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Fostering the process of belonging online through teaching and learning interactions

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Abstract

There is an established relationship between teaching and learning practices and educator's ability to foster belonging in university towards improved student success and retention. This qualitative grounded theory study using a longitudinal research design examined the experiences of first-year students, lead educators, and support educators in ICT (Information Communication Technology) to develop a process of belonging when studying online in higher education. We found belonging is fostered by connecting interactions online through signalling practices. Drawing on this process, this paper outlines the associated principles of fostering belonging in teaching and learning. These principles are: developing signalling skills, catering for signalling preferences, proactive adjusting and matching, providing opportunities through understanding students signalling preferences, and signalling for belonging and retention. The principles make a significant contribution to online teaching and learning in ICT by proposing implementable online teaching and learning practices that foster the process of belonging for diverse students, to support their retention and success.

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Practitioner Notes

1. We propose it is helpful to understand online interactions and communications, both synchronous and asynchronous, as meaningful signalling practices.
2. Practitioners should scaffold their teaching and learning experiences for a range of disciplinary and signalling skill levels.
3. Practitioners are advised to be aware of students signalling preferences to create inclusive teaching and learning interactions.
4. We propose that all educational design affects student belonging and connection. Online learning delivery needs to be resourced to ensure relational signalling in a variety of methods and modes.
5. Practitioners should develop their signalling capability and confidence to be aware of the possible interpretations of signals they send and are sent by students.

Keywords

higher education, belonging, teaching, connection, first-year students

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Introduction

Student success in university study is more than acquiring knowledge to pass assessments, it depends on student's experiences while learning. This is demonstrated in the link between student belonging and success and retention (Crawford et al., 2023; Kane et al., 2014; Pedler et al., 2021). Belonging has been shown to be a relational bond that is a human motivation and need (Baumeister & Leary, 1995), therefore it may not be surprising that belonging plays a key role in the student experience in higher education. Student's development of a sense of belonging can be embedded in teaching and learning, as it is affected by pedagogical and curricular practices (Cohen & Viola, 2022). However, less is known about how students belong in their online courses. Interacting online can disrupt our understandings of belonging based on face-to-face learning as they are different (Tice et al., 2021). It is important to understand how students belong when studying online to inform how educator practices foster belonging. For students studying online, there are particular challenges. Online students have a greater risk of attrition than students learning face-to-face (George et al., 2021; O'Shea et al., 2015). There are additional barriers to students developing a sense of belonging during online learning such as a lack of in-person connection opportunities (Allen et al., 2024). Educators need strategies to foster belonging online so that online learning experiences can be enhanced and retention improved (Peacock et al., 2020; Thomas et al., 2014). These strategies can work with the difficulties online learning presents (Tice et al., 2021). For online learning in ICT, even less is known. Studies focusing on face-to-face belonging in ICT often focus on the gendered disciplinary culture (e.g.: Adams & Morgan, 2021; Yates & Plagnol, 2022). Educators can potentially benefit from drawing on strategies that work for all diverse students studying ICT online. It is possible for educators to foster belonging online to improve the student experience and outcomes. While it is harder to connect online it is not necessarily inherently exclusionary (DiGiacomo et al., 2023). By better understanding how to foster student belonging online within teaching and learning interactions, educators can be supported to improve the experience of diverse students. Principles for fostering belonging in online learning practices must be based on an understanding of how students belonging online and educator perceptions of their role fostering belonging.

Belonging initiatives are supported by an enduring aim by universities globally to find ways to foster student belonging both on-campus and in the online learning environments (Australian Universities Accord, 2024; Thomas, 2012; Wonkhe & Pearson, 2022). In 2012 a student retention and success programme involving 22 institutions in the United Kingdom found that nurturing a culture of belonging can occur through mainstream activities (Thomas, 2012). There is a drive to incorporate belonging principles in teaching and learning in Australian institutions. More recently, the Australian Universities Accord Report calls for the "need to explore innovative ways to facilitate student belonging" in online and hybrid learning (Australian Universities Accord, 2024, p. 168). In the context of the Australian institution of this study, the institution's Learning Principles and Practices highlight the need for fostering relational belonging and inclusivity within educational design (Deakin University, 2025).

Belonging online is intricately interconnected with teaching and learning practices and design. For example, Stone (2016) outlined national guidelines for improving student outcomes in online learning through practical actions some of which can foster belonging. Utilisation of inclusive teaching and learning frameworks can foster belonging. The principles of Universal Design for Learning can be employed to create practices that are related to belonging, such as in hybrid

learning, including teacher presence, social presence, interactive learning, safe interaction spaces, and increased access to using technology (Mendoza & Venables, 2023). Educational design for belonging has been shown to have many aspects to consider. Delahunty et al. (2013) emphasise the need for socio-emotional interactions for community building and identity formation. One large scale study in the United Kingdom suggested belonging for diverse students can be nurtured through stronger social connections (Wonkhe & Pearson, 2022). Seifert and Bar-Tal (2023) describe how belonging for student teachers learning online is associated with their technological literacy which supports good experiences collaborating online. While many studies outline various teaching and learning practices that hamper or foster belonging, they are not based on a cohesive theory of students' process of belonging when studying online over time. The research gap we are addressing is to develop practical and implementable principles of fostering belonging online based on an understanding of how students' progress through their process of belonging when studying online, designed for academic teaching staff and the learning designers that support them.

The purpose of the larger study was to generate a grounded theory, using a longitudinal research design, of the process of belonging for higher education students studying ICT online. From this theory, the effects on the process of belonging were drawn upon to develop principles for fostering belonging online in teaching and learning. The research questions, drawn from the larger study, are:

> **Research Question 1:** What is the process of belonging for undergraduate students studying online in the first year of their ICT degrees?
>
> **Research Question 2:** What effects the process of belonging for undergraduate students studying online in the first year of their ICT degrees?

The first section of this paper outlines the literature and conceptual background, the next section summarises the method, before an outline of results of the study that led to identifying the process of belonging online, leading to the principles of fostering the belonging process in teaching and learning, and finally the principles, implications and limitations are discussed. The significance of this work is in providing educators with strategies for fostering belonging designed for online learning environments where diverse students have the potential to pursue belonging. The theoretical significance of this work is in basing the principles for fostering belonging on a theorisation of the process of belonging online, accounting for student's agency to connect. This research can ensure educator's strategies are evidence based and student focused.

Literature

Sense of belonging when studying online

We can draw on belonging studies of both online learning and ERT (Emergency Remote Teaching) practices to consider how to approach research on belonging online. Studies based on ERT practices contribute to our understanding of the unique challenges of fostering belonging online (Tice et al., 2021). For example, students connect online in individual ways. Korthals Altes et al. (2023) found anonymity can decrease or increase belonging for students. Many studies that focus on fostering belonging within online teaching and learning, both during ERT and sustained online learning, consider the different categorisations of ways of belonging in higher education, including the social, emotional, material, and through community building (Delahunty et al., 2013;

Gravett et al., 2023; Thomas et al., 2014). Many studies highlight the importance of the relationship between the educator and students (e.g.: Stone, 2016) and peer interactions (e.g.: DiGiacomo et al., 2023; Peacock et al., 2020; Tang et al., 2023). A study of belonging during ERT found belonging online is complex and the experience differs by race, gender, learning modality, and feeling of representation in the curriculum (DiGiacomo et al., 2023). Some studies focus on interaction types, such as social interactions through discussion groups (Tice et al., 2021). One recent study of belonging calls for a consideration of personalised purposeful socio-political ways of belonging (Ajjawi et al., 2023). The existing literature that considers fostering online covers broad ways of belonging and of student characteristics. Therefore, it is not surprising that there is disagreement in the literature as to how people experience belonging (Allen et al., 2021).

There has been a large volume of recent studies considering belonging online, many contextualised during ERT during COVID, however these studies may not be generalisable to sustained online learning practices outside ERT practices. There are many studies of belonging for online higher education learning related to ERT that account for ill-prepared and short-lived online learning environments developed at a pace (e.g.: DiGiacomo et al., 2023; Morán-Soto et al., 2022; Reid et al., 2024; Tang et al., 2023; Tice et al., 2021). These findings may not apply to online learning in non-crisis times. Students can choose to undertake online learning and post pandemic teaching and learning practices may involve pre-planning and development over time. In addition, since the pandemic, educator approaches to online learning are adapting pedagogically and technologically (Broadbent et al., 2023). The effects on the student experience of online learning since the pandemic are being felt beyond changes in teaching. In Australia since the pandemic, there has been an exodus from online learning by students (Higher Education Statistics, 2024). While there is extensive literature on belonging before and during the pandemic, we need to know more about student and educator experiences of online environments, that are planned, organised and sustained. From these understandings we can draw practical implementable strategies for fostering belonging online that are suited to sustained online learning.

Less is known about how students experience belonging during sustained online learning. This lack of understanding impacts our ability to foster belonging online. While there has been attention to different possible ways of belonging and effects on belonging online, there is a lack of knowledge of practical cohesive approaches to fostering belonging that consider various ways to belong, the role of educators, and the individual student needs within diverse student cohorts during online learning that continues over time. By drawing on a process of belonging online that accounts for student and educator experience over time, principles for fostering belonging within teaching and learning practices can account for diverse student experiences and the challenges of fostering belonging during sustained online learning that can be as varied and complex as the potential ways to belonging.

Sense of belonging for first-year students

While the need to foster belonging in teaching and learning online is well recognised, first-year students have additional challenges while transitioning into higher education. It can be difficult to foster smooth transitions for first-year undergraduate students who enter university with various backgrounds, ages, and motivations. There can be racial/ethnic differences in the ways that students adjust to university environments and university study (Ramirez et al., 2023). Students can commence university with a readiness to belong (Meehan & Howells, 2019). However, some

students can also experience a gap between their expectations of university studies and their experiences (Holmegaard et al., 2013). The practicalities of student transition issues can occur as they try to adapt to the autonomy required for higher education study. For example, students with autism spectrum disorder, can have heightened stress, anxiety and ambivalence from the challenges of transition (Van Hees et al., 2018). First-year students can also be challenged by being mature aged with commitments outside study (Thomas, 2015). While, belonging can be enabled by first-year university teaching academics (Meehan & Howells, 2019), to be effective educational transition solutions need to work for diverse students with different academic abilities such as first in family students (Groves & O'Shea, 2019). Educator's efforts to foster belonging for first-year students can be frustrated by their lack of visibility of students online, leading to assumptions about their characteristics, goals, and values (Coutts et al., 2025). These studies suggest that facilitating belonging for diverse first-year students through online teaching and learning needs to be understood with more breadth.

Belonging as relational, situated, and processual

Belonging online is conceptualised in this study as being made up of interpretations of interactions that have meaning within different situations over time. Belonging has been conceptualised in existing literature in a variety of ways, including as something that is received when feeling accepted, valued or respected (Goodenow & Grady, 1993; Strayhorn, 2021). Using an interpersonal lens, Baumeister and Leary (1995) found that belonging is an attachment between one and others, that has intention. This conception contributes to an understanding of belonging as having strong emotional and cognitive effects (Baumeister & Leary, 1995). These framings of belonging show the potential for belonging to be influential on the student experience. Like an interpersonal lens, sociological conceptions of belonging can be affective as part of student belonging interactions but have a greater focus on the situations they occur within. For example, for Bourdieu and Wacquant (2007) belonging is relational with a focus on the effects of cultural and social capital, where students with more capital find it easier to belong. For Yuval-Davis (2006) individuals feel at home when belonging relationally with a focus on identities, positionality, politics and the situated nature of belonging. Yuval-Davis considers how there are those who are inside, those outside, and those who control the movement (Yuval-Davis, 2006). These macro sociological lenses can focus the view of student belonging as though seen from outside the experience. Similarly, identity lenses have the potential to move the focus of students as considering themselves as objects (Charmaz et al., 2019). These lenses contribute our knowledge of aspects of the dynamics of belonging interactions; however, these conceptions may need to be considered differently online due to the challenges belonging online presents, by considering how students are able to interact online towards developing a sense of belonging.

While belonging is understood as relational across the belonging conceptions less is known about situated belonging processes, or how belonging occurs and changes. Belonging is understood to be situated and processual (Gravett & Ajjawi, 2022), where the situated process of belonging can be understood as a negotiation (Guyotte et al., 2019). Aspects of situated relational belonging processes can be inferred. Relational belonging indicates that it is part of an exchange between people. The conceptualisation of relational belonging being processual and situated suggests that belonging experiences change over time and between online learning environments as the interactions change. Indeed, the spaces of belonging can be conceptualised as relational across trajectories that are never fixed (Massey, 2005). While belonging can be understood as a situated

process and an emotional experience, there is potential to better understand students' belonging practices through the way they may change. From a micro perspective, relational belonging is made through small acts of connection between students and others (Ajjawi et al., 2025). However, it is important to understand how belonging interactions occur as a process during online learning in changing environments that are fluid and not fixed. Where belonging experiences are diverse, changeable, and there is an element of decision making, choice and action in online belonging interactions, then student agency is involved in the process of belonging. Agency is understood as the ability to have practical relations and voice online, that is situated as part of a process of relationality (Hildenbrand, 2007). Students studying online are interacting in situations that are dynamic and constantly under construction, made up of the interrelations in the space. This study investigated how belonging is relational, situated, and processual to draw principles for fostering belonging when studying online that accounts for student agency, interactions with educators, and how belonging changes over time.

Belonging and symbolic interactionism

Symbolic interactionism was employed to investigate the process of belonging, as a student practice. Blumer (1969) proposed a sociological symbolic interactionism theory that explains the dynamics of interactions and social systems over time from a micro perspective. The analytical framework of symbolic interactionism includes the changeable dynamics of space, time, and social contexts created in interplay with individual actions, interactions, interpretations, meaning, and ways of communicating within situations (Blumer, 1969). Through a symbolic interactionist lens, people make gestures when they interact online that can be interpreted to find the meanings within interactions. These meanings inform actions. In this study we use the concept of signals to represent the virtual gestures communicated intentionally and not intentionally that can be interpreted. Blumer (1969) accounts for the role students may have in their belonging process, in interaction with others, as they make up the online learning environment. This lens aligns with the concept of belonging being relational, situated and processual. Examples of signals that could influence an individual's actions include something someone says or does, their body language, text or a recording such as feedback, or a technological sign like a green change in status light in conferencing software. In this study, using a symbolic interactionist lens, the individual experiences of diverse students in situations over time were investigated by understanding their online interpretations and connecting and disconnecting interactions. This study uses the terms belonging, connection, and disconnection to focus student's and educator's descriptions of how they perceive belonging through connectedness (Hehir et al., 2021). This study considers the choices, practices, interactions, and interpretations students have during their belonging process over time.

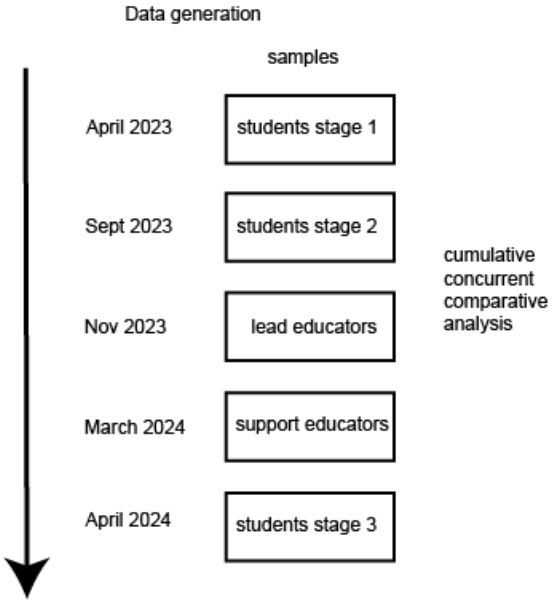
Method

This grounded theory study, using a longitudinal research design, sought to theorise the process of belonging online in higher education. Grounded theory with a longitudinal research design was chosen to be able to develop a theory of the process of belonging online. Grounded theory was employed to investigate how students construct meaning through intersubjective experience as part of our process of theory development (Suddaby, 2006). The purpose of grounded theory is not to present raw data or quantify experience but to achieve abstract theoretical advancement (Conrad, 1982; Suddaby, 2006). The resulting theory was not a presentation of reality but an

understanding of patterns of interactions and how they construct the situations (Suddaby, 2006). The study integrated a longitudinal research design with grounded theory methods. The study employed the essential grounded theory methods of iterative analysis, concurrent comparative data generation and analysis, memo writing, coding and theoretical sampling to develop an abstract theory of the process of belonging that is grounded in the data (Birks & Mills, 2023). The resulting process of belonging was developed reflexively with the researchers in conjunction with the data generation. Data and analysis took place over staggered stages (Figure 1) while concurrent comparative analysis was undertaken cumulatively across and between all data samples. Concurrent data generation and analysis focused on participant actions and interactions within situations based on the grounded theory approach by Strauss (1987) and situational analysis was used to consider micro, meso, and macro dynamics of situations (Clarke et al., 2018). Storyline analysis was also employed to create a narrative of the process of belonging (Birks & Mills, 2019), while developing an associated grounded theory visual model.

Figure 1

Cumulative concurrent data generation and analysis in grounded theory with a longitudinal research design.



Research participants and data generation

The study participants included 19 first-year ICT (Information and Communication Technologies) undergraduate students, eight lead educators and four support educators in an ICT School at an Australian university. Participants were recruited within first-year unit sites and through researcher presentations in first-year online classes. Maximum variation purposeful sampling was used to create a diverse sample. Participants were selected to attempt to have a balance of male and female genders in the sample, then prioritising students of different nationalities and ages. The student sample of 19 students represented 3% of eligible students. 44% of the student participants identified as female. At the time of recruitment female students made up 21% of the university ICT cohort. One student participant identified as non-binary. 37% of the sample were international students (10.5% from India and 5.2% from each of Bangladesh, China, Fiji, Iraq, and

Vietnam). The remaining participants in the sample were Australian citizens, one of whom identified as First Nations. 37% of student participants studied online and 63% were hybrid students who conducted a majority of their studies online. Over 60% of the student participants were retained after one year.

A series of three semi-structured interviews were conducted with student participants across the first year of study concluding early in their second year. The duration of interviews ranged from 15 minutes to one hour and 15 minutes. Students who withdrew from their course or took intermission were contacted for interview, which was also included in the data. Through theoretical sampling, eight lead educators who coordinated the units and four support educators who taught the students were interviewed at the conclusion of the trimester. All interviews were semi-structured and conducted online on Zoom. Educators came from all first-year ICT units. The theoretical sampling of lead educators drew from analysis of stages one and two of the student data generation, and the theoretical sampling of support educators came from the additional analysis of lead educator data. 38% of lead educators and 50% of support educators identified as female. Lead educators primarily managed and oversaw units, gave weekly online lectures, and developed online content. Support educators taught students independently in online classes. In the interviews, students and educators were asked about their experiences online. There were over 60 interviews conducted in the study.

Students were asked questions in relation to connecting and disconnecting in their course, in whichever form that took. Interview questions with students included: What does connecting mean to you; Describe a recent experience where you were connected/disconnected; What happened. Interview questions with educators included: What does student connection mean to you; To what extent is fostering student connection part of your role; If and how can you tell if students are connecting or disconnecting online; Describe a recent experience of students' connection or disconnection. When referring to lead educators and support educators collectively, we use the term 'educators'.

Teaching and learning context

The context of this study is an ICT school where most of the first-year units that were part of the study employed competency-based learning. This structure of assessment involves task-based grading, where higher grades require the completion of more tasks, increasing in complexity. This differs from assessment where higher grades are attributed to higher quality versions of a task. The grading system allows for revisions of submissions based on feedback. Students were taught with a combination of online learning materials, online lectures and classes, and a task-based assessment management system. Online and hybrid students were offered fully online lectures, online materials, and an online assessment task system.

Results

The results of the study highlight four stages in the process of belonging online. The stages of the process of belonging were determined through coding of data including interviews and memos before the use of situational analysis and storyline for advanced analysis. The progression of analysis involved the creation of over 30 storylines and 65 grounded theory models. The data was reviewed to ensure the grounded theory was theoretically saturated and no new information could be drawn from the data. Through analysis of the data, we developed an abstract theory of the

process of belonging for the participants that accounted for variations in belonging experience that changed over time. The stages are outlined in Figure 2. Online and hybrid students went through the same process of belonging. As part of this process, signalling was identified as being important. Online interactions include online communications with others, that can symbolise different things to different actors. These communications are understood as signals. The concept of signalling online in the process of belonging aligns with symbolic interactionism, where the actions of people and technology are interpreted to draw meaning which actors then respond to (Blumer, 1969). Students learnt to signal online and read into others' signals to be able to operate in the online environment. Signals can be interpreted differently by individual students. Sometimes a signal is not interpreted as originally intended. Signals can take place between people and with technology. Examples of signals by students or educators that were open to interpretation in day-to-day interactions include students completing a technical task successfully, an educator's tone of voice in a lecture, feedback on assessment, students exchanging comments synchronously or asynchronously, or a support educator commenting that an aspect of a topic is important. Students had signalling preferences that were their preferred ways to interact online to maintain meaningful connection. Examples of students signalling preferences are used throughout the results section.

The process of belonging online represented in the model in Figure 2 involves: Student first orientate to signalling when they commence their course, as they start *acquiring signalling skills* and *choosing their preferred ways to signal*. In the second stage, students and educators are adjusting and matching their preferred signals in interaction with each other. They try to align and adjust with others such as peers and educators. Students level of agency from the stage of adjusting and matching preferred signals affects their ability to connect in this and the following stages. The third stage sees students demonstrate effective signalling to themselves and others in a variety of situations that work in the environment, that they find connecting. Students are interacting with different actors in the space synchronously and asynchronously. Finally, students who can signal effectively go on to pursue maintaining their connection and committing to connection, seeking out ways to reconnect when their connection fluctuates between connection and disconnection. Examples of individual student's process of belonging with their preferred signals follow Figure 2.

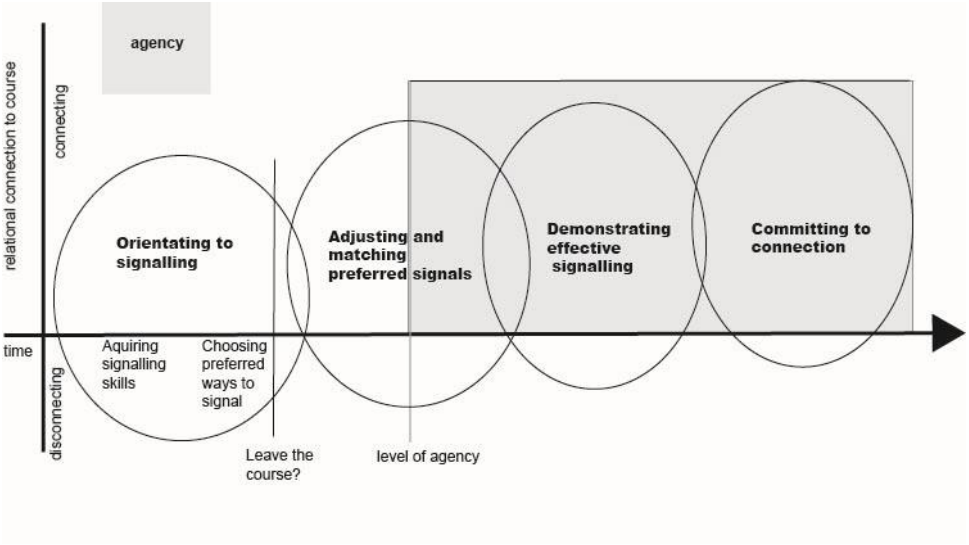
Students move back and forward between stages at their own pace; however, they all progress through the stages towards committing to a way of connecting that works for them. Students find connection in diverse and individual ways. The circles in each stage represent the student's potential for different degrees of connection and disconnection that fluctuates at any time. The grey box represents how agency affects the student's ability to signal and connect in the way they want. Student's ability to work through the stages are affected by many aspects including the development of their signalling skills, their agency to connect in the way they want, their interpretations of the signals of others.

Student participants had different experiences of the process of belonging, and of the way their signalling preferences developed. For example, one student's experience of the process of belonging (Student T), was as a first in family student who did not previously know how university worked. Initially during the *orientating to* signalling stage, he felt disconnected as he interpreted educator's signals as unresponsive and impersonal, which was different to secondary school. He came to find his preferred signalling with peers in class through online chats. In his *adjusting and*

matching preferred signals stage he aligned with peers in a social media chat during lectures, and while he adjusted to signalling with his educators, this was not his preference. In the *demonstrating effective signalling* stage he identified that his communication skills were important for his connection, and he *committed to connection* as his confidence grew with his developing communicating skills as he worked towards being connected with both peers and to work productively with educators.

Figure 2

Stages in the process of belonging online



In contrast Student R was an international student based outside Australia and a carer for family members. She had internet issues at times. She was doing the course to get work in ICT but not necessarily to finish the degree. In the *orientating to signalling* stage, she felt connected doing teamwork with peers. After being disconnected by some of her failed attempts to get help, she reassessed her signalling preference and started to prefer to find ways to get the help she needed. In the *adjusting and matching preferred signals* stage she found ways to build on her ability to signal with educators. In the *demonstrating effective signalling* stage she found her strongest signalling skill was finding the quickest way to get in contact with educators and to have meaningful conversations. She became *committed to connection* as she efficiently worked on her study and was able to reconnect as she solved problems completing tasks.

These student experiences were affected by their goals and by the signalling of others. Students were always at the threat of disconnection as they moved between units in the course and had different interactions. However, as they progressed through the stages, with commitment, they found it easier to reconnect. Developing signalling skills and being able to signal in their preferred way in the orientating stage was essential for retention. When students were disconnected and considered themselves unable to reconnect, they could withdraw. This finding is described further in the principle *signalling for belonging and retention*. The principles of fostering belonging online in teaching and learning are drawn from this process of belonging.

Principles of fostering belonging in teaching and learning

There are principles that can inform interactions in teaching and learning drawn from the four stages of the belonging process as determined through analysis of the data. These principles address the connecting and disconnecting experiences that students and educators described as effecting student belonging. The process of belonging was fostered within teaching and learning practices. The principles developed from this study are based on the underlying concept that signalling is important to the process of belonging online. For educators and students, signalling is a situational skill that develops according to the interactions within the online learning environments. Through signalling students and educators begin building relationships with each other and with their course. Students interacted synchronously and asynchronously with lead educators, support educators, peers, Disability Liaison Unit staff, student help services, senior students, mentors, professionals and with the public through social media. Interactions with people could be mediated by technology such as the Learning Management System (LMS), formative activities, and assessment software.

These principles for fostering belonging in teaching and learning were developed as part of longitudinal grounded theory analysis of the process of belonging. They include: developing signalling skills; catering for signalling preferences; proactive adjusting and matching; providing opportunities through understanding students signalling preferences; and signalling for belonging and retention.

Developing signalling skills

The principle of developing skills to ensure interactional signalling focuses on educator's fostering signalling skills in students, their awareness of how their signals might be interpreted, how they interpret and respond to the signalling of others. This principle is fundamental to the success of the entire process of belonging online as it forms the foundation of educators and students being able to interact and communicate effectively. Signals could be found in communication, educational design, and in all stages from orientating to signalling to committing to connection. The messaging in signalling could be overt or subtle, such as overt announcements in the unit site or more subtle signals of the length of time educators spent talking to advanced students in class.

Supporting students to learn how to signal effectively within online teaching and learning interactions was essential for fostering the process of belonging. One of the fundamental signalling skills students needed to develop to connect was an understanding of the possible effective ways of signalling with lead and support educators in a unit, with peers, and university services. Some students described a lack of support for them to build foundational signalling skills such as knowing the signalling channels of communication and appropriate ways to use them.

> If someone doesn't even know where to reach the discussion forums, how is he supposed to raise the other person to help him out? To actually help him out on a problem?... It's like once you're done with the first step of figuring out how to reach people and then building up your confidence, I think it's easy for you all the way up. (Student C, trimester 1, second year, he/him)

When lead and support educators helped students to develop signalling skills that were effective, students felt in control of their interactions and were supported to move through the stages of the

process of belonging. The type of support students needed through the process of belonging was individual and changed over time; however, they were based on the ability to signal effectively.

Educators could tell if students had the foundational signalling skills by their ability to actively use the appropriate channels for communication. For example, a sign that students needed assistance developing signalling skills included where they did not follow the unit expectations of channels for communication and repeatedly sent emails to the wrong staff member in quick succession. Such students were showing they were disconnected and seeking to reconnect but did not know how. It was essential that educators supported these students. However, educators were challenged by managing individual student needs within large cohorts of students. One lead educator (Lead educator E) described being overwhelmed by the volume of student queries at the start of the students first year and had systems for triaging them to manage the responses. This meant students were at times not responded to for an extended period or were redirected. For the students in this study, knowing where and how to interact was their lifeline to connection. Educator's ability to signal channels of communication clearly not only helped students to operate and connect online but helped students to know how to reconnect if they became disconnected.

As important as developing students signalling skills, was the way lead and support educators signalled with students, including educators being aware of the possible meanings of their signals or understanding student-initiated signals. Educators could not always determine what worked for the students or if the students were connected by interpreting students' signals. For educators, along with the ability to send signals and exchange them, the interpretation of signals was an essential skill to assist with forming clear responses. For example, there was an event where large numbers of students stop attending a class at one point early in the teaching period, due to a student repeatedly muting the educator when speaking. Multiple students described this incident as disconnecting. The educator misread these signs as the students not engaging with his personal characteristics. All educators tried to interpret if and how students were connecting however it sometimes took investigative work to decipher what was happening to respond appropriately. Lead educators and support educators were adapting their signalling methods in their units through interactions as they got to know the class and interpreted the students' signals. Educators' awareness of how their subtle signals are interpreted by students online was enhanced where they had an understanding that students want educators to be skilful in the discipline and technology and interested in the students as individuals.

As part of their online interactions, students could develop a view of the educators as the object of "teacher" where the student was the receiver of teaching. Some students described this as dehumanising educators, creating distance and disconnecting students. Students demonstrated this in a lack of personalised or respectful signalling with educators. In addition, educators positioning themselves as distant unreachable experts could 'other' students, breaking down the student's agency to communicate. Educators who used their signalling skills to position themselves as reachable, interested, and personable fostered student's ability to adjust and match with them. For example, interactions that were constructive, individualised, timely, and part of a two-way discussion with students strengthened the belonging process for students and humanised the educator. Most students wanted to connect with educators. Educators wanted to connect with students and to foster student's connection. Educator commitment to signalling with students to foster connection helped educators and students with their ability to signal.

Catering for signalling preferences

Catering for signalling preferences was found to be essential for fostering belonging online through the use of various signalling methods. In the orientating stage of the process of belonging online, students started to identify and choose their preferred ways to signal. Student's preferred ways to signal varied greatly, for example, some students liked to signal asynchronously through the learning tasks to connect (Student M) while others preferred discussion groups (Student K). Students built confidence in signalling when they felt their signalling style and the content of their signalling would be responded to positively by others. The signalling methods supported by educators were largely determined by the university and the learning management system. Most signalling opportunities were scheduled before the teaching period began. In this study lead educators utilised the limited available signalling options provided by the university such as online content, online discussion forums, and large weekly online lectures.

Students had diverse ways of belonging to be catered for. For one student, the 'aha' learning moments that occurred while watching lecture videos was the only connecting experiences they had (Student Q). While not all student connection experiences were social, some students preferred to interact with peers or to make friends (e.g.: Students K, G and W). One student (Student U) described it being connecting interacting with others academically to talk about the topics and ask questions. While educators could accommodate as many signalling options as possible within their restraints, some students found effective ways to signal outside the university technology using social media to communicate with peers, even during class unseen by educators.

With a lack of signalling options, students could disconnect. For example, multiple students in the study described the stand and deliver large scale lectures provided by most educators as disconnecting, particularly where there was no chat function available (Students A, C, G). Some students in the study needed signalling options not to meet a social need but to enable them to engage, interact, hold their attention and connect with the content.

> We have one unit that does it all [as traditional lectures] on zoom when they turn off the chat and everything. So, you don't really get any participation in that one...It's one where like it's just a full-on lecture and they're kind of spewing out information the whole time. So, I'm just kind of zoned out the whole time…I'm not so much a social person. So, I don't really need to be speaking to people, but it kind of just helps me to keep my attention there if I'm actively doing something during classes (Student A, trimester1 first-year, she/her).

Educators were often unaware of the diverse interaction needs of students and the impact of restricted signalling options on student connection and success. It was challenging for educators to have insight into of what their diverse students needed.

While most interaction opportunities were scheduled before the start of teaching period commenced, students signalling preferences developed and changed over time. For example, Student M's preferences became more social as he moved through the process of belonging, while Student R's preferences became less social. Students were evaluating and adjusting their signalling in their class or course as part of a negotiation between their preferences and the situation, that were more connecting when they had choices. Educators could not always cater for all signalling preferences with the limited signalling opportunities supported by the university.

Educators needed to be able to offer various options and to adjust to foster student connection. Rather than trying to meet all students signalling needs with one option, educators who provided choice fostered belonging for more students.

Proactive adjusting and matching

Proactive adjusting and matching involve planning for diverse students as well as actively responding to their needs. When describing their belonging experiences, student participants in the study expressed a desire for educators to be proactive in their signalling interactions and with how they adjusted and matched with them. For example, one lead educator (Lead educator C) described by students as effective at fostering connection, connected with students by using their names, starting the class with small talk within teaching time, being responsive to repeated questions with additional resources, and providing options for smaller scale interactions. These initiatives were well received by students. Some educators created online environments that were more hospitable to students signalling interaction preferences.

Students responded positively to educators who fostered a culture of inclusion for students with varied previous experience in the discipline. Students struggled to adjust and match when educator's signs were interpreted to be unwelcoming of various disciplinary skill levels. Students were sensitive to whether they felt educators designed the course with a preference for students with more knowledge.

> I came in with not as much I.T. background, so I really did need that extra support, like just, you know, kind of introducing myself in. Yeah, but like, I had to do it a lot on my own to familiarise myself. You know, I feel like if you come in with a lot of knowledge, it's a lot easier than if you come in with minimal or none... Also, as I said, it's not really kind of beginner friendly. You need to know some stuff [to connect] (Student D, trimester 2 first year, she/her).

It took conscious effort for educators to proactively include diverse students in their signalling. Support educators were tasked with being inclusive of all students in the one class, but they described the difficulty in pacing each class to concurrently keep the interest of those students new to the topic and those who were advanced. Educators were able to focus on building student trust through their proficiency in discussing the discipline topic for all skill levels and offering different interaction options.

Educators could be proactive about fostering the process of belonging online by signalling to students without seeking validation or a response. For example, individual students could be more connected by 'lurking' in online classes while educators could respond in a connecting way to these students by signalling without expecting a direct response. However, most educators in the study said they sought a response from students, to be able to see they were listening and engaged. For educators, understanding these diverse student preferences is more than interpreting the active signals students send, it is also about how they interpret a lack of signs positively. The students in this study sought signalling opportunities with educators who they found personable and receptive to their various ways of interacting, as they could better adjust and match with them in an unthreatening way. To foster effective signalling for connection, educators can position themselves as interested in students without expecting a response.

Educators need to be proactive to address any mixed signals that challenges their ability to interpret student signals. For example, students who were behind in their studies, could send different signals to the rest of the class such as asking a question that did not make sense to the support educator or referring to past topics. Such signals could indicate the student was having a barrier connecting. It was essential that these students were not disregarded. Such students were often capable of the tasks but were disconnected due to other reasons. Students who were behind and disconnected were typically at risk of withdrawing. Educators could read the signals of student's disconnection through the topic and tone of the communication seeking clarification or assistance. Students did not always warn educators explicitly that they were disconnected. Educational practice to foster belonging involved constant proactive adjustment to individual student needs indicated through their signalling and could require some investigative work to interpret student signals.

Providing opportunities through understanding students signalling preferences

All educational design affects signalling for belonging, and these teaching and learning interactions need to be designed based on an understanding of what the students need. Students opted for signalling choices during stages of their process of belonging based on how connecting they interpreted a signal to be, their goals, their different desires for anonymity or privacy, the scale and style of interaction they sought, their agency to connect, and the type of signalling responses they received. Student signalling preferences were influenced by multiple factors including assessment task requirements, constraints from the technology they used, the help options available, experience interacting online, or the signalling options available.

In this study, educators based their education design on preconceived interpretations of what the particular student signs of being connected would be based on the limited information they could gather on students. These preconceived signals could be based on whether students aimed for higher grades as part of the competency-based learning. Students aiming for pass grades were potentially seen to be less capable, or less ambitious and engaged. However, many pass grade students were highly motivated and committed to their studies to be able to succeed with their additional commitments outside study. Student's obligations included having family carer responsibilities, working long hours, having limited access to the internet, professional sporting commitments, or being new to ICT so needing to work harder to establish the assumed foundational knowledge. These students looked at educator signals to see if they had an interest in their success including in educational design and assessment design. The competency-based learning design meant that one student with extended commitments outside study needed to compromise on his desire for higher grades for his wellbeing. He felt that the assessment was not designed for students like him.

> Because I work full time and I've got kids and whatever, so. Yeah, it's a lot...I was pushing for higher grades and the way that they set up the, um, the units, it's different to prior tertiary education...to get the marks, you have to do more work, not just do better at the work, but doing so… I do feel like that's a little bit biased towards people who have more time available than I do, but yeah, so I did push myself. I push myself really hard and I was really on top of most of the session. And then at the end I was just flagging and, you know, I just kind of got over the line (Student O, trimester 2 first year, on intermission, he/him).

Student's commitments outside study affected their signalling preferences due to the practicalities of balancing study with their other demands. In this study, some of the teaching and learning experiences were designed based on the assumption students were time rich that affected some student's ability to connect and succeed.

Students signalling preferences were affected by their technological restrictions and their comfort interacting online. For example, some students had a lack of access to the internet at home and travelling several hours each way to use the computers in the library on campus. Joining class in public spaces compromised their ability to signal within the class, needing to have their microphone and camera off. Educators understanding of student's potential signalling preferences, and how they cater for them, was often more important than what students were actively signalling due to educator's lack of visibility of student signals. For example, educator expectations that all students had their microphone and camera on in class could discourage students from attending. Students appreciated learning materials being available to download for access later at home without the internet. Students signalling preferences were often based on the type of interactions they were comfortable with. For example, multiple students did not want to take advantage of the interaction opportunities in large lectures due to a lack of comfort interacting in large public classes (e.g.: Students A and E). Some students described preferencing small scale signalling options as more connecting, as they did not interpret judgement from others when asking a question. Providing diverse signalling opportunities ensures educators were able to foster connection for more of the student cohort.

Student signalling preferences were influenced by cultural differences and diverse needs as well as individual choice. The study included students from diverse cultures and backgrounds. Some female students from cultures others than Modern Western culture, expressed a preference for meeting and talking with other female students. Students' motivations to undertake the course affected their individual preferences, such as wanting to gain the necessary knowledge to pass assessment tasks without extra information, others wanting to explore topics deeply, or wanting to extend upon the base course knowledge to become expert in the field. Some students described having certain connecting preferences due to their ableness. Class cultures also developed differently in each unit, affecting student signalling options and preferences. There were no absolutes in student preferences, they were fluid depended on the situation, their influences and student needs at the time. Educators were not able to pre-empt all students signalling preferences. Understanding student needs requires trial and error and being responsive to the signals students sent. By seeking to understand diverse student preferences when designing learning and assessment students had opportunities to find alignments in the belonging process and gain more choice and agency over their learning experience.

Signalling for belonging and retention

Signalling preferences for connection is an important element in the relationship between belonging and retention. The initial orientating stage was critical for retention, particularly for female identifying students. In the orientating to signalling stage students were developing skills and finding their preferred form of signalling. At this stage they assessed the suitability of the course to their needs, for interaction, learning and their goals. If they couldn't find their preferred ways to signal early in the orientation stage, they could withdraw from the course. These preferred interactions could include the style of signalling interaction in classes. For example, one student

who preferred connecting through discussions but didn't have that option, withdrew from the course in their first trimester.

> The ICT course it very much had that lecturer feeling. … I think that's because of like I don't think you could have those kind of conversational online classes for ICT, which is unfortunate because they're not very like, it's not like a conversational thing…in ICT, you're not really discussing anything (Student K, trimester 2 withdrew earlier, first year, she/her/they/them).

Multiple students in the study expressed a preference for discussion, not just for connection but to learn. They said it occurred fleetingly and it impacted their ability to belong. Other female identifying students who withdrew described their lack of comfort with the available signalling options, such as the large public lectures, interpreting the signals as though they were being judged by having a lack of a background in the discipline (Students D and E). The orientating to signalling stage was a crucial time for student retention decisions. All student participants who withdrew from the course in their first year did so within six weeks of each other, in the second half or end of their first trimester in the orientating to signalling stage. 80% of these students identified as female. Female identifying students reported the primary reason for their disconnection was a lack of choice in their preferred signalling; while additionally being affected by their lack of foundational ICT knowledge, falling behind in their studies, and interpreting they were unrepresented in learning materials and technology. The male identifying student who withdrew also described a lack of preferred signalling as disconnecting. The primary reason for withdrawing for the female identifying students who participated in interviews after withdrawing was a lack of their preferred signalling interactions, both the method of signalling and the meaning of signals.

Discussion

This study highlights how first-year ICT student's process of belonging can be supported through educators teaching and learning interactions. The principles for fostering the process of belonging formed through this research study underlies the practices that foster the process of belonging as part of supporting student signal skill development, agency and choice, together with educator signalling capability. These principles address some of the difficulties of fostering belonging online as student belonging needs change over time.

While existing literature often focuses on fostering belonging particular student groups, this study highlighted that educators could foster belonging for diverse students who belong as part of the same process, by accommodating their diverse needs and preferences to connect. Diverse students find it harder to belong, so institutions need to find ways to support students to connect (Allen et al., 2024). Existing studies often consider women's belonging in ICT could be affected by their underrepresentation in class numbers and being subject to stereotypical assumptions (Yates & Plagnol, 2022). Some existing literature also suggests the need for more female role models to foster belonging for female students in STEM (Pietri et al., 2019). In contrast, we found a lack of preferred ways to signal was more impactful to the retention for the female identifying participants in this study. Student belonging needs were individual, but they had commonalities that can be used to inform educator teaching and learning practice. These initiatives range from providing opportunities for students to have signalling interactions they found connecting, and educators being aware of how signals can be interpreted by students. Diverse students can be

supported through the implementation of practical strategies in day-to-day teaching that allow for students to have different needs.

Many existing strategies focus on ways to foster belonging online through educator responsiveness and communication; however, this study extends these findings to show that responsiveness includes the provision of multiple interaction options for students to choose from. In the existing literature, the development of "teacher-presence" online can be developed over time to support student belonging through being part of a community using strategies such as being responsive, personable, and fostering learning interactions (Stone, 2016). In addition, educator's knowledge and understanding of student's is essential for improving online delivery and support (Stone & Springer, 2019). Educators can minimise "transactional distance" through their signalling behaviours including regular and personalised communication (Orcutt et al., 2024, p. 348). In this study, educators could use their knowledge of students to not only provide individualised signalling responses to student-initiated signals but also interaction options. An essential element of these principles is for educators to be responsive to student needs within teaching and learning practices using a variety of methods and modes for signalling and support. Some existing literature suggests increasing synchronous interaction opportunities can support belonging (Tice et al., 2021). These principles extend this focus on using interaction options to fostering belonging into using multiple channels of interaction, synchronous and asynchronous, for classes and materials. Educators can offer fundamental interaction options based on a general understanding of what student's need without assuming which individual preferences they will meet. For example, multiple student participants (e.g.: Students A, C and G) wanted the availability of a chat function in all lectures and classes, not just for social interactions but to interact to pay attention. When students have limited ways to meet with educators online in small scales, they can disconnect. These options could be personable and responsive at all scales.

This research contributes to our understanding of fostering belonging during sustained online learning, where students belonging needs can change and adapt, as they move through the process of belonging during their first-year transition. To be responsive to students, educators need to develop their capacity to signal online for changing disciplinary and signalling skill levels. It has been recognised that by employing diverse educator practices, building relationships, leveraging technology and creating inclusive environments, belonging can be fostered (Allen et al., 2024). However, changes in the belonging process over time means we must also consider the ways educators need to adapt during teaching periods to consider students changing needs that can affect the way students signal and connect over time. Students may focus on different signalling preferences as they develop and transition. Students are exercising choice in how and when they interact with learning online (Turner et al., 2024). Educators can focus beyond disciplinary knowledge by scaffolding the development of interacting skills for students in sustained online learning as a pedagogical tool to foster belonging and students' ability to exercise choice.

Practical Implications

Educational design to foster the process of belonging needs to be embedded in teaching and learning where educators can adapt to student needs over time. Educators can use the principles outlined in this paper as practical and implementable strategies for fostering student belonging online. Educators need to be aware of students diverse signalling preferences. Educators can

start by accommodating a range of student signalling options, ways of being personable, relational, and supportive within everyday teaching and learning. These initiatives need to occur in multiple ways. For example, educator practice can include ensuring student representation in content; providing diverse opportunities for help for students out of hours; using a personable tone even when students are not responding; providing large- and small-scale interaction opportunities; and always enabling the chat function in lectures and classes. To adapt to students, educators need to learn about students developing needs, and to model effective signalling even when they don't receive a response or validation from students. Educators fostering a connecting environment can be a process of trying different ways of responding and by offering different interactions options at varied times. Educators need to learn about students and the effectiveness of their initiatives through student signals, their assessment submissions, and learning analytics. Through educators creating opportunities to meet with students in smaller scale interactions, they also open the possibility of learning from students about their belonging needs. It is important to note that these initiatives may need to change over the teaching period. For example, polling tools may be effective at the start of the year can help students to gain signalling skills while later in their first-year students may prefer to connect through in-depth discussions on a topic as their signalling skills have developed. In addition, educator practices to foster belonging may work with one student cohort, or learning situation, but not another, as the student's needs vary. To foster belonging in practice, educators need to be responsive to students and provide them with choices. This benefits the students finding their preferred ways to signal but also educators as they do not need to meet the needs of all students in one large scale class.

The traditional lecture, a staple of university teaching, does not work for the belonging needs of all students within online teaching and learning practices. Online learning requires a variety of interaction styles so that students can align their connecting preferences with those that are available. Providing diverse online interactions may mean adopting pedagogies typical of other disciplines or developing teaching skills in new areas. Starkey et al. (2023) found there are disciplinary differences that influence pedagogical practice and use of technologies. For example, the typical ICT pedagogy does not involve facilitating discussion and so providing discussion style signalling options to students may require educators developing this skill. As part of this shift, educators may need to adjust to focusing on the learning process rather than technical knowledge, by asking students 'why' in these classes rather than positioning themselves as the overseer and transmitter of truth. Fostering belonging is a relational skill that educators that can develop, hone and gain confidence practicing in parallel with pedagogy, while responding to the changing needs of their students.

Student perception is that online learning is a cost saving exercise for universities (Turner et al., 2024), however with additional investment it could be an area where we see the greatest returns in fostering belonging for student success and retention. Universities can support fostering belonging by enabling educators to have the agency to change their teaching and learning approaches according to the way their student's needs change and develop over time. Students can benefit from having the means and resources to belong (Ajjawi et al., 2023). University support is needed as the time needed to develop teacher presence is often not accounted for in workload models (Stone, 2016). Educator's ability to be responsive requires manageable class sizes, class format options, time, and support. Educators can be supported to take advantage of the technological affordances of online learning to simultaneously scaffold learning interactions

for students with different disciplinary and signalling skill levels. For example, universities can utilise technology to make multiple inclusive interaction platforms available to educators (Allen et al., 2024). Central university learning designers play a key role in supporting educators to foster belonging online through accessibility, inclusivity, the effective use of technologies, and as sounding boards for interpreting student signals. Universities can support educators by providing time and means to develop the skills and effective learning environments that address the needs of diverse students in online learning.

Theoretical Implications and Future Research

The theoretical implications of these findings are that principles for fostering belonging can be based on student's ability to progress through the process of belonging online, including an understanding of effective online interactions, or signalling. Students need agency to connect in their process of belonging, to engage in their preferred signalling, and to reconnect when disconnected. Educators play a key role in supporting student's agency to signal and connect through interactions. Educators can foster student belonging through supporting signalling interactions, even when a student does not prefer to connect with the educator. This research focuses on online interactions, and in doing so explores how student's ability to interact in their preferred way online has an impact on their belonging. This finding highlights that strategies for fostering belonging based on a conception of belonging that focuses on online interactions can be inclusive of diverse ways of belonging while being student centred. Such a conception of belonging can support educators to foster student connection in practice by focusing on signalling interactions, including how they are interpreted and aligned with.

There were four limitations to this study that calls for further research. The first limitation of this study is that the findings may be particular to ICT. There is a potential that the disciplinary culture of ICT affected the process of belonging. For example, many students in this study did not seek social belonging which may not be typical of all disciplines. In addition, the ICT units in this study used competency-based assessment that is not typical of university assessment. The grading system was often commented on by students as affecting their ability to belong either positively or negatively. The second limitation is that online and hybrid students were considered as a collective in the study. While the data generation focused on online experiences and all participants studied predominantly online, there is a potential to further explore the difference in the process of belonging for those students who have some face-to-face teaching time. The third limitation is that participants recruited for this study were asked to speak about belonging and connectedness. The study may have appealed to student participants who thought favourably of belonging. The student participants in this study sought belonging in some form but could not always maintain it. In addition, educators may have agreed to participate because they see fostering belonging as part of their roles. The fourth limitation is the process of belonging does not categorise students by their descriptions of their characteristics or study modes. These details, such as ableness, first in family, full-time or part-time, were not collected explicitly during recruitment or used in coding to be inclusive of all students in the theorisation without categorising them. Some students provided this information voluntarily. The aim of the study is to have practical and implementable principles for fostering belonging that educators can apply to the whole cohort. We also looked to protect the privacy of participants. Participants were asked which pronouns they would like to be identified by. One participant identified as First Nations. We let the participant

lead the direction of the interview in terms of what they found significant and wished to discuss. The student did not discuss being First Nations.

This research may not be generalisable to the larger student population. Further research on the effectiveness of the process of belonging applied to other countries, diverse cohorts and disciplines may add knowledge to the field of belonging and online learning for first-year students that accounts for the process of change in belonging over time.

Conclusion

There is a close relationship between teaching and learning practice and design, and the ability of educators to foster belonging online. Starting with the process of belonging online, and the importance of signalling, from the grounded theory analysis five principles of fostering belonging in teaching and learning were proposed. They include developing signalling skills; catering for signalling preferences; proactive adjusting and matching; providing opportunities through understanding students signalling preferences; signalling for belonging and retention. These principles are interconnected and foster the ways for belonging in online learning environments as well as showing how to action the effective aspects of online teaching and learning, such as scaffolding disciplinary and signalling skills, being responsive by offering multiple interaction options, and adapting during sustained online learning. Student belonging needs change over time and educators need the support to be responsive to them. These principles can be embedded in teaching and learning practices through providing multiple personable ways of relating online with students so they can find their preferred connecting signalling while accommodating their diverse needs. Through educators providing for student agency and choice, they can create ethical environments that foster the process of belonging for diverse student needs when learning online. Applying these principles supports diverse students, including students who identify as female, in persisting and succeeding in ICT. Educators need resourcing and support from universities to be able to implement practices for fostering belonging online. If students are understood as individuals with diverse preferences for connecting, course design can be approached to maximise learning for all students and to foster their belonging in whatever form that takes.

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