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Making the transition from on-campus to online learning: Pre-service teachers' experiences of online learning as a result of COVID-19

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Abstract

Online learning is rapidly becoming the preferred study option for many higher education students, due to its accessibility, convenience and flexible teaching arrangements. For other students who have access to a university campus, their preferred option is to attend on-campus classes, where advantages include synchronous interaction with peers, lecturers and access to practical experiences, materials, and resources. The impact of COVID-19 resulted in interruptions to social, economic, cultural, and educational life, with social distancing measures and health and well-being concerns leading to widespread restrictions in numerous different contexts. Universities throughout Australia restricted access to campuses and shifted their teaching of classes to purely online delivery. This shift posed many challenges for students and staff as ways of teaching and learning were reconceptualised. This paper examines the experiences of two different cohorts of pre-service teachers from two different universities who were studying full-time on-campus at the time when the restrictions were applied and reports the impact the shift to online had on cognitive, social and teaching presence within a model of community of inquiry. The findings indicate that despite the challenges involved with the rapid transition to online delivery, participants were able to identify the presence of core elements of the model, and how these factors impacted upon their engagement with the course.

Practitioner Notes

1. Provide timely asynchronous and synchronous interactive opportunities to establish teacher presence.
2. Have confidence in using appropriate online tools and resources to maximise student engagement.
3. Allow for students' diverse needs in order to promote social presence.
4. Support the development of cognitive presence by providing well-design and structured course content.

Keywords

online learning, COVID-19, community of inquiry, teacher presence

Introduction

Adapting traditional courses to online learning in a time of crisis requires rapid improvisation by teachers with little support beyond the structural use of digital tools, resulting in a distinction between emergency remote teaching and planned intentional online learning. This distinction is acknowledged as a key aspect of post-digital research (Hodges et al., 2020). Understanding how teachers or instructors responded to a crisis can highlight aspects of instructional design for online learning (Rapanta et al., 2020), that may be an important consideration for designing online courses and adapting on-campus pedagogies to online spaces.

As a result of COVID-19, instructors who were reliant on materials-based or hands-on approaches needed to adapt how they might represent ideas and concepts for teaching their subjects within the mediation afforded by the digital context. In the context of this study, pre-service mathematics education instructors were required to consider additional pedagogical dimensions to ensure continued access for pre-service teachers (PSTs), while at the same time creating a virtual space that imitated on-campus face-to-face seminars. While it is recognised that trying to make online learning the same as face-to-face will lead to less optimal learning (Swan, 2003), online education has the potential to support paradigm changes in teaching and learning. In particular, models such as Garrison et al's (1999; Garrison, 2007; Garrison, 2017; Garrison & Cleveland-Innes, 2005) Community of Inquiry identify that key elements, such as cognitive, social, and teacher presence, can have a significant impact on how online learners engage with their courses.

To investigate how students studying primary mathematics education experienced the rapid shift to online learning as a result of COVID-19, we used a case study approach to address the following research question:

- How did the rapid shift to online teaching impact university students' perceptions of their engagement with their mathematics teacher education courses?

While acknowledging that increasing numbers of students are choosing to study online due to a range of factors, in 2020 COVID-19 restrictions meant that students who had elected to study on-campus were suddenly thrust into the online learning space. Similarly, on-campus instructors were suddenly faced with making a rapid transition to adapting and teaching online. The following review of literature defines factors that impact online learning, including student perceptions of online learning, teachers' perceptions of online teaching, engagement and motivation in an online environment, and online pedagogies.

Review of literature

Student perceptions of online learning

During COVID-19 students who did not choose to learn online were forced to adapt to online learning. Some students may have been familiar with online learning because an increasing number of students of all ages and backgrounds are choosing to study online. In 2016, there were over 1.4 million higher education student enrolments across Australia, and while the majority

studied on-campus, 15% studied online and 12% studied multi-modally (Department of Education & Training [DET], 2016). Therefore, moving from 15% to most likely 100% of students studying online is a very significant difference. While studying online has its advantages in terms of widening access to higher education and providing students with the opportunity to balance study with other demands and responsibilities (Stone et al., 2016), concerns have consistently been raised about levels of completion and first-year attrition rates (e.g., DET, 2017; Stone & O'Shea, 2013).

Recent student experiences in online learning comprise both positive and negative experiences. Positive aspects of online experiences include flexible access to materials, good access to academic support and advice online, effective use of technology, and the capacity to manage their own time better (Tertiary Education Quality and Standards Agency [TEQSA], 2020). Conversely, negative issues include academic interaction, Instructional Technology (IT) related issues, and staff expertise with using IT applications, as well as feelings of isolation, lack of engagement, and reduced motivation. Even more recently, Abushammala et al. (2021) found that reduced student satisfaction, extra coursework, and inability to pay course fees were identified as issues. Other evidence points to the ongoing pandemic negatively affecting learning experiences and creating social distancing concerns (Wilson et al., 2020). In addition, there were also concerns raised about the difficulty with the translation of some subject areas from an on-campus to an online mode of delivery (TEQSA, 2020).

Teachers' perceptions of online teaching

Less has been reported related to the impact of online learning on teachers. Given many teachers have most likely never been tasked with teaching online prior to COVID-19 they too would have experienced positive and negative experiences. One of the biggest challenges would have been to develop alternative approaches to engage students in the learning outcomes which may well challenge the existing pedagogical content knowledge (PCK) (Shulman, 1987) of instructors. Research has shown, however, that student retention and engagement can be improved through the use of relevant online learning tools, increased opportunities for interaction with students and instructors, attention to teacher presence, and the use of sound pedagogical principles (Stone, 2017). Interestingly a common error made by teachers when transitioning to online teaching is the tendency to apply the face-to-face syllabus and teaching approaches directly to the online environment (Kenzig, 2015).

Engagement and motivation in an online environment

The shift to online teaching forced educators to seek out resources and tools that were accessible, creative and effective (e.g., Livy et al., 2021). When engaging students in synchronous online tutorials, instructors were often faced with student reluctance to use the video in Zoom (or equivalent) sessions or to 'perform' at tutorials and other discussions while being filmed or recorded (TEQSA, 2020, p.17). Kenzig (2015) also found that online learning instructors often neglected to consider appropriate ways of interacting online and that communicating online required different skills than communicating in person, particularly in text-based forums such as

discussion boards. Further, in a review of the literature on online teaching and learning, Carrillo and Flores (2020) noted the importance of social, cognitive and instructor presence in the engagement of online learners. The ability of teachers and learners to engage in meaningful relationships, along with components of cognitive and teaching nature were crucial to maximising teaching and learning impact.

Online pedagogies

While a recent report (TEQSA, 2020) showed that a great deal of effort was put into making the transition to online or remote learning as successful as possible, students indicated a desire to return to on-campus teaching. Pedagogical approaches that really make online learning 'work' for students is when they can connect with the content, the course instructor, and the other students in the course. These aspects are likely to be particularly pertinent in the context of COVID-19. Kara (2021), for example, found that during the COVID-19 pandemic, students identified the willingness of the instructor to be flexible, understanding, positive, and respond to students in a timely manner as enablers to their learning and engagement. Together with instructor competence, behaviour and attitudes, well-structured content, and assessment were also identified as factors that made online pedagogical learning experiences successful (Kara, 2021).

In making the rapid shift to online teaching, teaching staff of all backgrounds and levels of experience were required to prepare and deliver their classes from home, with all the practical and technical challenges that this entailed, often with limited technology support (Hodges et al., 2020). As a result, instructors experimented with different tools for online interactions, such as web and video conferences, chats and forums, but often experienced difficulties translating required PCK to online teaching (Rapanta et al., 2020). Online learning and teaching approaches involve a diverse range of tools, resources, pedagogical approaches, roles, and forms of interaction, monitoring, and support (Rapanta et al., 2020), which pose challenges for instructors whose PCK was developed when teaching face-to-face. Online learning requires a high degree of instructor/student interaction. As Kenzig (2015) noted, one of the biggest mistakes made when adapting a course for online delivery is attempting to replicate the face-to-face interactions, which does not work.

For mathematics teacher educators, whose on-campus face-to-face classes were characterised by participation in interactive activities, the challenge was to devise alternative ways to provide their learners with appropriate mathematical experiences. Learning online requires different forms of representations when considering the use of concrete visual representations of abstract concepts, the scaffolding of complex learning content, and engagement in lifelike environments (Means et al., 2014).

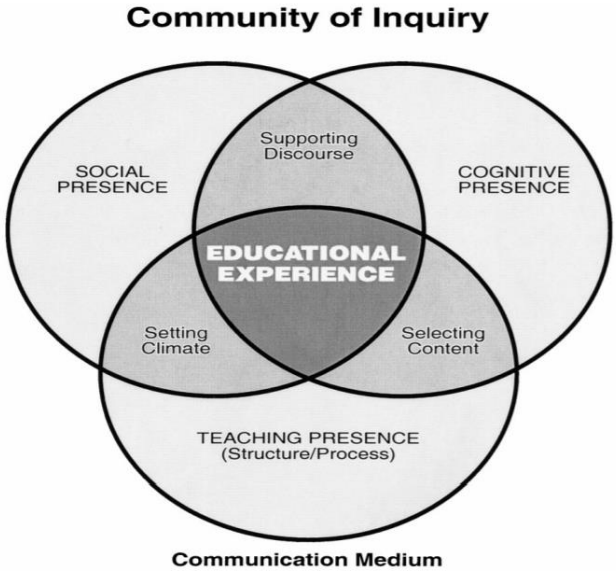
Theoretical framework

If the instructor is seen as a designer for learning, then online learning requires re-assembling teaching and learning activities in ways that help to situate the learning in a new context. According to Garrison et al. (1999), a worthwhile educational experience is embedded within a Community of Inquiry, with learning occurring through the interaction of three core elements:

cognitive presence, social presence, and teaching presence (see Figure 1). This next section examines Garrison et al.'s (1999) model, the three elements; social, cognitive, and instructor presence, and their role in supporting online learning.

Figure 1

Community of Inquiry Framework (Garrison et al., 1999, p. 88)



Cognitive presence refers to how the instructor takes into consideration students' preparedness to participate in online learning experiences. It refers to the extent to which learners can construct meaning through sustained reflection and discourse (Garrison, et al., 1999) and is primarily connected to the learning context. In practice, online cognitive presence may be manifested in web conferences, structured and unstructured forms of participation, and practical videos of authentic classroom situations that facilitate high levels of reflection (Carrillo & Flores, 2000).

Social presence is established through the social communication channels that teachers open to maintain student-student and student-teacher interaction. Social presence functions as a support for cognitive presence and involves the ability of learners and teachers to interact, collaborate, and build relationships with other members of a Community of Inquiry. In practice, social presence is characterised by consistent participation, prompt communication, regular group discussion, timely and relevant contributions, and commitment to tasks (Vinagre, 2017). While it has been suggested that social presence is difficult to establish in online collaborative learning environments using text-based asynchronous communication media (e.g., discussion boards), social presence can be cultured if participants project their identities through carefully drafted posts or messages (Kreijns et al., 2014).

Teaching presence is primarily the role and responsibility of the instructor who designs the teaching experience and facilitation of students' learning and interactions. Teaching presence encompasses design and administration, facilitation of discourse, and direct instruction (Anderson

et al., 2001). In practice, teaching presence can be seen in the way instructors structure pace and flexible learning experiences, set expectations, and manage participation requirements and timelines whilst targeting students' needs and interests.

Teaching presence has been seen as more predictive of student success in online learning than peer interaction (Means et al., 2014). Other theorisations have proposed the mediating relationship between social presence and teaching and cognitive presence (Garrison et al., 2010), and the mediating relationship of cognitive presence between teaching and social presence (Kozan & Richardson, 2014). Recent re-examinations of the relationships between teaching, social, and cognitive presence suggest that teaching presence exercises a distributed rather than centralised function (Dempsey & Zhang, 2019) that impacts directly on the cognitive presence and social presence, with indirect positive impact on student learning (Law et al., 2019).

Given the study's focus on understanding the factors which impact students' online engagement, Garrison and colleague's (1999) Community of Inquiry Framework provided a useful model for examining evidence of the core elements of social, cognitive, and teaching presence in each of the case studies. The value and relevance of the framework to higher education online learning is also evidenced by extensive reference to it in the research literature (e.g., Rourke & Kanuka, 2009).

Methodology

This study adopted a qualitative, case study approach (Stake, 2005) to explore the phenomenon of online learning for two groups of PSTs in primary mathematics education. Case Study 1 involved PSTs and their instructor who were obliged to move to online teaching as part of the emergency due to COVID. Case Study 2 involved PSTs and their instructor who had access to online discussion boards and content materials as part of their course before the pandemic, along with attending on-campus face-to-face tutorials. Both case studies obtained full ethical approval from their respective institutions. Details about the context and background of participants in each case study are included in the Results section.

Within an interpretivist methodology, the aim was to determine PSTs' perspectives in each case. The approach was generally descriptive (Yin, 1984) in using semi-structured interviews to find out what online learning was like for participants in both cases through questioning them about their experiences, interactions, and feelings when reflecting on their online situation. The use of semi-structured interviews enabled the interviewer to utilize a range of tailored questions and prompts to fully draw the participants into the research topic (Galletta & Cross, 2013). The versatility of this method of data collection facilitated the exploration of participants' experiences based on the differing contexts of the two mathematics teacher education courses investigated.

Questions related to the PSTs' previous experiences of studying online or on-campus, their reasons for selecting online or on-campus tutoring, their engagement with the course, what the PSTs felt they missed about on-campus tutoring, and what they enjoyed about online tutoring formed the basis of the interviews. Further questions explored how comfortable they felt with engaging online, and what aspects of on-campus tutorials were and were not successfully

transitioned to online. Finally, PSTs were asked about ways that online delivery impacted their preparations to teach mathematics.

Interviews were conducted online with five participant PSTs in Case Study 1. Four were interviewed as a group and the fifth PST was interviewed individually. In Case Study 2, interviews were conducted with six PSTs. Three of those participants were interviewed as a group, two were interviewed individually and one provided a response via email. Data were collected from participants through these differing modes due to participant convenience and preferences. As such, interviews were carried out late afternoon or early evening when students did not have other commitments. The length of interviews varied from forty minutes for group interviews to twenty minutes for individual interviews. Whilst these different modes led to some inconsistencies, interviews were conducted to ensure that participants had the opportunity to respond individually with prompts to draw out perspectives. As there was no opportunity for prompts in the email response, this was less consistent but still provided for the participant to give their perspective. The number of participants from each case was small and their experiences were intrinsically linked to the two different contexts. As such, the findings from this study are not intended to be generalisable, and the adopted approach produced rich qualitative data sufficient and appropriate to address the aim of the study to understand the individual issues regarding online learning.

Data analysis

Analysis of interview transcript data employed a recursive thematic approach (Braun & Clarke, 2012; Merriam & Tisdell, 2016; Miles et al., 2014) in which the researchers considered the data in light of pre-existing themes identified from the literature, while at the same time, being sensitive to new emergent patterns (Percy et al., 2015; Vaismoradi et al., 2013). Data from one interview were coded by two researchers to establish inter-rater reliability (Denzin & Lincoln, 1994), and the resulting codebook was applied by the project research assistant to the remaining transcripts. The coding process identified initial descriptive topic codes (Miles et al., 2014), which were ultimately gathered under themes of broader, over-arching significance (Braun & Clarke, 2012). Those themes included the affordances or benefits, and challenges arising from the transition to online teaching, as well as the engagement of PSTs' reflections related to studying online. Deductive analysis was then carried out according to Garrison et al.'s (1999) framework; cognitive, social, and teaching presence. A matrix query focused on the affordances and challenges against the three deductive codes provided an overview of participant perspectives in each case (Table 1; Table 2). The interview responses in each cell of the matrix query were then interrogated further to identify perspectives specific to each case. These perspectives are presented for each case in the results below.

In keeping with case study methodology (Stake 2005), the results have been written as two individual cases to illustrate the experiences of the two different cohorts of PSTs, from two different universities, who were studying full-time on-campus at the time when the restrictions were applied. The case study quotations were drawn directly from the participants' interview transcripts, with allowances for anonymisation.

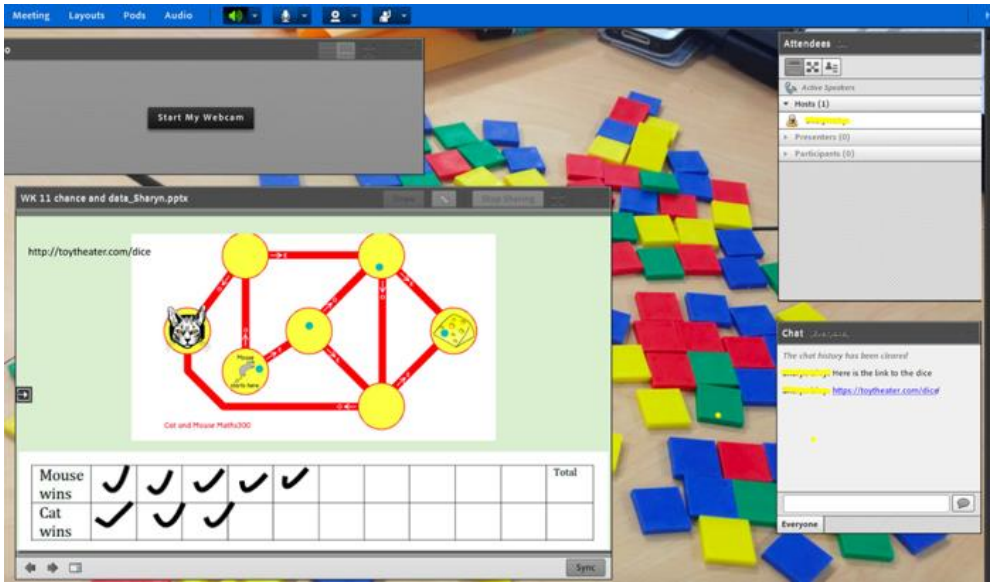
Results case study 1: Primary mathematics education (Bachelor of Education)

Context

Case Study 1 took place in a metropolitan Australian university and involved a cohort of 20 third year PSTs who were enrolled in a four-year undergraduate teaching degree. Data were collected from five participants after they had completed their second and final mathematics education unit of a four-year Bachelor of Education (Honours) specialising in primary education. COVID-19 restrictions in Semester 1, 2020 necessitated an immediate transition to online teaching utilizing an Adobe Connect (version 2019.9.2) virtual classroom (see Figure 2) for 90 minutes with their instructor. This arrangement replaced the planned, ten-week, face-to-face, two-hour tutorials. The virtual classroom included an online white board, links for screen sharing, breakout rooms, camera, microphone, and chat box feature. Figure 2 shows an example of an activity which incorporated interactive features and a chance and data gameboard. In addition, each week PSTs watched a pre-recorded lecture and completed set readings.

Figure 2

Screen Shot of Adobe Connect Virtual Classroom Activity: Probability



The following results report on data collected from the PSTs (n=6) who agreed to participate in focus group interviews. The results are structured around three elements of the educational experience framework: cognitive, social, and teaching presence. For each element, the affordances and challenges as identified from the data in Table 1 are presented.

Table 1
Total of Affordances and Challenges for Case Study 1 Participants

Elements	Affordances	Challenges	Total
Teacher presence	0 (0%)	14 (19%)	14 (19%)
Social presence	8 (11%)	21 (28%)	29 (38%)
Cognitive presence	11 (15%)	21 (28%)	32 (43%)
Total	19 (25%)	56 (75%)	75 (100%)

Table 1 shows that overall, for Case Study 1 there were more challenges (75%) than affordances (25%) for each of the three elements of the Community of Inquiry framework. The highest numbers of responses in relation to affordances and challenges were coded as cognitive presence, while no affordances were noted for teacher presence and the overall total for this element was low (19%).

Cognitive presence

In terms of cognitive presence, 32 responses were coded with 15% being identified as affordances and 28% as challenges. Affordances included positive comparisons with face-to-face experiences when interacting with the technology and sharing experiences with each other online. Some students who identified affordances referred to benefits specific to online learning. The following quotes are illustrative examples of the responses received. One participant described mathematics online learning as more engaging:

> *Like, a lot of the other units were just, you know, you watch we'll tell you, but like, there was a lot more engagement and actual, like, an attempt to use computers as a means of trying an activity, which is quite difficult* (R4).

The teaching tools within the online platform encouraged PSTs to interact and engage and were described by participants as "feeling more normal", including the "virtual whiteboard, which I found a bit more similar to a classroom" (R4).

Participants also agreed that the direct instruction from the lecturer was similar online when compared with face-to-face experiences, with responses such as, "She asked a challenging [mathematical] question to us, and then let us work on it and let us think about it. So that was really good" (R5). Another benefit, when compared to face-to-face, was the ability to play back recordings of the online lecture if needed or skip sections. One participant noted that, "You can skip along or replay an idea, if it's tricky. Or skip along, if it seems like it's rambling and it's not relevant. So yeah, I think voice recordings to explain ideas was very, very good" (R5).

There were 21 responses that were coded as challenges in relation to cognitive presence. Challenges related to the useability of technology and technology functionality; the delivery of online content, including access to hands-on materials; and lack of interaction with the lecturer and peers.

As the technology was new to the PSTs (and the instructor) it was not surprising that some PSTs reported difficulties navigating the software. As one PST observed, “The software itself was just a nightmare” (R1). When learning online students had the option of joining a live session or watching a recording of the session afterwards. For those who watched the recordings, there were no opportunities to participate in reflection and discourse with others in the moment. As one PST commented, “So, if you wanted, you could do it online [watch a recording], but obviously you miss out on the content … not a good way of doing it” (R4).

The structure of the live tutorials also had limitations, with one PST noting that “The digital [platform] just made it a bit hard to concentrate … two-hour face to face class is better, but yeah … it’s hard to concentrate for that period of time online” (R2). Other obstacles identified included, “It was a bit clunky trying to get break out rooms organise … or forgetting to turn your mic on” (R1) and “when cameras are turned off or a microphone is turned off it’s much harder to be comfortable” (R5).

There were limitations encountered online as to how the instructor assisted students to learn mathematics, particularly in areas such as problem-solving. When teaching students about the need to consider different ways to solve problems as preparation for teaching, it was noted by one PST that, “not being able to have your written working out, checked by the teachers … it’s not impossible [online], but it’s very, very easy in the classroom … to raise your hand and ask for some help, get some instant assistance” (R5).

Others described the limitations of online learning in relation to the use of materials when compared with face-to-face learning. Typically, PSTs used materials such as counters, measuring equipment, blocks, and dice when learning on-campus how to teach mathematics. However online experiences were a challenge when modelling because the PSTs could not explore the materials for themselves. A participant commented that “Not having that was sometimes a bit difficult for me” (R1).

Social presence

Most social presence comments related to a lack of interaction and challenges of online learning. Eleven per cent of responses were coded as affordances, and 28% were coded as challenges. Overall, PSTs described online learning as “comfortable” (R2), they were “happy to share” (R4), and they “definitely developed lots of different friendships” (R3). However, as the PSTs had been together for the past two years on-campus, memories of prior learning experiences influenced many of the following comments relating to the social benefits and challenges of online learning.

In other comments, the mathematics online tutorial was compared with other online subjects by participants. “I found our class was actually quite good with the interactions” (R4). The interactions and activities supported social presence because, “This class had a lot more activities and more involvement of the students” (R2).

Challenges again related to the interface of technology, and participants made comparisons to what was missing.

> *When you were with your peers and with your lecturer [on-campus] whereas opposed to something like Zoom, that's not real human, [but] you can share your screen – but other than that, like, you know, you can actually like both do the same worksheet or ask the same questions [when on-campus].* (R1)

One PST made several observations with regard to challenges related to social presence. They described their feelings of not liking communications online.

> *I feel like when you're actually in a class together, you work together to, like fill in the blanks that each other are missing, whereas, like, I just felt like a bit of a pest whenever I message any friends, like, "Hi, how are going with your assignment?"* (R5)

This response suggests online learning may have impacted the participant's learning because of a lack of social interactions. Equally the chat box feature was a negative experience for them. In the view of one PST, "The chat box was there when the answers were being put in. I don't know, I just found it not very good" (R5). Two other communication challenges included "[not] being able to look around and judge everyone's body language" and "when you speak, you're the focus of everyone's screen" (R5).

R5 particularly found the experience socially challenging as they had deferred the previous year and did not know the other students. They felt, "much more nervous than I would have otherwise" and also uncomfortable learning online. As that participant commented, "Absolutely more uncomfortable than I do in class for some reason … feeling really, really nervous" (R5).

Other social presence factors related to motivation and lack of opportunities for social interaction. Participants felt that "sitting at home and trying to focus" was challenging and difficult, because, "when you're at university you end up talking about other things [and] we only spent classes [online] together that's like all we'd bond over" (R1).

Teaching presence

Teaching presence related to how and what the lecturer did when online with the PSTs. There were no instances of affordances identified, while a total of 14 codes were identified as challenges. There was also a tendency identified among the participants to compare the online experience with past interactions with the instructor conducted in on-campus tutorials (prior to COVID-19).

Identified challenges included a lack of opportunity to ask questions of the lecturer. Participants observed that "I always like to ask questions at the end of the lesson" (R2), and "Familiarity with the teacher [or] … for the teacher to come over and have a look at what you've done" (R5).

Other students focused on how the instructor seemed to find the technology challenging to use. In the view of one participant, "If they [the lecturer] had some sort of training or spent a bit more time working on that [the technology] … things would have been a little bit more smoother" (R1).

Summary of case study 1

The PSTs reported in Case Study 1 had experienced face-to-face learning of mathematics teaching in the previous year, and so many of their comments involved comparing their recent online learning with previous on-campus experiences. Responses may have been different if the PSTs had chosen to learn online for all of their course because they would not have a comparison. Overall, their feedback suggested that they found the online platform limiting in terms of interaction with the instructor, other students and the learning content itself, such as access to hands on materials and the lack of immediate feedback.

Results case study 2: Teaching primary mathematics 1 (Master of Teaching)

Context

This case took place in a regional Australian university and involved a cohort of 90 PSTs who were enrolled in Teaching Primary Mathematics 1 (TPM1) in Semester 1, 2020. This unit was the first of two mathematics pedagogy units studied by PSTs in a two-year Master of Teaching degree. At the beginning of 2020, there were two cohorts of students within the unit: on-campus and fully online. Each cohort had the same access to the weekly learning content materials and general online discussion boards. The on-campus students attended a scheduled face-to-face tutorial each week, while the online PSTs engaged in online asynchronous activities and contributed to dedicated weekly discussion boards related to each week's content. Three weeks into the semester, on-campus tutorials were discontinued because of COVID-19 restrictions and delivery of TPM1 became fully online. During the next two weeks, attempts were made to assimilate the on-campus group into asynchronous tutorials (not in real time, no interaction), but from week 6 onwards, two-hour synchronous tutorials (interactive, two-way online) were held weekly. Online synchronous tutorials were delivered in a format that attempted to replicate what PSTs had been experiencing in their on-campus tutorials. As for Case Study 1, Case Study 2 results are structured around the three elements of the educational experience framework: cognitive, social, and teaching presence, using data gathered from focus group interviews conducted with six PSTs who experienced the transition from on-campus to online learning. For each element, the benefits and challenges as identified from the data are presented (see Table 2).

Table 2

Total of Affordances and Challenges for Case Study 2 Participants

Elements	Affordances	Challenges	Total
Teacher presence	6 (9%)	7 (11%)	13 (20%)
Social presence	9 (14%)	12 (18%)	21 (32%)
Cognitive presence	18 (27%)	14 (21%)	32 (48%)
Total	33 (50%)	33 (50%)	66 (100%)

Cognitive presence

In terms of cognitive presence, 32 responses were coded, with 18 being identified as affordances and 14 as challenges. Affordances included reference to the online delivery of webinars and lectures which students found valuable in terms of accessing and revisiting. The PSTs found that the "online lectures were really valuable" because "I was able to pause them, rewind them, re-watch them, whenever I needed … and that was really valuable for taking notes" (R3). Others felt that the "content online was a lot richer … we had all these amazing linked articles … and I don't think you get that in a traditional lecture" (R1).

Some participants found the online environment conducive for engaging more comprehensively with the content. For example, one student commented that:

> *When you study online, particularly the mathematics component, you have a chance to go away and have a think about it. So rather than trying to squeeze everything into a two-hour lecture, I can think about fractions, I can go off do the reading, I can even have a little practice myself. And before, you know, I've spent three hours. So just that ability to break it up with a bit of practice and a bit of extra thinking, I think makes it more effective in getting the content across to students.* (R1)

A large part of the online learning experience involved the use of discussion boards. In terms of positive affordances associated with the use of discussion boards in this unit, students commented on the flexibility of contributing and reading posts at convenient times, as well as the affordance of being able to think and respond to discussion posts and questions over time, rather than on the spot as is often expected in on-campus tutorials. Illustrative participant comments that refer to these aspects included the following.

> *The discussion boards when they're really well structured and set up can be a real advantage because you can ask the simple questions, which I think gets missed if you're face-to-face. We tend to only want to ask the questions which make us intelligent, whereas when we're on the discussion board, you can ask that small question which you're a bit unsure about*. (R4)

> *I find it interesting to read other people's views. I know these things would be discussed in the classroom, but it kind of makes you think I didn't really think of that in that way. Because you have kind of like a week to do the content, so throughout the week, everybody keeps adding and going into different areas. So you kind of consider more things.* (R5)

There were 14 responses that were coded as challenges in relation to cognitive presence. Common themes included reference to workload in general; webinar participation; and the limitations associated with the delivery of online content, including access to hands-on materials and lack of interaction with lecturer and students. Some participants felt that they needed more guidance with the content, particularly when it was perceived as difficult. For example, one PST noted that "If there or if there's a topic that, you know, is it more content rich or a bit harder to understand? Perhaps maybe a web session would be good?" (R5).

The platform was perceived by a number of students to be limiting in terms of providing hands-on experiences. For example, R4 commented that:

> *I think it was definitely a bit different because you weren't able to use like the manipulatives in the maths. So that was quite hard sometimes to get your hands on what is was like as you couldn't just fiddle around with them and work things out ... you have to kind of almost use them as an abstract idea rather than building a block of 10 and kind of having that practical experience wasn't really there. ... it's a hard one for online because the manipulatives can be quite expensive. ...*
>
> *They had a whiteboard and you could draw things, but it seemed to just get a bit of a scribbly mess, to be honest. So I think that was probably the limitation of the platform. And a lot of people didn't use the video as well. So like, you know, they didn't share their screen or share a book or something like that, which could have maybe enhanced things.* (R4)

Another participant observed that they "missed some of that more like practical hands-on sort of activities … being able to have a go at doing some of that stuff" (R5).

Social presence

For TPM1, the main communication channels for fostering social presence were the live webinars and the discussion boards, with challenges (12) and affordances (9) identified with these interaction opportunities. The webinars and discussion boards were generally referred to as a substitute for on-campus experiences, as illustrated by one participant who advised, "I like the discussion boards, but nothing would substitute for sitting in a room with a bunch of people and just throwing ideas around" (R1).

Similarly, students appreciated the opportunities to engage in live webinars, but also recognised the limitations of these:

> *With some webinars as soon as you get over a certain number of people, it does get out of control or inefficient perhaps. (R3)*
>
> *I'm not a big public speaker. Certainly, when there's a group of, you know, 50, 60 students in a webinar, I think it makes it more challenging. And so you tend to hear from one or two.* (R1)

The live webinar sessions were more favourably received when break-out rooms were incorporated:

> *[Breakout rooms] are tremendously beneficial because as soon as you get over a certain number of people, it does get out of control or inefficient perhaps. And then when you go into a breakout group with that smaller number, it is a way better conversation. And then you can all come back in and have a group conversation on after that. I think that's probably the best way to run a webinar when it's available.* (R3)

Teaching presence

Thirteen responses were coded to teaching presence, with a similar number of affordances (6) and challenges (7) identified. In the online context, teaching presence incorporates both the organisation of learning content and discourse as well as direct instruction and interaction. The TPM1 lecturer maintained a background teaching presence through the provision of weekly content and opportunities to engage in activities, discussions, and webinars. Discussion prompts, responses to students' discussion posts, and emails were also indicators of teacher presence in TPM1. Live webinars also provided opportunities for connecting with the teaching staff and providing direct instruction. For example, a participant observed that the lecturer or the other tutor "put on webinars most weeks and that was something that I really enjoyed being able to get along to when I was able to" (R3).

Most students acknowledged that they were more motivated and engaged when their lecturer or tutor was engaging. For example:

> *It does depend on the tutor because if you've got an engaging tutor, then you're more likely and willing to turn up and we're much more likely to skip something online if we don't think it's worth our time. … So I think, yeah, that it really does depend on the tutor and how engaging and how relevant the students feel that that is.* (R4)

Aspects such as the lecturer's effective use of technology and the online platform influenced students' perceptions of the effectiveness of teacher presence. For example, one student commented on tutors' ability, in general, to adapt to the online teaching environment:

> *When we started out the tutors weren't sure whether we should be drawing things and holding them up to the screen, or should they be preparing slides or how they should kind of go about it, particularly being quite a hands on practical course, so that was probably quite a challenge for them initially to work out how can we transfer from a hands on concrete, using the manipulatives and the concepts to ... actually online*. (R4)

Another participant responded with a similar comment, that "I think my impression is not all of the unit coordinators or the lecturers know how to operate the technology" (R3).

Summary of case study 2

Overall, the feedback from the PSTs in this cohort indicated that there was not a lot of difference in terms of the number of affordances and challenges identified for cognitive, social, and instructor presence. While the PSTs were able to identify affordances associated with online delivery, such as convenience, flexibility, and accessibility, they were also able to point to limitations such as effective use of technology, opportunities for live interaction, and physical use of manipulatives.

Discussion

As a consequence of the COVID-19 restrictions enacted throughout Australia in 2020, the educational experiences of the student cohorts examined in the case studies were impacted. The students' learning became, abruptly, situated within a new, online, context. That environmental shift of the learning communities from on-campus to online both necessitated, and created, inter-related changes in the instructors' teaching presence, as well as the students' cognitive and social engagement.

Adaptations to teaching presence

The instructors in both case studies retained the traditional lecture presentation by making the weekly recorded lectures available through the universities' digital learning platforms. This enabled the instructors to maintain a weekly teaching presence (Anderson, et al., 2001). Like the findings from the recent TEQSA report (2020), students from both cases reported favourably on the availability of recorded lectures which allowed them to revisit the content, and gave them time to reflect on the learning content at their own pace. Both lecturers were responsible for designing the teaching experiences making decisions regarding the pacing of material and providing flexible learning experiences (Garrison et al., 1999).

The online format afforded the instructors an opportunity to increase their teaching presence through using a range of interactive tools. They did so through the provision of additional learning content in the form of recorded teacher narratives to expand on PPT slides, activities with teacher demonstrations, teacher-created videos, and video content from outside sources. This involved the adaption of suitable on-campus pedagogical practices to online ones (Rapanta et al., 2020). This was not always perceived as entirely positive from the students' perspectives. PSTs in the case studies reported that, with asynchronous delivery, they were unable to raise questions with, and get answers from, the instructor "there and then" as they would have been able to do in a face-to-face class. Overall, their feedback indicated a desire for increased interaction with the instructor, supporting other research findings which point to the crucial role played of instructor presence as an influence on student engagement and success (e.g., Kara, 2021; Means et al., 2014). Even when the instructors provided synchronous opportunities in the form of live webinars, students found the platform limiting, and like the TEQSA (2020) findings, expressed a reluctance to participate. The active presence of the instructor on a discussion board, or the availability of a synchronous webinar discussion between instructor and students, did seem important to the students, however, despite their limitations.

As a consequence of the COVID-19 restrictions, both instructors switched to an online tutorial format, using digital tools for interaction and activities. The instructor and students in Case Study 1 had little or no previous experience with the use of these tools, and this was reflected in the participants' comments. The technology utilized in Case Study 1 may have been adequate to support the tutorials conducted online. However, the speed with which the transition to online learning was, by necessity, undertaken meant the instructors and students initially experienced difficulties in using the technology for interactions and representations. Further, the instructors

often lacked the appropriate PCK (Shulman, 1987) to effectively utilise the affordances of the technology and the platform. This improved during the semester as instructors were able to locate appropriate digital applications, and familiarity and knowledge of the technology increased. In Case Study 2 the instructor also used a weekly webinar to replace on-campus tutorials. Instructor-student and student-student communication and interaction were further supported by the use of asynchronous discussion boards. The adoption of online teaching and learning was less challenging in Case Study 2 as the instructor had already been teaching the unit to an online cohort of students and possessed considerable experience with adapting their teaching approaches to the online context.

Cognitive and social presence

Both of the reported case studies highlighted affordances and challenges associated with their experience of transitioning to online learning. It was widely agreed by participants that, compared to attending face-to-face sessions on-campus, the online mode allowed PSTs flexibility as to when, and where, they chose to learn. In this way, their study could be better fitted within busy lives of family and employment responsibilities, often at a considerable physical distance from the university campus – factors that have been highlighted elsewhere with regard to the benefits of online learning (e.g., Stone, 2017). Inasmuch as online teaching and learning were enacted largely through asynchronous activities, participants also commented favourably on the opportunity to reflect on and process the learning content at their own pace, rather than the instant responses attendant with face-to-face learning.

However, not all aspects of students' cognitive engagement during the semester were positive. Similar to the TEQSA (2020) findings, a number of commonly voiced complaints were associated with limitations of the technology platforms utilized, instructors' unfamiliarity with the technology available, and fellow students not complying with accepted virtual meeting conventions. These issues were exacerbated by participants' lack of comfort in engaging online where the usual non-verbal signals were unavailable. Many of these negative aspects were associated with a lack of experience in online learning, and the impacts were reported as lessening over time.

The transition to online learning highlighted issues that were particular to the participants in their capacity as PSTs, and, especially, as PSTs of mathematics. In respect of the former, some students noted that not being in the classroom limited their opportunities to learn about how to be a teacher, and that the virtual engagement they experienced did not satisfy their desire to learn how to teach in the real world. Associated with that perceived disconnect, many participants observed that lessons in the use of manipulatives for teaching mathematics did not transfer well to the online setting, which was also identified as an issue by Means and colleagues (2014).

As might be expected in a study about the transition to online learning from the face-to-face experience, participants from both case studies reported a lack of social interaction with their peers during the semester. However, while the transition to online learning is likely to have been relevant to the participants' experiences, the online environment may not have been the only contributing factor. Other elements identified by the participants themselves included their unequal progress through their degrees and a pre-existing lack of friendship networks with peers.

Interestingly, a number of participants who were active and engaged with their study during the semester commented favourably on their capacity to establish friendships through their online study interactions.

Conclusion and recommendations

The study reported in this paper focused on the experiences of eleven PSTs transitioning from on-campus to online learning as a consequence of COVID-19. Two case studies have been presented which describe the cognitive and social engagement of two cohorts of PSTs of mathematics at two Australian universities, as well as the teacher presence which supported their learning. The first case study was based around a mathematics education unit taught by an instructor with little or no previous experience with teaching online. Likewise, the students, who were PSTs, had little or no previous experience with the digital tools required by online teaching and learning. The speed of change from on-campus to online learning resulted in instructors and students experiencing challenges in using the online learning technology. Participants reported less than positive experiences in terms of their cognitive and social engagement. This did, however, improve somewhat over time as both instructors and students became more familiar with the digital tools and the affordances they offered. Data for the second case study were collected from students enrolled in a mathematics education unit taught by an instructor experienced in online delivery. Shifting to an online mode proved less challenging in Case Study 2 as the instructor had already been teaching the unit to an online cohort and had extensive experience in adapting their teaching to an online environment.

The participants in both case studies identified affordances and challenges raised by their transition to online learning. They found that the flexibility of the online environment allowed for greater cognitive engagement with the learning content. However, most of the participants felt that their social engagement with instructors and fellow students was not as deep as they had experienced through face-to-face, on-campus interactions, supporting similar findings elsewhere (e.g., Kara, 2021). The Community of Inquiry Framework proved to be a useful lens for examining the social, cognitive, and teaching presence aspects of each of the case study instructors. While students' feedback indicated that all these elements were important and present to some extent, it seemed that, at times, technological elements impacted negatively on students' experiences. As a result of this finding, we would recommend that online instructors are familiar and confident with using appropriate and relevant online tools and resources. In addition, allowances and considerations need to be made for those students who are not comfortable or confident with interacting synchronously with others online.

While the results of this study are not widely generalisable, they offer useful insights in relation to students' reactions to the adaptations required of both instructors and students when teaching and learning is shifted from an on-campus to an online mode. This study has shown that the online experience can be equivalent, but is in no way identical, to that of on-campus study. The online environment presents its own particular affordances and challenges, to both instructors and students. The success of transition will be strongly influenced by the implementation of appropriate teaching and learning design and technology by experienced instructors. The study has

implications for online learning providers in general and instructors required to make the transition from on-campus to online delivery, particularly when this shift occurs rapidly. Further research could investigate how the rapid shift to online learning was managed in other educational contexts, such as primary schools, and whether or not some aspects of online learning should be retained when transitioning from online back to campus. In addition, while the students' perspectives have been reported on in this paper, instructor perspectives would provide further insights into the affordances and challenges of adopting effective online pedagogies.

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