beck, C., Marshall, B., Goodwin, A. L. and Murray, J. *Building Bridges: Rethinking Literacy Teacher Education in a Digital Era*. Rotterdam: Sense Publishers.