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James Deehan
Charles Sturt University

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Online Education Practices and Teaching Team Compositions in Australian Preservice Primary Science Education

James Deehan
Charles Sturt University

Abstract: Australian Initial Teacher Education (ITE) has long been marred by instability, scrutiny and high academic workloads. University wide workforce changes and the proliferation of online education require ongoing consideration as these factors have the potential to both enrich ITE and exacerbate existing issues. As subsect of ITE, preservice primary science education faces unique hurdles as establish student-centred, authentic practices have historically been delivered by tenured staff in traditional face-to-face settings. This paper aims to explore online teaching practices and teaching team composition in Australian preservice primary science education via interview and survey data collected from 17 academics in a Type II case study. Results showed varied, often asynchronous approaches to online education; punctuated by elements of academic resistance. Teaching teams were increasingly dependent on sessional staff, which has resulted in complex benefits and detriments. Researchers and administrators need to work proactively to determine how both online practices should be utilised and teaching teams should be structured to deliver high quality ITE.

Introduction

It is hard to overstate the importance of high quality education, and by extension the provision of strong initial teacher education (ITE) programs, as there are quantifiable links to economic productivity, growth and equity (Cahill & Toner, 2018; Holden & Zang, 2018) amongst other long-established cultural and social benefits (Preston & Green, 2003). Yet, despite such trends, Australian teacher education has been remarkably inconsistent in terms of form, function and status over the past 50 years (Mayer, 2014). The Dawkins reforms of 1988, implemented during the period of economic rationalisation in the 1980s that continues unabated (Fitzgerald & Knipe, 2016), had a seismic impact on Australian teacher education as it was unified and moved from Colleges of Advanced Education to Universities (Mayer, 2014). This shift lead to the requirement for academic research alongside traditional teaching roles roles; a tenuous balance that has increased pressure on teacher education professionals as they have to publish as academics, in a less established field often without clear measures of 'success' (Bain & Zundans-Fraser, 2017; Louden, 2008) and still maintain authentic connections to the school systems. Issues such as widespread symptoms of burnout (Heffernan & Heffernan, 2019; McKay & Monk, 2017) and school-university divides (Anagnostopoulos et al., 2007) could be interpreted as evidence of suboptimal outcomes. The central tension of the theory-practice nexus has only been exacerbated by excessive government scrutiny, with over 100 reviews in 50 years, increasingly negative public perception, contradictory policy agendas and decreasing net funding (Fitzgerald & Knipe, 2016; Louden, 2008; Mayer, 2014). The "more with less" agenda persists as the push for

higher professional standards has been accompanied by sector wide funding cuts. These high level issues impact all areas of ITE in Australia.

While broad issues in ITE are clearly applicable to preservice primary science education, as a sub-discipline it faces some unique challenges. For the past 15 years, the Trends in International Mathematics and Science Study (TIMSS) has shown a substantial decline in the overall science performance, and by extension the scientific literacy, of Australian Year 4 students (Martin et al., 1997; Martin et al., 2016). According to these data, the average Australian Year 4 student does not understand how science knowledge and skills relate to the world beyond the classroom. However, any interpretation of the TIMSS must acknowledge that the validity large scale international assessments are threatened by flawed sampling, lack of sensitivity to cultural differences and lack consideration for the differences between the science syllabi of different nations (Baker, 1997; Bracey, 2000; Schuelka, 2013; Wang, 2001; Zhao, 2020). Still, declines in students' scientific literacy could lead to a more damaging divide between scientists and broader communities in the future. ITE providers are one of the most economically viable and accessible stakeholder groups for affecting long-term change in a renewing workforce (OECD, 2019) because changes could be more easily implemented across Australia's 48 ITE providers (AITSL, 2019) than within the 4790 Australian public primary schools (ABS, 2020). However, potential interventions, either directly through university-school partnerships (Allen et al., 2013; Lemon et al., 2018) or indirectly through recently trained graduate teachers, can be challenged by practical and cultural disconnections between schools and ITE providers (Zeichner et al., 2015), although this is not always the case (Hobbs et al., 2018).

The generalist role of Australian primary teachers presents a unique challenge as preservice primary academics educators need to educate preservice teachers in a discipline for which they often do not have a strong affinity. Indeed, preservice primary teachers have long been marred by low science interest, confidence and knowledge (Appleton, 1992; 2003; Bleicher & Lindgren, 2005; McDonnough & Matkins, 2010). Recent research conducted by Pino-Pasternak and Volet (2020) showed that nearly half (47%) of a cohort of 108 preservice primary teachers held generally unfavourable (i.e. vulnerable or uncommitted) science attitudes upon entry into a science subject. Furthermore, uptake of science in post-compulsory education in Australia has been declining (Kennedy et al., 2014; Norton et al., 2018), possibly indicating that science disengagement is not limited to preservice primary teachers. This trend highlights the importance of ITE programs as a point of intervention. Indeed, current research has shown that graduate primary teachers who attribute their favourable science attitudes to their preservice primary science education can function as agents of change in primary schools by actively overcoming resource barriers, pursuing science professional development, taking science leadership roles and trialling more student-centred approaches, such as peer teaching (Deehan et al., 2020). An argument could be made that broad issues within Australian ITE could be intensified within preservice primary science education due to the reliance on constructivist, synchronous approaches (e.g. Palmer, 2008) and preservice primary teachers' aversion to science as a discipline (e.g. Pino-Pasternak & Volet).

Despite the challenges associated with Australian preservice primary science education, many academics have managed to successfully balance the theory-practice nexus. Since the data were collected for the last substantial review into this subsect of ITE (Palmer, 2008), a plethora of student-centred pedagogies have been substantiated through scholarly publications. In direct contrast to passive student centred practices, such as notetaking, lectures and teacher-modelled investigations that once dominated Australian primary science education (Goodrum et al., 2001), research has emerged supporting the efficacy of approaches including, but not limited to constructivist approaches (e.g. Hume, 2012),

problem-based learning (e.g. Etherington, 2011; Ford et al., 2013), cross curricular integration (e.g. DeLuca et al., 2015; Parker et al., 2012), mentoring (e.g. Kenny, 2012; Sempowicz & Hudson, 2011) authentic tasks/ curriculum development (e.g. Kim & Bolger, 2017; Lewis, 2019; Wallace & Coffey, 2019), inquiry learning (e.g. Chen & Tytler, 2017; Saçkes et al., 2012), in-subject practical teaching experience (e.g. Kahn & VanWynsberghe, 2020; Lewis, 2019; Palmer, 2011); school-university teaching partnerships (e.g. Hobbs et al., 2018; Kenny et al., 2014), cooperative learning (e.g. Deehan, et al., 2017; Deehan et al., 2019), student-centred investigation (e.g. McKinnon et al., 2017; Wu & Albion, 2019), nature of science instruction (e.g. Demirdöğen et al., 2016; Mesci & Renee'S, 2017), modelling (e.g. Donna & Hick, 2017; Menon & Sadler, 2018), reflective practices (e.g. Aydeniz & Brown, 2017; Dalvi & Wendell, 2017) and alternative conceptions targeting (e.g. Deehan, et al., 2017; Deehan et al., 2019; McKinnon et al., 2017; Trundle et al., 2007). It should be noted that many of these approaches are resource and time intensive. During the same 15 year period ITE providers, and by extension preservice primary science education programs, have been altered by the increasing reliance of online teaching technologies and general changes in workforce composition.

Online learning in Australian higher education increased by 226% from 2002 to 2014 (Norton & Cakitaki, 2016). ITE has progressed in a similar fashion with the proportion of preservice teachers studying through online or blended models increasing from 22% in 2005 to 41% in 2015, with 40% of providers offering online study options (Dyment & Downing, 2020). While the proportions of mixed, on-campus and online learners have remained steady for five years, growth in the sector can be attributed to online learners, with enrolments nearly doubling from 3818 in 2008 to 7877 in 2017 (AITSL, 2019). These numbers will have increased dramatically in 2020 as even traditionally on-campus ITE providers were required to rapidly transition to online learning modes to cater for their students during the Covid-19 crisis. It is probable that this represents an acceleration of the existing trajectory and online learning is unlikely retrocede as the financial impacts of the crisis are to be felt by the university sector for years to come (Thatcher et al., 2020). In their systematic review of 492 refereed articles on online ITE practice Dyment and Downing (2020) classified the field as rapidly developing in haphazard and repetitive ways; perhaps showing reactive academic responses rather than considered development of research trajectories. Still, despite the substandard circumstances, online learning practices have considerable potential benefits for a variety of stakeholders. Indeed, interview data from 19 Australian online teacher educators revealed beliefs that online ITE offered equitable, contemporary experiences that could, in fact, surpass on-campus learning (Downing et al., 2019). While this perspective is difficult to corroborate, positive findings are emerging in this space. Early research into preservice teachers' (n=324) perceptions of Blackboard showed positive beliefs about accessibility and collaboration (Heirdsfield, 2011). However, these findings were at least partially offset by the more negative reactions of the academics (n=43), who focused on the costs in terms of face-to-face interaction and modelling. Consequently, later research has sought to bridge this gap by focusing on teacher presence and dialogue in online learning (Huss et al., 2015).

Established ITE online approaches include synchronous video discussions (Clark et al., 2015), collaborative video reflections (Liu, 2012), social networking (Habibi, 2018) and GoPro video recording (Hyndman, 2017). In preservice primary science programs, asynchronous online cooperative learning has shown to reasonably approximate on-campus learning (Danaia & Deehan, 2016). Tomas and others (2015) found that hands-on, inquiry learning could be facilitated effectively through an array of online resources (i.e. vodcasts, modules, virtual classrooms & forums). Still, the positive and rapidly expanding literature base is likely to reflect the perspectives of innovators and early adopters. One cannot help but wonder if the perspectives offered in this rapidly expanding field are wholly representative of

Australian primary science educators in a more general sense. 'Online education' is a nebulous term open to an array of distinct interpretations in terms of design, delivery, engagement, attitudes and expectations. So, for the sake of inclusion and to avoid undue researcher influence, 'online education' in this paper is defined in the broadest way to mean learning that occurs through a digital interface rather than traditional face-to-face interaction.

The changing nature of academic work in Australian universities must be considered in an analysis of preservice primary science. The increasing insecurity of the sector is the most important trend, with casual employees now assuming over 20% of university teaching responsibilities nationally (Norton & Cakitaki, 2016; Norton et al., 2018). In ITE programs, casualization is an established means of providing more diverse authentic learning by bridging divides between schools and universities (Palmer, 2008). Indeed, a sample of 22 casual ITE academics reported high levels of efficacy in their university teaching practices (Klopper & Power, 2014). The benefits of casual academic contributions are optimised in a balanced, stable workforce but can be threatened if too much responsibility is shifted to casual staff (Norton & Cakitaki, 2016; Rothengatter & Hil 2013, Ryan et al., 2013). Due the tenuous, often inconsistent nature of casual academic work, individuals in these positions are particularly susceptible to issues such as work overload, time dilution and role confusion (Bodak et al., 2018; Klopper & Power, 2014). Read and Leathwood (2020) found that casual academics struggled to develop long-term student-lecturer relationships, were isolated from the design of the subjects they taught and struggled to hide their issues from students. In order to further understand the nature of online education and changing workforce conditions in preservice primary science education in Australian ITE programs, this paper aims to answer the following research questions:

1. How do a sample of academics perceive and reportedly utilise online teaching practices in the provision of Australian preservice primary science education?
2. What are the views of a sample of academics on the teaching teams responsible for preservice primary science education within their Australian universities?

Methodology

The research reported utilised a Type II case study approach (Yin, 2014) wherein a single form of datum was collected over multiple sites. An interpretivist perspective was adopted to answer the open ended research questions (Bryman, 2016). As part of an extensive overview Australian preservice primary science education, academics were invited to give their insights into online teaching practice and teaching team compositions via semi-structured interviews or online surveys. Ethical approval was obtained for this research project.

Sampling & Participants

Targeted, purposive sampling was used to recruit Australian academics involved in the delivery of primary science education in ITE programs. University websites were used to identify relevant participants. Snowball sampling and general inquiries were utilised to supplement the primary method of reviewing public staff profiles on university websites. A total of 141 emails were sent to academics across 33 Australian ITE providers from late 2018 through to the middle of 2019. 17 academics representing 15 institutions agreed to participate in the project. The low response rate (11.8%) is sub-optimal (Nulty, 2008) and may be related to impersonal sampling techniques and the limited available time of the target population.

However, it should be noted that 45% of primary ITE providers were represented in this sample.

Data Sources

There were 13 primary science academics who participated in semi-structured interviews on online practice and teaching team compositions within their programs. A further four academics opted to instead respond to an equivalent online survey. It should be noted that these data were part of a larger review of preservice primary science education in Australian ITE programs, meaning that the participants' views on online education and teaching team compositions are more likely to be representative of the target population as they were not recruited for their perspectives in these areas specifically; thus diminishing the likelihood of extreme views being presented. The interviews took an average of 43 minutes per interviewee, with none being less than 31 minutes and two being more than an hour in length. All audio files were transcribed by the author. Participants were given the opportunity to check their data prior to data analyses.

Data Analyses

The qualitative data were analysed through a typical, iterative processes of open, axial and selective coding (Bryman, 2016). The familiarity with the data necessary for the open coding was achieved through active note taking during interviews and journaling throughout the research project. Interview transcriptions and survey submissions were uploaded to QSR NVIVO 12 to facilitate the initial grouping of themes based on the research questions. Axial coding occurred through multiple reviews of the raw data, refinement of thematic grouping and supplementary NVIVO queries to ensure an appropriate degree of objectivity. Selective coding occurred as key narrative themes in relation to the questions, and by extension the field, were identified and presented as unifying principles within the write-up of the finding.

To supplement the informed reading of the researcher, the relative strength of themes were partially determined by the number of contributing of sources and the overall number of mentions. While this strengthened the rigour and objectivity of the analysis, subjectivity is unavoidable as mention counts can be skewed by interviewing style, question structure and response type. For example, the four academics who responded via asynchronous survey are more likely to have reduced mention counts as there was no option for further elaboration via interviewer follow-up questions. In acknowledgment of this issue, the number of sources was chosen over overall mention counts in the presentation of findings.

Findings

The finding will address the research questions in sequence. First, the preservice primary science academics' perspectives of online education will be presented. Second, their views on teaching team compositions within primary science programs will be elucidated.

Question One - How do a sample of academics perceive and reportedly utilise online teaching practices in the provision of Australian preservice primary science education?

There was considerable variation in the preservice primary science academics' perspectives on and reported utilisation of online teaching practices. Table 1 outlines participants' perspectives on online practices in the delivery of preservice primary science education at their universities. More than half of the respondents indicated that either there

was no online education or they were not involved in online education at their institution. Douglas' preference for face-to-face teaching was echoed by other participants, "*We have a big cohort of online students but I have been fortunate enough to work on campus because that's what I like doing. I like face-to-face teaching*". Kylie's emphatic response, "*NO*", was telling. Edward appeared to believe that the slow uptake of online education practices amongst his colleagues may be related to tradition and academic resistance, "*Historically that's just the way the university has run its programs. You know what, people hang onto it but I know students would sometimes prefer other options for accessing the curriculum*". More central might be that the active, constructivist teaching common in primary science education is seen as antithetical to online learning by some participants; indeed, Helen summed up academic struggles with adaptation to online learning in her institution, "*we're all kind of at a total loss at how you can teach education online*". It may be argued that loss of professional identity, potentially leading to academic burnout, is a major risk requiring thoughtful incorporation of online learning components.

Sub-Theme	Number of Contributing Sources	Number of Total Mentions
Asynchronous Learning	9	21
No Online or Not Involved	9	15
External Requirements- Self Guided Learning	8	13
Problems	7	19
Benefits	7	18
Synchronous Learning	7	12
On-campus Versus Online Learner Expectations	6	20
Alignment with On-campus Learning	5	18
Cooperative Learning	3	5

Table 1: Reported Perspectives on and Approaches to Online Education in Australian Preservice Primary Science Education (n=17 preservice primary science academics)

Asynchronous Delivery (9) and Self-Guided Learning (8) were prominent sub-themes. Online students were mostly required to complete activities "*in their own setting*" and "*source their own materials*"; potential barriers to effective learning. Asynchronous delivery tools included, Moodles, forums, Padlets, pre-recorded lectures, quizzes, modules and eBooks to allow students to learn material and interact with others in the online learning community. Flexibility aside, such tools do not allow for the facilitation and direct guidance that typically occurs in traditional face-to-face modes. Helen said that, unlike her on-campus students, the way their online learning is designed "*online people have to do more or less the same on their own*". Charlotte expressed a similar, albeit softer, view that there is "*less opportunity to provide one-on-one support*".

Despite the above-mentioned personal aversion to online education, interviewees and survey respondents conveyed a balanced view of the Benefits (7) and Problems (7) associated with online education. Reported benefits to online education included accessibility, flexibility for students, flexibility of academics, engaging design, authenticity through synchronous tutorials and diverse technology tools. Douglas' quote synthesises a number of these themes and broadly describes the importance of online delivery in improving educational access:

> *"Well the benefits are clearly that it's more accessible to many more students and I do appreciate that lots of students, for family reasons or distance reasons or financial reasons, cannot come on campus. And a lot of them are already working."*

Misalignment with traditional face-to-face practices, passive learning, poor professional preparation and inauthenticity were the main problems identified through

the analyses. Douglas felt online education to be fundamentally divorced from active, constructivist principles that have traditionally underpinned preservice primary science education, "*We can show them things, we can suggest they do things but it's quite difficult to actually see what they do*". Regardless of his efforts, Franklin felt that passive learning was unavoidable, "*They need to be prepared to spend time online and not many students will engage because they don't want the hassle.* ***People think they can learn by just watching as opposed to learn by doing, and that's a problem***". Helen pointed out the dissonance between message and mode with online teacher education, "*We want children to be collaborative and work together and inquire together. But you know, we've got individuals sitting at home with a computer, learning to be teachers*". This disconnect represents the ultimate challenge of providing effective teacher preparation online.

Online educators are uniquely challenged to balance the inherent flexibility of the mode with the provision of authentic learning experiences; as can be seen through sub-themes of Synchronous Learning (7), On-campus Versus Online Learner Expectations (6), Alignment with On-campus Learning (5) and Cooperative Learning (3). Brian and Franklin chose to utilise synchronous tutorials with active design and make tasks. With an aim to catering for different learners, Andrew held online lectures, with voice or text communication options, that were recorded and uploaded to YouTube for later viewing. He felt this worked well as an approximation of on-campus learning, "*Distance attendance is quite strong. If you do after hours, you can get 20 students in a chat room, which is quite similar to an on-campus tutorial*." Still, attempts at approximately face-to-face learning opportunities can be undermined by the different expectations of online learners, as Franklin attests, "*the online guys generally want to get through the degree with a minimal disruption, and for them to stop and cover their dining room table with recycled material and have to spend time putting something together, it's quite an inconvenience*". Bianca noted that school-based experiences were a part of the on-campus and online programs, with the online students being required to organise their own experiences. Brian used Padlet and Andrew used forums and recommended synchronous tools (Zoom, Facebook, etc.) to promote cooperative learning. Andrew believed the incorporation of cooperative learning to be effective, "*we find they are quite capable and sometimes more capable of producing high quality work than their on-campus counterparts*". Even with the challenges associated with online education, Josephine's remarkably positive outlook and internal locus of control was indicative of a sophisticated conceptualisation of online education:

> *"I guess some people might say it's challenging to have them (online learners) engage in those materials. But I think that's more about meaningful design. And we don't have that issue because we've built the subject to support the content and engagement".*

Question Two - What are the views of a sample of academics on the teaching teams responsible for preservice primary science education within their Australian universities?

Like most tertiary education sectors (Andrews et al., 2016; Percy & Beaumont, 2008), casual or part-time academic staff are reported to play a substantial role in the provision of preservice primary science education in Australia. This reliance on insecure labour is largely reflected in the interview and survey data provided by the 17 academics. Table 2 describes the key themes relating to reported teaching team characteristics. Casual and Part Time staff were discussed by 16 contributing academics, with nine mentioning casual staff's roles as assessment markers. It appears that casual staff, often current or former primary schools

teachers, are commonly brought in to deliver tutorials and mark assessments designed by full time academic staff. Bianca described how casual staff can build relationships with schools and enhance the authenticity university learning:

> *"It can be good to have people who have had really recent teaching experience. Like some of our tutors are still teaching in schools. So they bring with them both contacts with schools and really good, recent understanding of the way things work in schools".*

Sub-Theme	Number of Contributing Sources	Number of Total Mentions
Casuals-Part Time Staff (sub-themes in brackets)	16	50
(Tutors)	(14)	(27)
(Markers)	(9)	(17)
(Coordinators)	(6)	(7)
(Additional Support Required)	(4)	(5)
(Above and Beyond)	(3)	(4)
(Online Support)	(3)	(3)
Positive (sub-themes in brackets)	15	54
(Tenure-Consistency)	(11)	(26)
(Quality-Motivation)	(11)	(23)
(Experience-Expertise)	(11)	(18)
(Recruitment-Turnover)	(9)	(11)
(In-school Teaching Experience)	(9)	(11)
(Mentoring-Succession Planning-Team Teaching)	(7)	(19)
(Cross Faculty Collaboration-Integration)	(5)	(9)
(Control-Autonomy)	(3)	(3)
Negative (sub-themes in brackets)	11	37
Recruitment-Turnover	(10)	(15)
Inconsistency-disruption	(6)	(10)
Lack of control (discipline-faculties)	(4)	(8)
Lack of Expertise-Experience	(4)	(6)
Academia (e.g. workload, progression)	(3)	(11)
Balancing Consistency and Adaptability	10	23

Table 2: Perceptions of Teaching Teams in Australian Preservice Primary Science Education (n=17 preservice primary science academics)

Based on the Coordinator (6) theme, casual staff may be taking on more responsibility and exercising more discretion in preservice primary science education according to the sample of preservice primary science academics. An increasing role for casual staff may warrant further investigation in preservice primary science education and ITE general. It would be interesting to see whether full time staff work separately from casual staff (academic separation), alongside casual staff with similar/ overlapping roles (vertical division) and/or alongside casual staff with distinct roles (horizontal division). The overlap between full time and casual-part time staff may vary considerably. Franklin used the phrase, "*pawned that off*" to describe bringing a casual staff member on board to deliver a subject offering. Such language may relate to the pressure to engage in non-teaching activities to advance in academia (McKay & Monk, 2017). Grace framed her role differently, "*I'm in a curriculum development leadership role, so I'm developing the unit for others who come in and teach*". It would be worthwhile to consider the long-term impact of increasing uptake of non-teaching roles, such as curriculum design and quasi-administration roles, on academics in teacher education.

Much like individuals within any organisation, casual academics are perceived by the participants to be going Above and Beyond (4) and/or in need of Additional Support (3). Despite the relative insecurity of their positions, casual and part-time staff reportedly elect to

involve themselves in "*optional project(s)*", "*teacher-research*" and professional development "*workshops*". Conversely, the induction of new, often time poor, casual staff can place additional workload burdens on continuing academic staff. Faye described the additional support required by a new staff member teaching out of field, "*she has to sort of learn and pick up some of the primary teaching strategies. That's been really difficult. So, I've had to work with her on that and some of the other tutors would work with her*". Isobel talked about the additional workload associated with large marking teams, "*when you have a whole bunch of people marking one assignment, then you have moderation issues of consistency across marking, which falls to the subject coordinator to manage and moderate*". Clearly, there is a complex mix of benefits and challenges associated with high casualization that extend well beyond financial cost.

A multitude of positive teaching team themes arose from the data analysis. Quality-Motivation (11), Experience-Expertise (11) and Tenure-Consistency (11) were viewed as the strongest aspects of teaching teams by the participants. Teams were described as "*very good*", "*lovely people*", "*cohesive*" and "*very strong*", showing evidence of collegiality and high morale in preservice primary science education in Australia. A diversity of experiences and areas of expertise were represented, including generalist primary teachers, specialist science educators and doctoral candidates. Douglas commented on the stability of his teaching team, "*I think that for the past few years all teaching has been done by full time, continuing members of staff*". Connor attributed the success of an in-school teaching program to stakeholder consistency, "*it's also testament to the longevity of my partner in the school and also that I've been here. The two key drivers have sort of stayed doing the same things and we've introduced other people into it*".

Recruitment-Turnover (9), In-school Teaching Experience (9), Mentoring-Succession Planning-Team Teaching (7), Cross Faculty Collaboration-Integration (5) and Control-Autonomy (3) were additional positive themes of note. Low turnover was reported by representatives from nine institutions. Turnover was categorised as "*relatively low*"; Faye noted that there had only been a single change to her team in years and Grace spoke about similar circumstances, "*we have a band of casual staff who tend to be fairly loyal*". Andrew felt there was a symbiotic relationship between full time academics and casual staff with recent teaching practice, "*We bring on teachers from the local area and they offer in class real experience to complement the theoretical stuff that I have*". Bianca expanded on the perceived benefits of practicing teachers in preservice primary science education, *"if you've got new people coming in, it can really help you think about new possible ways. We have a really great experience with that this year with different people coming in".*

Internally, there was an interest in mentoring, succession planning and team teaching for the sake of quality educational experiences. Such collaborative approaches have the potential to safeguard against the staff turnover issues, as Elizabeth attested, "*To safeguard against turnover, the unit coordinator, who is a tutor, supports the tutors and facilitates a team approach to problem-solving and unit development*". Direct collaboration with science faculties was also expressed; Grace described how this was arranged at her institution, "*The unique thing with our program is that we have lecturers from the Faculty of Sciences who actually come in and deliver some of the content to the students".* Isobel was involved in a similar arrangement, but felt there was far more room for improvement:

> *"We've developed a good relationship with them. But it's really a limited way, and it's specific to a couple of academics who have this teaching and learning focus. And interest and willingness to give a lot of time to the co-teaching responsibilities and the coordination responsibilities to make it a coherent subject".*

Isobel also felt that autonomy was a major factor:

> *"The biggest strength is the academics have a lot of autonomy for what it is they want to do. And have some freedom and flexibility to try new things. So continually trying new things and innovating and adding and adjusting".*

For the participating academics, Recruitment-Turnover (10) was the most pervasive challenge, followed by Inconsistency-Disruption (6). As a full time academic, Edward described his team as "*not consistent nor extremely experienced*". Isobel's comment suggested that issues of finance and administration may thwart the establishment of long-term relationships with casual staff members, "*we're under continual pressure to spend less money on casual staff*". Helen's cynicism as a casual staff member was palpable as she believed turnover didn't register as an institutional problem, "*I think as long as they can get a bum on a seat to teach the students, they're not bothered*". Abigail, Andrew and Isobel felt that the reliance on casuals with multiple jobs, often at late notice, negatively impacted the integrity of science subjects. Abigail remarked, "*Some casuals are not brought on board until very close to session, and they are just concerned with getting in, doing the teaching, doing the marking and then getting out again. So you're not always guaranteed the same person*". Andrew, a full time academic, expressed his reluctance to formally incorporate an in-school experience in his subject due to casualization, "*one of my coordinators is a sessional, so I was not willing to write it into the subject formally because I thought that would be exploitation*". Isobel expressed similar views:

> *"We do have issues of consistency across tutorials because people who are regular classroom teachers, don't necessarily have the time or interest. Those who do eventually get tired of it or run out of energy for it or have another commitments and they can't do it anymore".*

More minor negative themes included Lack of Control (4), Lack of Expertise-Experience (4) and universal issues within Academia (3). Lack of consultation on team composition, limited discretionary power in the pursuit of educational opportunities for students and external demands all purportedly limited academic control. One participant felt that diminished academic discretion reduced practice to the "*lowest common denominator*". Kylie discussed expertise limitations as the science program was developed by a staff member without a science background and delivered by "*by two sessionals with no science background*". Relating back to the additional support required for casual staff, Brian said, "*A lot of the staff at the beginning don't actually know anything about (the concepts we cover)*". The pressures of modern academia were raised by three individuals, including increased tutorial numbers, financial restraints, unpaid practice and overwhelming pressure. Isobel's observation succinctly captured such problems, "*our official workload model shows that our academics should not be doing as much teaching as they do*". Helen lamented the plight of her younger colleagues, "*the pressure on them is massive. You've got to get your PhD, now you've got to publish, now you've got to teach all these classes, now you've got to coordinate these units. So it's a nightmare for them*". She went on to offer a concerning insight, "*People are really abused in academia*".

For many respondents, a core consideration in staffing and team composition is striking the right balance of providing consistent educational experiences whilst adapting practice to reflect emergent opportunities and learner needs (10). Connor believed it is important for educators to make choices in how they support their students, but also identified key areas that must remain consistent, "*the message is the same, the assessment is the same, the passion is the same*". For Andrew, academic autonomy appeared to be a core part of his philosophy, "*I urge the other coordinators and tutors to make decisions in their particular classes to take advantage of their strengths and to cater for their particular students*". Faye expressed similar views on academic autonomy:

> *"I think that's really important having your team where you all feel as though you own this, you know, it's not just my course, we own it and I ask for their opinions and their advice and, and give them a lot of leeway to be themselves. Like I provide them with everything they need, but I let them sort of go and do their own style".*

On the other end of the spectrum, Helen described how a focus on fairness can dissuade the pursuit of student-centred opportunities, "*You see the problem there is of course equity across all the students. They haven't all got the same opportunity. So that's always the line that is run*". From Brian's perspective, too much leeway can negatively impact the education for students, "*You just have to be mindful of sessionals who are doing it for the first time. Quite often it's one of those situations where people don't tell you if they're having an issue and you only find out at the end of the unit that they did something very different to the rest of the team*". Building on Brian's theme of inconsistency resulting from isolation, Andrew stated, "*it's improving because people are brought into the subject in an apprenticeship model as opposed to, you know, a Frankenstein subject emerging because random people are assigned the subject at different times with no view as to what the subject is aiming to be*". The delicate balance between adaptability and consistency in the provision of teacher education warrants further probing and investigation. The most common view expressed in this sample of preservice primary science educators seemed to be that different paths could be taken as long as everyone arrives at the same destination.

Discussion

The participants displayed considerable diversity in online education practices and attitudes. The majority of respondents (53%) either came from institutions that did not offer online learning or were not personally involved in online delivery. Many of these interviewees expressed a strong preference for face-to-face learning and appeared relieved to not be involved. These experienced, passionate educators seemed to view online learning as threatening both the quality of their science teaching practice and their professional identities. Thus, the incorporation of online education into ITE programs should occur with respect to academics' perspectives and identities to avoid diminishing quality and maximising benefits. The key problems the academics associated with online education were divergence from traditional face-to-face practices, passive learning, poor professional learning and inauthenticity. The latter may be the biggest risk factor, given the sectors' broad commitment to authenticity (Palmer, 2008). Personal preferences and reservations aside, academics were not Luddite in their beliefs about the potential benefits of enhanced accessibility for students and flexibility for all. Indeed, some respondents had incorporated cooperative learning, synchronous engagement opportunities and alignment with on campus deliveries into online primary science subjects. To some extent there was still a belief that on-campus and online learners had fundamentally different expectations as university learners; with online learners finding hands-on, authentic learning practices to be disruptive or burdensome. Whether rightly or wrongly, some participants held the view that online practices would place preservice teachers in passive learning roles that would undermine their professional focus on active, constructivist teaching on-campus. These views are worthy of further interrogation as they relate to online ITE. As the data presented in his paper were collected in 2018 and 2019, it would be worthwhile for researchers to revisit online education in Australian preservice primary science education in the wake of the Covid-19 causing unexpected and rapid transitions from on campus to online learning globally.

When probed on the composition of teaching teams within Australian preservice primary science subjects the focus on casual and part-time staff emerged organically in the participants' data. In a reiteration of established views (Palmer, 2008), interviewees and survey respondents were mostly united in the belief that casual academics with recent primary teaching experience were vital for supporting preservice teachers and establishing connections between schools and universities. Aside from traditional roles of marking and tutorial support, there was some tentative evidence to suggest that casual and part time academics were exercising more control and discretion in the delivery of preservice primary science subjects; which could possibly be related to tenured academics engaging in less direct teaching roles. Neither the nature nor impact of this finding can be reasonably addressed in this paper, but this may be an area worthy of further investigation. Depending on the individual, casuals were perceived to require additional resources in the form of ongoing support from full time academic staff or could rise above and beyond baseline contract expectations. However, lower and higher functioning casual staff members heighten the risk of exploitation via unpaid labour for both tenured staff and themselves respectively. The role of casual staff needs to be considered thoughtfully by institutional stakeholders lest the pursuit of more the resource and time intensive student centred practices should result dissatisfaction and burnout as unintended consequences (Heffernan & Heffernan, 2019). This is not the say that casual or part time staff are undesirable; rather it is imperative that higher level institutional decision makers consider staffing profiles and expectations explicitly alongside university teaching approaches. Balance is the headline point and this was reflected in the complex array of strengths and weaknesses articulated by respondents. The consistency of teaching teams and the quality and experience of team members were viewed favourably by participants. Negative themes were discussed less overall, 37 comments to 54, but Recruitment-Turnover and Inconsistency-Disruption were areas of concern. It would be interesting to conduct further research into team structures in Australian teacher education programs, such as complete separation, organised handovers, vertical division, horizontal division and/or fluid structures.

The broader role of ITE institutions to potentially enhance and hinder preservice primary science education was an underlying theme within this paper that was beyond the immediate control of the sample of academics. Even though institutional factors were not the direct focus of this paper, they warrant some speculation to contextualise the academic perspectives. A majority of participants (9) reported that either they or their institutions were not involved in any online teaching practices. Amongst the online practices described, asynchronous learning and self-guided learning were the most prominent. Taken together, these findings could be a tentative signal that online learning is not consistently prioritised at institutional levels. However, participants expressed nuanced understandings of the benefits of online practices, described some student-centred approaches and thoughtfully discussed the needs of different preservice teacher cohorts. While further research is clearly needed to better understand this space, a possible interpretation it that preservice primary science academics could adjust their teaching practice to capture the benefits of online education practices. At the institutional level, online education practices could be fostered through clear guiding principles, policy adjustments, prudent resource allocation, sufficient time for reflective practice and, most importantly, meaningful consultation with academic teaching staff. There can no universal approach to the incorporation of online teaching practices institution differ significantly in terms of student cohorts, degree structures, traditions, financial resources and human capital. The author does, however, speculatively suggest that strict or non-consultative institutional approaches to online teaching practices could catalyse the academic trepidation and resistance evidenced in this paper. Key to ensuring that institutions enhance their incorporation of online practices into primary science ITE will be

ensuring that academics are given sufficient autonomy to find innovative ways to maximise the benefits of online teaching practices for each unique context. The absence of an institutional commitment to online practices can hold back professional imperatives to innovate; alternatively, overly prescriptive policy settings could also dissuade innovative, context specific approaches to preservice primary science education and ITE as a whole.

There were some limitations that must be considered in the interpretation of the findings presented in this paper. The low response rate (11.8%) and reliance of convenience sampling limit the generalisability of findings. However, this can be partly excused by the highly specific targeted population of primary science educators in Australian ITE programs. Sampling of academics is inherently challenging given the time-poor nature of the group. Another limitation is that the mention counts in the analyses are rendered less meaningful as survey respondents provided shorter responses without any of the discussion associated with the interviewees' responses. This means that there may be some bias in the presentation of findings, but this is partially offset by the use of source counts as the primary organising variable. Finally, this paper analyses the broad areas of online teaching practice and teaching team composition through the perspective of a singular stakeholder group. This vital, albeit limited perspective is also hindered by the reliance on a single data source, meaning that the research presented cannot account for the differences across Australian ITE providers, including online, mixed and on-campus course deliveries, student traits, cohort sizes, financial resources, human capital and institutional policies. Ideally, future research should investigate different stakeholders' perspectives on these areas through more varied data sources.

The research presented in this paper presents clear implications for researchers and administrators in Australian ITE. It is necessary for further research into the form and function of online preservice primary science practice in relation to the needs and perspectives of different stakeholders. Deeper research is needed to account for differences in ITE institutional contexts for the sake of more nuanced understanding of the issues raised in this paper. Also, online education practices in Australian preservice primary science education should be investigated similarly to face-to-face practices that are most commonly the focus of research in this space (e.g. Deehan et al., 2017; Deehan et al., 2019; Deehan et al., 2020). It also needs to be understood the extent to which online practices are enriching ITE practices versus functioning as more efficient, flexible modes of content delivery alone. For example, it would be interesting to see whether or not ITE academics are utilising the efficiency and flexibility associated with online teaching practices to pursue different practices, such as in-school teaching experiences, extended group projects and non-linear learning experiences. It would be worthwhile to determine where the possible efficiencies from online teaching practice are being felt in ITE: whether it is in reduced academic workload, more student-centred practices or financial efficiencies as academics take on additional teaching responsibilities. Additionally, the differences and similarities of the perspectives of preservice teachers, administrators and academics need to be more fully understood to ensure each stakeholder group's needs are met. For example, while many preservice teachers appear to value the flexibility of online learning options, a number of academics within this study appeared to believe that online learning was anathema to their professional identifies and beliefs (Dyment et al., 2013). It would also be interesting to learn more about how primary school teachers, administrators and parents view online practices and primary teachers' roles in ITE.

University leadership teams need to ensure that policies relating to online education in ITE afford the desired flexibility without compromising the professional identities of academics, many of whom have built their careers as face-to-face educators. As discussed above, incorporation of online practices should not come at the cost of academic autonomy to

innovate. Deeper research into the composition and impact of teaching teams in Australian ITE is warranted. Specifically, the collaborative practices and distributions of roles amongst casual and full time staff members need to be better understood to maximise the positive impact of casual staff, often with currency of practice and alternative perspectives, whilst mitigating issues potential issues relating to inconsistency, inexperience, role confusion and exploitation. It is imperative that teaching team structures, such as synthesised team teaching (mixed roles), horizontal division (roles separated), vertical division (separate periods within subjects) and academic separation (academic design & casual delivery), are investigated to ensure the continued improvement of Australian ITE programs. Ideally, such research would inform teaching team and employment decisions at higher administrative levels within universities.

Conclusion

According to the sample of preservice primary science academics, there is some diversity with online education practices and workforce compositions within preservice primary science programs in Australian ITE. Primarily asynchronous practices, alongside some synchronous learning opportunities are reportedly employed by academics who are feel a degree of resistance to the notion of online learning in ITE programs. Diverse and consistent teaching teams, featuring tenured academics and casual teaching staff with currency of practice working towards shared curricular understandings, are seen as beneficial to the quality of preservice primary science education. However, reports of staffing inconsistency, increasing reliance on insecure labour and role confusion could threaten workforce balance, and by extension, educational quality. The theory-practice nexus that has long been a central tension in Australian ITE could be potentially exacerbated by medium-message and authenticity-flexibility tensions that continue to emerge as a result of the greater adoption of online learning practices and continuing changes to workforce composition. The search for solutions should not threaten ITE academics' professional autonomy and discretion because principled agency is central to many academics' professional identities (Clegg, 2008). Therefore, issues must be directly addressed by academics and administrators to ensure the benefits of technological advancement and diverse teaching teams do not come at the cost of the integrity and quality of Australian ITE. There are unlikely to be universally beneficial approaches as Australian ITE providers are contextually diverse in areas such as financial security, human capital, institutional structures, student characteristics and traditions. This means that the onus is on the stakeholders within each institution to explicitly consider and address issues related to online teaching practice and workforce composition.

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