Major, A. D. C., Lei, J., Jack, L., & Liu, Y. (2026). An empirical study of international graduate students' technology use and sense of belonging. *International Journal of Technology in Teaching and Learning, 22(1),* 15-32.

An Empirical Study of International Graduate Students' Technology Use and Sense of Belonging

Amona Da Conceição Major
Jing Lei
Leytisha Jack
Syracuse University
Yang Liu
Bethel University

A sense of belonging is widely recognized as a critical factor in students' academic engagement, persistence, and well-being; however, limited research has examined how international graduate students leverage digital technologies to cultivate belonging within higher education environments. This qualitative study explores how international graduate students use digital tools to navigate academic integration while studying in the United States. Drawing on 14 semi-structured interviews with students from nine countries across diverse disciplines, the study investigates the ways students use communication platforms, learning technologies, and social media (i.e., WhatsApp) to connect with peers, instructors and the broader academic community. Thematic analysis revealed the nuanced role of technology in fostering participant's sense of belonging. Participants described leveraging AI tools (i.e., ChatGPT) for anxiety reduction and language support, asynchronous platforms and modes for processing time, and collaborative technologies for visibility and validation. Findings highlight that technology-mediated belonging for international graduate students is fundamentally influenced by intentionally designed digital learning environments, linguistic accessibility, peer recognition, and authentic opportunities for participation. This study contributes to a deeper understanding of technology-mediated belonging that supports inclusive participation and community building in higher education.

Keywords: international graduate students, sense of belonging, digital technologies, artificial intelligence, technology-mediated belonging.

Amona Da Conceição Major is a doctoral student in Instructional Design, Jing Lei is a professor of Instructional Design and Department Chair, Department of Development and Evaluation, and Leytisha Jack is an Instructional Designer, three of them are at Syracuse University. Yang Liu is a learning experience designer at Bethel University. Amona Da Conceição Major can be reached at amdias@syr.edu
DOI: https://doi.org/10.37120/ijttl.2026.22.1.02

INTRODUCTION

Sense of belonging has been widely recognized as a critical factor influencing students' academic success, engagement, and well-being in higher education (Ahn & Davis, 2023; García et al., 2019; Swain, 2022). International graduate students (IGS) in U.S. higher education experience a sense of belonging that varies not only across academic disciplines, but also across course formats – synchronous, asynchronous, and hybrid – in ways that is still scantly explored. International students' enrollment continues to shape U.S. higher education (Institute of International Education, 2025) intensified barriers to belonging, cultural differences, language demands, and isolation, which distinguishes their experiences from those of domestic students (García et al., 2019).

Increasingly, technology has been leveraged in academic settings to bridge educational gaps, becoming what Han et al. (2022) describe as the 'new normal' that international students are expected to quickly adapt to. Social, technological, and academic support factors are consistently documented as shaping this population's learning experiences (Dulfer et al., 2025; Koo & Jiang, 2022), yet how they intersect specifically around belonging, and across course formats, remains underexplored.

Notwithstanding the substantial growth in belonging research, important gaps persist, particularly regarding IGS and their experiences in learning environments where technology mediates learning at every turn. Most existing literature centers on undergraduate populations (Gopalan & Brady, 2020; Strayhorn, 2018) leaving IGS, who navigate graduate-level academic expectations, cultural adaptation, and the cognitive labor of linguistic negotiations, while pursuing academic belonging simultaneously (Allen et al., 2024; Han et al., 2022; Koo & Jiang, 2022; Swain, 2022), largely underrepresented in research. Technology has become increasingly ubiquitous in higher education and has been proven to act as a pull attracting international graduate students, yet its role in fostering or hindering belonging for this population also remains underexplored.

This study addresses these gaps by exploring how IGS leverage digital technologies to cultivate belonging within the U.S. higher education environments, with attention to how course format mediates those experiences. In doing so, it expands current conceptualizations of belonging by centering the perspectives of a linguistically and culturally diverse graduate population whose experiences challenge assumptions embedded in frameworks developed primality with domestic, undergraduate learners in mind.

LITERATURE REVIEW

INTERNATIONAL GRADUATE STUDENTS: BELONGING AND TECHNOLOGY

While prior studies examine belonging and technology separately, limited research has explored how international graduate students experience belonging through technology-mediated participation. A growing body of research highlights the importance of a sense of belonging in higher education, linking it to student retention, academic achievement, and overall well-being (Pedler et al., 2022; Strayhorn, 2018; Tinto, 1998). For IGS, belonging carries additional complexities shaped by cultural adjustment, language barriers, and varying institutional practices that influence their integration into academic and social communities (García et al., 2019; Swain, 2022). As higher education increasingly relies on technology to deliver instruction across online, hybrid, and face-to-face (F2F) modalities, questions emerge about how digital tools shape belonging in diverse learning environments (Koo & Jiang, 2022; Olivier & Weilbach, 2024). This review builds toward the study's central claim by tracing three intersecting arguments: the heightened importance of sense of belonging for IGS, where technology mediates rather than determines connectedness, and the Community of Inquiry (CoI) framework's ability to rationalize how presence and participation shape belonging across learning modalities.

Sense of belonging has emerged as a central construct in higher education research, frequently linked to student persistence, consistency in academic performance, and wellness (Pedler et al., 2022). Strayhorn (2018) defines belonging as students' perceptions of being socially supported, connected, and valued within their academic communities, highlighting its role as a basic human need with direct implications for success in college. Similarly, Gopalan and Brady (2020) describe belonging as the psychological sense of being a recognized and meaningful member of the university environment. Pedler et al.'s (2022) questionnaire of 578 first to fourth-year university students, revealed that students with a stronger sense of belonging were more likely to report higher engagement and higher academic motivation, than their counterparts with lower sense of belonging. More recent scholarship views belonging as a dynamic and evolving process, shaped by institutional culture, peer relationships, and faculty engagement (Allen et al., 2024). Together, these perspectives underscore belonging not only as a feeling of inclusion but also as an outcome of interactions between students and their academic environments. This foundation is particularly important for understanding international graduate students, whose belonging may be mediated by multiple intersecting factors, including culture, language, and technology, in their learning experiences.

For IGS, belonging is shaped by factors that extend beyond academic performance, and Koo and Jiang (2022) and Swain (2022) argue that this population often faces unique belonging challenges due to limited social support and unfamiliarity with U.S. academic norms. Similarly, García et al. (2019) highlight how perceptions of exclusion and difficulties navigating institutional structures can weaken this group of students' sense of connectedness to their host institutions. Research further suggests that cultural differences and isolation can limit opportunities for meaningful interaction with faculty and peers, thereby diminishing belonging (Koo & Jiang, 2022). (Dulfer et al., 2025) add that institutional practices play a critical role in shaping international students' experiences of inclusion, as intentional efforts to promote cross-cultural engagement are strongly correlated with a greater sense of belonging. These findings highlight the complex, multidimensional nature of belonging for IGS, positioning it as both a social and academic process that is often mediated by broader contextual challenges.

One such contextual challenge is technology. Technology has become central in higher education, particularly in online and hybrid course formats where opportunities for learning often depend on digital tools and platforms. Research shows that tools such as discussion boards, learning management systems (LMS), and video conferencing can foster community when designed to encourage interaction and collaboration (Parrish et al., 2021; Peacock et al., 2020). For instance, collaborative technologies and structured peer interaction have been linked to stronger perceptions of social presence and community among students (Olivier & Weilbach, 2024). At the same time, technology can introduce new barriers to belonging, such as uneven participation, digital fatigue, or inequitable access, which may disproportionately affect international students navigating unfamiliar academic systems (Han et al., 2022). These findings suggest that technology is not a neutral medium but rather a space where belonging is actively shaped, either supported or constrained, through design, facilitation, and usage patterns.

THE COMMUNITY OF INQUIRY (CoI) FRAMEWORK AND BELONGING

The Community of Inquiry (CoI) framework provides a useful theoretical lens for analyzing belonging in technology-mediated higher education. The CoI model, developed by Garrison, Anderson, and Archer in 2000, distinguishes three key elements: cognitive presence, social presence, and teaching presence. These presences together create a collaborative and supportive learning environment. Cognitive presence refers to the extent to which learners are able to construct and verify meaning through reflection and discourse

(Cleveland-Innes et al., 2018). Social presence emphasizes students' ability to identify with the learning community, develop interpersonal relationships, and communicate openly (Cleveland-Innes et al., 2018). Teaching presence, meanwhile, encompasses both the instructional design of the learning environment and the facilitation of meaningful dialogue by the instructor (Garrison et al., 1999). While the CoI framework has been widely applied to studies of online and blended learning, it has seldom been explicitly linked to belonging as a construct. Yet, belonging is closely tied to the development of cognitive, social, and teaching presence (Parrish et al., 2021; Peacock et al., 2020; Szeto, 2015) making CoI a promising framework for examining how international graduate students experience inclusion and engagement in technology-mediated learning contexts.

Although technology has the potential to enhance belonging, it can also create new barriers that affect student engagement and integration. Han and partners (2022, p. 167) note that technological limitations such as poor internet access, differing levels of familiarity with technology might affect international graduate students' learning experiences. Koo and Jiang (2022) also argue that digital fatigue, unequal access to resources, and inconsistent faculty support can also undermine students' sense of connection in online courses. Conversely, when faculty effectively integrate technology with intentional pedagogy, students often report greater satisfaction, stronger collaboration, and a heightened sense of belonging (Parrish et al., 2021). Recent innovations, such as the use of generative AI chatbots, are beginning to show promise in supporting CoI presence by facilitating real-time feedback and learner interaction (Olivier & Weilbach, 2024). These findings suggest that the role of technology in fostering belonging is highly contextual, depending not only on the availability of tools but also on how they are implemented, utilized and supported within academic environments.

GAPS IN CURRENT RESEARCH AND RATIONALE FOR THE STUDY

Studies that explore technology and belonging often emphasize general student populations without considering the unique perspectives of IGS, who must navigate additional layers of cultural adjustment, language barriers, and institutional unfamiliarity (Han et al., 2022). Moreover, while the CoI framework has been widely applied to examine online learning (Cleveland-Innes et al., 2018; Olivier & Weilbach, 2024), it has seldom been used explicitly to investigate belonging as an outcome, particularly for international graduate students across diverse disciplines and course formats. This study addresses these gaps by exploring how IGS interpret belonging through their use of technology in U.S. higher education, framed within the dimensions of social, cognitive, and teaching presence.

Taken together, the literature illustrates that belonging is a critical factor in academic success and retention, which might be exacerbated for international graduate students whose experiences are shaped by cultural, linguistic, and institutional challenges. Technology has emerged as both a barrier and a potential enabler of belonging, depending on how tools are integrated into learning environments, utilized by IGS and instructors, and supported through pedagogy (Han et al., 2022; Peacock et al., 2020). Yet, despite the growing body of work on belonging and technology in higher education, few studies explicitly center the perspectives of IGS or examine how course formats and digital tools influence their experiences of inclusion. This gap highlights the need for exploratory inquiry that focuses this populations' voices, attends to disciplinary and cultural diversity, and considers the role of technology in shaping inclusivity and community. Building on these insights, the present study asks: What does belonging mean to international graduate students across disciplines and course formats, and in what ways does technology contribute to, or detract from, their sense of belonging in U.S. higher education learning environments?

METHOD

DESIGN

This study leaned on a qualitative approach to data collection, using semi-structured interviews that probed the students' experiences with technology in and outside of classes, in assignments, and interactions with peers and instructors. The interview protocol was designed based on the Community of Inquiry framework. Questions aimed to first establish rapport and steer participants to define belonging in their perspective. Questions explored IGS definitions of belonging in academic contexts, focusing on course experiences (i.e., "can you describe a course where you felt a strong sense of belonging? What contributed to that feeling?"), technology use (i.e., "what academic technologies do you use most often? And how do they help you – or not help – you feel connected to your peers or instructors?"), and comparisons between online and in-person learning.

PARTICIPANTS

The 14 participants of this study were graduate students currently enrolled at a U.S. research university. Table 1 showcases participants' countries of origin - nine countries across Asia, Africa, and South America – expanding their acknowledged technology use at the institution. This diverse group comprised graduate students pursuing master's and doctoral degrees across various disciplines in higher education. This diversity, as noted by Peacock et al. (2020), supports the supports the diversity of perspectives and the diversity of technologies used by the participants, across disciplines and experiences (see Table 1).

Table 1. *Participants' Academic and Technology Biographies*

Participant	Origin	Gender	Academic Discipline	Prior Work Experience	Primary Technologies Used
QJ	China	Male	Instructional Design (Master's)	Yes (Teaching)	Zoom, Blackboard, Google Workspace, ChatGPT, Microsoft Teams, WhatsApp, WeChat, Zotero
KC	India	Female	Information Technology (Master's)	Yes (Data Analyst)	Zoom, Google Workspace, Microsoft Teams, Slack, Jira, development tools
MdZ	Bangladesh	Male	Media (Doctoral)	Yes (N/A)	Adobe Creative Suite, Zoom, Microsoft Office Suite, Blackboard
SM	Pakistan	Female	Sociology (Doctoral)	N/A	ChatGPT, Google Workspace, Zoom, WhatsApp, Blackboard, Zotero, WhatsApp
JT	China	Female	Psychology (Doctoral)	Teaching Assistant	ChatGPT, Google Docs, Zoom, translation apps, Grammarly, Microsoft Teams
GB	Ghana	Male	Mathematics Education (Doctoral)	Yes (N/A)	ChatGPT, SPSS, GeoGebra, Desmos, Zoom, Google Workspace, WhatsApp

AA	Nigeria	Male	Business Management (Master)	Yes (N/A)	ChatGPT, Zoom, Google Workspace, YouTube
WM	Myanmar	Female	Environmental Science (Master)	No	Google Docs, Zoom, coding environments, translation tools
QL	China	Female	Information Science (Doctoral)	Yes (Library Services)	Microsoft Teams, Zoom, Google Workspace, ChatGPT, translation tools
VJ	India	Female	International Relations + Business (Master)	Yes (N/A)	Zoom, Google Workspace, Blackboard, WhatsApp
LP	Ecuador	Male	Business Analytics (Master)	Yes (N/A)	Zoom, Google Workspace, Microsoft Teams, WhatsApp, Blackboard
SS	India	Female	Computer Science (Master)	Yes (internship)	Zoom, Google Workspace, Blackboard, Microsoft Teams, WhatsApp
SC	Bangladesh	Male	Chemistry (Doctoral)	Yes (N/A)	Reaxys, ChemDraw, Zotero, SciFindr, Zoom, Blackboard
AM	Indonesia	Female	Mathematics Education (Doctoral)	Yes (Teaching)	Google Docs, Grammarly, Zoom, Blackboard, Microsoft Teams, translation tools, WhatsApp

PROCEDURES

The interview was piloted with five international graduate students across disciplines and gender – feedback informed minimal modifications, including the development of a brief screening Google form to collect participants' demographics (age, country of origin, technologies used, and voluntarism to participate in the study). Recruitment commenced right after the IRB approval was secured – the recruitment process involved sending campus-wide emails via the graduate listserv (approved and sent by the graduate school director). 25 participants responded to the screening, and although all participants indicated willingness to be interviewed, only 14 responded for the interviews at the time of data collection – early Fall semester. The 45-to-60-minute-long interviews were conducted via Zoom and recovered following consent; all were completed between August and September 2025, in English as the common medium of communication. Transcripts were used verbatim and anonymized by the first author and interviewer before handled by the other coders.

RESEARCHERS' POSITIONALITY

Positionality disclosure is a foundational practice in qualitative research, as researchers' backgrounds and identities shape both the data collection and the analytical process (Annink, 2017). The three coders (first, third, and fourth authors) are international graduate students in instructional design, a positionality that informed their familiarity with the technological contexts of participants described. Reflexive practice was essential and ensured that individual prior experiences with technology and U.S. academic life did not unduly constrained interpretation. The research team also adhered to core ethical principles, including the protection of participant confidentiality, the securing of informed consent, and

a commitment to presenting findings in ways that honor the complexity and authenticity of the participants lived experiences.

DATA ANALYSIS

Data analysis was conducted by the first, third, and fourth authors, who applied Braun & Clarke (2006) six-phase thematic analysis process inductively across all interview transcripts. This approach is suitable for classifying, examining, and reporting qualitative data in depth. Coders first familiarized themselves with the transcripts, noting recurring ideas and inductively coded sample statements. For instance, a statement such as "he was very much responsive over the emails or whatever", was coded as "instructors' responsiveness". To ensure reliability of the data analysis, the three coders used a rotating assignment system (see Figure 1 for a complete process visualization) to analyze the data independently before comparing their interpretations and refining the initial coded date. Through iterative discussion, full consensus was achieved on the finalized coding book. The entire research team reviewed the codes collaboratively to identify broader categories and overarching themes grounded in the data. Finally, under the supervision of the second author, themes were refined to ensure accurate representation of participants' perspectives before the final reporting.

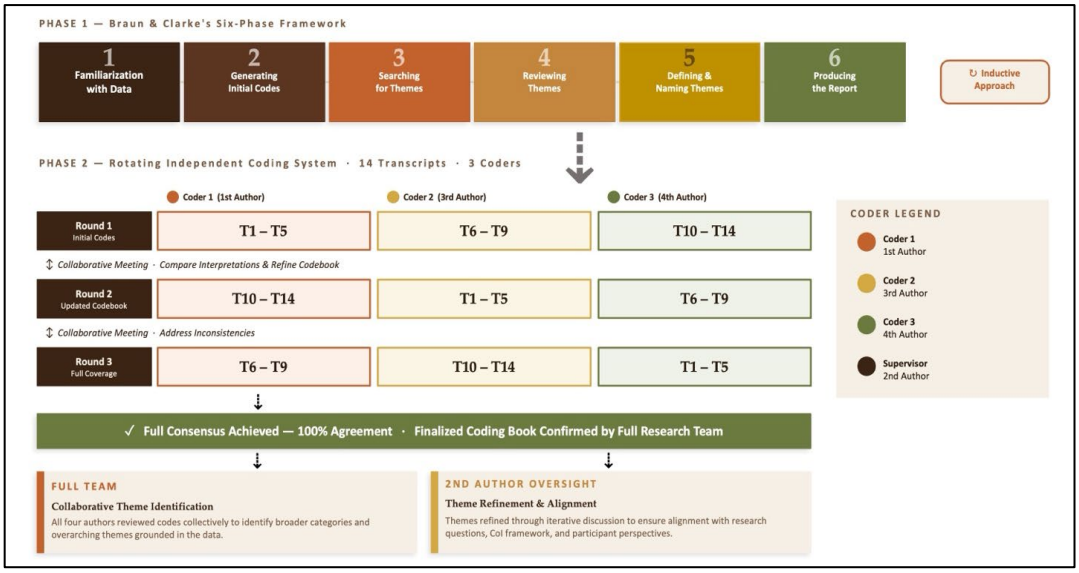


Figure 1. Data analysis process: Braun & Clarke's (2006) six-phase thematic analysis rotating coding system

FINDINGS

DEFINING BELONGING IN THE VOICE OF IGS

Before presenting the research findings, it is important to highlight how participants themselves defined belonging. This foundation both situates the findings and validates the theoretical framework guiding the analysis, while centering the voices of the participants.

When asked what belonging meant to them in the context of their academic experiences, participants offered definitions that were highly convergent despite their diverse national, disciplinary, and linguistic backgrounds. Three shared dimensions emerged: (1) the psychological safety to speak and contribute freely, (2) the experience of being recognized and valued as an academic community member, and (3) unconditional acceptance regardless of cultural or linguistic background. The participant, QJ, for example, framed belonging as the confidence to *"speak out freely, without thinking twice or third before saying*

something". Similarly, WM described it as feeling "comfortable sharing concerns and raising questions," adding that true belonging meant being "accepted for who you are, irrespective of your culture and your language proficiency." For SM, belonging meant "feeling part of a community, welcomed, and needed," while GB anchored it in membership: *"just trying to be part of a community."* JT emphasized the relational and identity dimensions: the willingness to seek support, the social connection to others, and the sense that one's identity is tied to the institution.

Taken together, participants' definitions align closely with scholarly conceptualizations of belonging as students' perceptions of being socially supported, valued, and connected within their academic communities (García et al., 2019; Pedler et al., 2022; Strayhorn, 2018). However, there is a distinct linguistic dimension not highlighted in the original definitions: for IGS in this study, belonging was inseparable from the ability to communicate, and therefore inseparable from the technologies that enabled or constrained that communication. This convergence between participants lived definitions and Strayhorn's theoretical framing provides a grounded interpretive anchor for the research themes that follow.

Following this definition, we focused on the thematic analysis of the 14 semi-structured interviews, which yielded four major themes that enlighten how IGS use technology to mediate belonging within U.S. higher education: (1) language as a universal mediating factor, (2) AI tools as transformative resources with psychological dimensions, (3) instructor presence and intentional technology integration, and (4) collaborative technologies as enablers of real-time co-creation. These themes are not mutually exclusive; rather, they function as an interconnectedly where language mediates all technology experiences, instructor design choices shape the affordances available to students, and collaborative tools create visible, validating spaces for participation. Taken together, they frame technology not as a direct creator of belonging, but as a compensatory bridge, a strategic mediator that can either amplify or constrain students' capacity to connect, contribute, and feel valued within their academic communities.

THEME 1: LANGUAGE AS A UNIVERSAL MEDIATING FACTOR

Across all participants, language emerged as the foundational variable through which every technology experience was filtered – here understood as the English language. Whether participants described selecting tools, engaging with course content, contributing to group projects, or interacting with instructors, language proficiency (at varying levels) and the cognitive demands of communicating in a second language consistently shaped how, when, and whether technology supported their sense of belonging. This pattern surpassed country of origin, discipline, and prior work experience, making language the only truly universal theme in the dataset.

Participants consistently described technology not as a replacement for language competence, but as a scaffold that allowed them to operate more effectively within linguistic constraints. JT, a doctoral student from China, captured this relationship explicitly, explaining that technology served a dual purpose – enabling communication while simultaneously buffering the anxiety that accompanied high-stakes, real-time language performance:

> *"Sometimes my language is not really sufficient to support me, to discuss some really professional ideas with others in person without the support of technology. But if I use those things, like ChatGPT, translators, grammar check, it will decrease my anxiety." (JT, Psychology)*

This anxiety-reduction function of technology was not peripheral; it was, for many participants, the precondition for participation itself. The ability to prepare, revise, and

translate before contributing to academic conversation transformed technology from a convenience into a means for access.

Asynchronous communication modes were particularly valued for the processing time they afforded. QL, another doctoral student from China (echoed by WM, from Myanmar), articulated how recorded lectures addressed a specific and persistent challenge – the demands of simultaneously listening for comprehension and note-taking in a second language:

> *"I still cannot do listening and writing down notes simultaneously in English... but the video is good, because you hear it, you pause, and then I write my notes down, so that way I can do it." (QL, Information Science)*

This quote exemplifies a broader pattern in which students repurposed available technologies, often not originally designed for multilingual learners, to compensate for the cognitive load of language processing. The same participant described flipped classroom formats as particularly enabling, noting that pre-class engagement with recorded content allowed for deeper, more prepared participation in synchronous sessions: "once you learn the content before going to class, I might have more time to think about the questions".

Language as a universal mediating factor has important implications for the CoI framework. Social presence: defined as the ability to identify with a learning community, communicate purposefully, and project oneself as a real person, was consistently dependent on linguistic accessibility. When technology reduced the pressure of real-time language performance, participants reported greater willingness to engage, a heightened sense of visibility, and stronger feelings of academic belonging. Conversely, when technology environments did not accommodate multilingual processing needs, social and cognitive presence were simultaneously diminished.

Ultimately, IGS experiences of belonging revealed firm ties to language proficiency, while using technology to reduce language related challenges, and support class participation and learning outcomes, highly contributes to the students' sense of belonging.

THEME 2: AI TOOLS AS TRANSFORMATIVE RESOURCES WITH PSYCHOLOGICAL DIMENSIONS

AI tools, ChatGPT in particular, emerged as a qualitatively distinct category of technology. Participants experienced it not merely as a functional resource, but as a psychologically significant presence in their academic lives. The majority of the participants (13 out of 14) reported using ChatGPT regularly, and the language they used to describe it frequently reflected dimensions of connection, trust, and building professional skills. These findings challenge reductive framings of AI as primarily an academic shortcut (Cotton et al., 2024) and points toward a more nuanced understanding of how AI functions within the belonging experiences of linguistically diverse graduate students.

At the most immediate level, AI tools served as language scaffolds that reduced the anxiety of professional communication in English. JT's description of ChatGPT as an anxiety-reduction tool reflected a pattern voiced by multiple participants: AI enabled students to engage with professional academic discourse with greater confidence by allowing research, revision, translation, and grammatical refinement before submission or contribution. AA, a master's student in Business Management from Nigeria, described a similar relational quality: *"ChatGPT has become another friend... most of our things, if there is a topic coming up, you can put on ChatGPT, it will tell you the book, where you can get the topic from."*

Beyond language support, participants articulated AI as a professional development tool and future-oriented competency. SM, a doctoral student in Sociology from Pakistan, explicitly framed AI proficiency as an equity issue with long-term stakes: "This is a skill

that we will need to use in the future. If we don't learn how to use AI efficiently, then I think we will lag behind." She also described an instructor supporting the use of AI for methodological reasoning in a graduate research course, where students were encouraged to use ChatGPT to think through statistical approaches for survey instruments. This context, in which AI was not only permitted but pedagogically integrated, provided a rare institutional validation of students' existing AI practices, and SM noted that this explicit endorsement reduced the ambiguity and anxiety that often surrounds AI use in academic settings.

Perhaps, the most theoretically significant finding within this theme was the role of AI in creating an unexpected community. JT described a collaborative group project in which students discovered, during the process, that they had all independently used AI, generating nearly identical responses and annotations:

> *"One thing that impressed me a lot is the time that we realized that we all use AI for that project... we even write the same comments. I have this from AI, so we can double-check it later... It's weird, like, ...but we feel the same with the same technology, and that connects us together. It creates a chance for us to build that connection." (JT, Psychology)*

This moment of shared discovery transformed AI from an individual coping strategy into a collective experience, one that bridged linguistic and cultural differences through a common technological practice. The normalization of AI use within a peer group reduced the sense of academic isolation that many participants described and created an unexpected path to social presence.

Participants also demonstrated sophisticated critical awareness of AI's limitations. Multiple students described habitually verifying, framing fact-checking not as a sign of AI failure but as a professional skill: "ChatGPT, it's really helpful, just that it has limitations of producing wrong answers sometimes, especially for math, it can give you wrong values, you would have to verify," (GB, Math Education). This critical AI literacy coexisted with enthusiastic adoption, suggesting that IGS approach AI not as passive consumers but as reflective practitioners navigating a complex and contested academic tool.

Within the CoI framework, AI tools appear to function across all three presences. As a language scaffold, they support social presence by reducing barriers to authentic, confident communication. As a cognitive tool for synthesis, methodology, and research efficiency, they strengthen cognitive presence. And when instructors explicitly integrate AI into course design, as in SM's statistics course, they activate teaching presence by structuring AI use as a pedagogical resource rather than an individual means.

THEME 3: INSTRUCTOR PRESENCE AND INTENTIONAL TECHNOLOGY INTEGRATION

Instructor design and facilitation choices emerged as the most significant determinant of whether technology supported or hindered belonging for IGS. All participants consistently distinguished between instructors who used technology as a passive delivery means and those who utilized it intentionally, either for inclusion, pacing, and/or community building. This distinction had noticeable effects on participants' reported sense of belonging, engagement, and willingness to contribute.

The clearest articulation of this pattern came from QL's account of an online course that stood out as an exceptional belonging experience:

> *"I had one instructor's online course that was so engaging. She really kept it at a very fast pace... I think that course was around 30 people, and she was able to play with the technology with Zoom, very fluently, by setting everybody up into smaller groups for discussion. And she has all of these*

> *documents, instructions, discussion questions, where to put answers. Every document, every slide, every Jam board already on Google Drive." (QL, Information Science)*

What QL described was not merely technical fluency but a carefully designed instructional planning: timed breakout sessions, pre-prepared collaborative documents, visible structure, and a pace calibrated to minimize cognitive disengagement. The instructor's mastery of Zoom's features, which QL openly noted, indicated to students that their time and engagement were valued, a perception closely linked to belonging in the literature on teaching presence (Cleveland-Innes et al., 2018; Garrison et al., 1999).

In contrast, MdZ, a doctoral student in Media from Bangladesh, described the online experience in different terms: It's very robotic, "It's not a human way of learning... the quality of communication in person is not the same as the quality of communication online,". MdZ's framing revealed that belonging in online environments is not a default condition achievable through mere platform access. For a true meaningful learning experience, it requires intentional instructor effort to reconstruct the human relational dimensions of learning that are more naturally present in F2F settings.

Additionally, instructor intentionality around language was particularly significant for this population. QJ, a master's student in Instructional Design from China, described how the absence of instructor accommodation for multilingual communication directly affected his sense of belonging. In courses where instructors did not account for language processing time – or where contributions from non-native speakers were overlooked in favor of more fluent communicators – QJ reported feeling marginalized despite his disciplinary competence. Several participants echoed this observation, noting that small instructor behaviors, such as pausing to invite quieter voices, publicly acknowledging written contributions in chat, or structuring group work to ensure equitable participation, had disproportionately large effects on their sense of being valued and included.

Conversely, when instructors made technology choices that accommodated multilingual processing needs, again such as recording lectures for asynchronous review, providing advance access to materials, using collaborative documents where all students could contribute simultaneously, in writing, participants reported significantly stronger belonging experiences. GB, a doctoral student from Ghana, described how the Blackboard discussion board format allowed him to engage with peer ideas across time: "at any time, you come and you see that a friend has reported... Then I just respond, and I go to sleep, I come back the next day, I see a reply,". This asynchronous engagement model created conditions for meaningful intellectual exchange that the time pressure of synchronous formats did not afford to many participants.

Within the CoI framework, these findings affirm the centrality of teaching presence as a precondition for both social and cognitive presence. The data suggest, however, that for IGS, teaching presence must explicitly account for the linguistic dimensions of participation. An instructor's facilitation choices, to record, select collaborative tools, structure group work, acknowledge contributions in multiple modalities, function not only as pedagogical decisions but as belonging interventions.

THEME 4: AI TOOLS AS TRANSFORMATIVE RESOURCES WITH PSYCHOLOGICAL DIMENSIONS

The fourth theme centers on participants' experiences with collaborative technologies, particularly Google Workspace, shared documents, and real-time co-editing platforms. These were described as spaces where belonging was actively generated through visibility, contribution, and peer validation. Unlike asynchronous tools which are valued for the

processing time they provided, collaborative technologies were described as powerful because they facilitated simultaneous, visible participation in shared intellectual work.

WM, a master's student in Environmental Science from Myanmar, offered a particularly vivid account of how a shared Google document in a seminar course created an inclusive participation structure:

> *The professor was the main person doing that, but we're all welcome to jump in and add more... we were all able to make some changes, so that makes me feel very, very included... that course makes me feel I belonged in the sense that, feel free to make changes if it is needed. (WM, Environmental Science)*

WM's description draws attention to the importance of the invitation to edit shared platforms. Being explicitly welcomed into a shared document was experienced not as technical permission but as an act of inclusion. The equal visual representation of all contributors, everyone's text appearing in the same font, in the same document, created a form of participatory equity that formal presentation formats often denied to students whose language proficiency made verbal contributions high stakes.

JT's account of collaborative Google Docs in group projects reinforced this pattern, describing how shared documents lowered the barrier to contribution by creating a low-stakes, visible space for incremental input: "we'll firstly have a Google Doc and share the link to everyone so that we can work in that space, freely put everything inside of it, and have some comments if we have any questions". The informality of the collaborative document format and its tolerance for tentative ideas, partial contributions, and iterative revision, made it particularly well-suited to students navigating academic discourse in a second language.

The visibility dimension of collaborative tools was consistently linked to what participants experienced as peer validation, which is a core component of Strayhorn (2018) belonging framework. It emphasizes students' need to feel valued and recognized within their academic communities. When students' contributions appeared in real time within a shared document, those contributions became part of the permanent, visible record of the group's intellectual work, independent of verbal fluency or presentational confidence. This visibility function was particularly meaningful for participants who described habitual self-silencing in synchronous verbal discussions due to language processing anxiety.

WhatsApp also appeared as a significant informal collaborative tool, particularly for maintaining peer networks outside of formal course structures. Multiple participants described using WhatsApp groups for assignment coordination, resource sharing, and the kind of informal academic conversation that builds the interpersonal familiarity underlying social presence. LP noted how WhatsApp groups organized around shared linguistic communities served as primary support networks, even as they reinforced the group formations.

Within the CoI framework, collaborative technologies most directly activate social presence, particularly the dimensions of open communication and group cohesion. By creating shared spaces, students can express themselves, contribute ideas, and receive visible recognition from peers. At the same time, when collaborative tools are structured around intellectual tasks, they simultaneously strengthen cognitive presence by externalizing the processes of reflection, discourse, and co-construction that Garrison et al. (2000) identify as foundational to inquiry-based learning. The convergence of social and cognitive presence within collaborative technology spaces suggests that real-time co-creation may function as a particularly potent belonging means for linguistically diverse learners who benefit from disassociating intellectual contribution from verbal performance. In the subsequent section, some of these findings will be further elaborated upon in this conversation.

SUMMARY OF THE FINDINGS

Across these four themes, a consistent logic emerges. Notably, language serves as the foundational condition for every other technology-mediated belonging experience. Consequently, theme 1 becomes an interpretative lens for themes 2 through 4. Theme 2 shows how AI tools are used as individual-level spaces that allow students to manage linguistic and cognitive demands privately before they become evident to instructors or peers. Theme 3 shifts this focus on agency to the instructor. The private, individual coping strategy transforms into a structural, classroom-level practice of inclusion when instructors intentionally design for multilingual, diverse and flexible participation. Theme 4 further extends this structural work into social interactions, showing that real-time collaborative platforms make participation visible and shared. This trajectory from individual (linguistic) mediation to individual technology compensation, to instructor structured inclusion, to peer co-created belonging substantiates this study's central claim: technology does not manufacture belonging. Instead, it functions as a compensatory bridge whose strength depends on language, instructor intention, and collaborative design.

DISCUSSION

This study extends and complicates current understandings of technology-mediated belonging in in higher education, particularly for international graduate students in the U.S. The CoI framework reveals that digital tools depend on context, emphasizing that their effects on belonging are shaped by language, instructor design, institutional structure, and technology affordances. Three integrative insights emerge: language's primacy as a mediator, AI's impact on belonging formation, and instructor intentionality as a belonging intervention.

This study reveals a crucial insight: technology serves as a compensatory bridge, rather than a creator of belonging. By compensatory, we mean that technology offsets existing structural disadvantages (e.g., language barriers, cultural unfamiliarity, and unbalanced social networks) rather than removing them or generating new academic or social ground. By bridge, we mean that technology crosses two existing sides: the student's current linguistic and cultural capacity on one end, and the academic demands of the U.S. graduate environment on the other. Framing technology this way distinguishes it from a creator of belonging: a platform presence does not, on its own, produce the relational conditions through which belonging emerges (Strayhorn, 2018). Instead, technology enables the conditions under which belonging can occur when the institutional end of the bridge is built intentionally. JT's account of recorded lectures illustrates this dynamic in concrete ways: "sometimes my language is not really sufficient to support me to discuss some really professional ideas without the support of technology…but, if I use things like ChatGPT, translators and grammar check, it will decrease my anxiety in a new environment." The recording itself did not create belonging, but it compensated for the cognitive load of second-language processing in a way that allowed QL to participate as a full member of the academic community – a bridge that worked because the instructor had built the landing on the institutional side.

Furthermore, participants saw technology as a tool to reduce the structural disadvantages when used intentionally. Asynchronous learning resources such as recorded lectures, discussion boards, and AI-enabled tools for language scaffold, expanded students' processing time and reduced the pressure of real-time English production, benefiting multilingual learners. This finding supports Han et al.'s (2022) observation that IGS often adapt rapidly to digitalized environments designed without their linguistic needs in mind but also shows that students' strategic use of technology is adaptive competence, not dependence. Importantly, the compensatory bridge metaphor implies that bridges require

infrastructure on both ends. Technology can only bridge the gap between a student's linguistic capacity and academic demands if the instructional environment provides conditions like recorded content, flexible participation, explicit AI permissions, and collaborative document access. Without these conditions, technology does not compensate; it only makes the gap more visible. This aligns with Strayhorn and Johnson's (2025) argument that belonging requires deliberate institutional and instructional design.

This study's most significant theoretical contribution to the CoI literature is language universality. The CoI framework, as articulated by Garrison et al. (2000) and expanded by Cleveland-Innes et al. (2018), treats social, cognitive, and teaching presence as overlapping dimensions of a shared learning environment. However, the findings suggest that language accessibility is a foundational condition that modulates the accessibility of all three presences; a dimension the framework does not currently make explicit. Language consistently moderated social presence – asynchronous formats, AI scaffolds, and real-time collaborative documents reduced cognitive demands, making social presence more accessible. When technology did not, students described withdrawal, silencing, and engagement without genuine participation. Language similarly mediated cognitive presence, the extent to which learners construct meaning through reflection and discourse. Students who took longer to follow real-time verbal exchanges spent cognitive resources on language analysis instead of disciplinary reasoning, impacting higher-order inquiry.

Teaching presence was partly constituted by instructors' willingness and ability to design for linguistic diversity, a dimension the CoI framework does not currently address. Instructor design and facilitation choices are central to students' belonging experiences, as emphasized by the CoI framework's focus on teaching presence. Across participants, belonging and not-belonging in a course were less influenced by modality (online vs. in-person) and more by specific instructor behaviors, such as recording lectures, using breakout rooms with prepared documents, publicly acknowledging contributions, randomizing grouping, and addressing AI use as a pedagogical resource. This finding supports Dulfer et al.'s (2024) argument that online classroom belonging is personal and intentional instructor practices enhance connection quality. It extends this argument by showing that for IGS, the personal stakes of instructor choices are amplified by students' linguistic vulnerability. For example, providing advance access to course materials serves as a time-management accommodation and a belonging intervention, allowing students with additional processing time to engage with content before synchronous sessions, enabling more confident and substantive participation. The exceptional online course described by QL, where an instructor's fluent command of Zoom's collaborative features created an engaging environment, demonstrates how teaching presence can transcend online limitations when instructors are technologically competent and intentional in designing instruction, learning experiences. This challenges the assumption that in-person instruction is inherently superior for belonging formation (Szeto, 2015) while affirming that online belonging requires deliberate effort beyond F2F design.

The fourth theme, collaborative technologies as enablers of real-time co-creation, introduces a lesser-known belonging means in the CoI literature: the visibility of contribution as peer validation. When students' additions to shared documents appeared in real time alongside peers and the instructor, their contributions were immediately incorporated into the course's collective record. This visibility recognized students without relying on verbal fluency, cultural familiarity, or confidence to speak, all of which were identified as possible barriers to belonging in synchronous verbal formats. This finding extends Lowenthal and Dunlap's (2018) work on social presence strategies in online learning, which emphasizes visible, authentic participation as central to students' perceptions of community. It also aligns with Peacock et al.'s (2020) finding that a sense of belonging for online learners is strongly associated with opportunities for genuine

contribution and peer acknowledgment. This study makes it more specific by identifying the real-time, simultaneous co-editing affordance of collaborative documents as a powerful way to level participation by separating intellectual contribution from verbal performance and creating a visible, persistent record of each student's engagement.

AI's unexpected role as a community-building tool emerges from shared discovery of similar strategies among peers. Notably, our findings suggest that AI tools, as directly cited by one of our participants (JT), shape individual learning and peer interaction dynamics as students navigate shared and contested AI use. The present findings suggest that for IGS, AI normalization within a peer group fosters academic solidarity, acknowledging multilingual learners' adaptive strategies in linguistically demanding environments.

Together, the four themes suggest that technology-mediated belonging for international graduate students is designed, not inevitable or impossible. The conditions under which technology supports belonging are deliberate choices about platform selection, course structure, instructor facilitation, institutional policy, and the explicit acknowledgment of linguistic diversity as a design constraint. Where these choices are made with intentionality and an awareness of the linguistic mediation at work, technology becomes a genuine compensatory bridge; where they are not, it becomes another surface on which students' marginalization is reproduced.

SCHOLARLY SIGNIFICANCE

This study has identified four major themes – including language as a universal mediating factor affecting all participants regardless of proficiency level, and AI tools serving dual roles as anxiety reducers and professional skill development opportunities – that reveal technology's compensatory function in fostering belonging (Strayhorn & Johnson, 2025) among international graduate students. These preliminary findings suggest that instructor intentionality matters more than modality (Dulfer et al., 2025; Szeto, 2015), and that real-time collaborative platforms create powerful inclusion experiences through visibility validation (Lowenthal & Dunlap, 2018; Parrish et al., 2021) in the form of collaboration tools. Figure 1 illustrates how these themes function as an interconnected system, with language serving as the foundational mediator upon which technology acts as a compensatory bridge; enabled by instructor intentionality and institutional support – to foster sense of belonging.

Based on these emergent themes, we have identified preliminary design implications across three main stakeholders. First, for instructional designers, designs should accommodate multilingual audiences with varied processing speeds (Han et al., 2022) by offering asynchronous alternatives to course content and assignments ((Martin et al., 2020) and multiple participation pathways (e.g., allowing access to session materials well in advance for preparation time), while addressing AI use explicitly rather than prohibiting it to ensure equity (Kasneci et al., 2023). Second, for instructors, technology fluency addresses equity issues beyond pedagogical preferences. Small intentional choices such as providing recordings, using collaborative platforms (e.g., Google Workspace, Miro) (Zheng et al., 2015), intentionally randomizing groups, publicly acknowledging contributions, and providing clear feedback can significantly impact students' sense of belonging. Additionally, creating diverse collaborative spaces requires active intervention, not default grouping. Third, for institutions, comprehensive technology access for international students (Peacock et al., 2020; Thomas et al., 2014) includes language support tools (e.g., Grammarly, ChatGPT), inclusive technology design training for faculty that emphasizes collaboration and community building, and professional development addressing AI's role in multilingual learning. Ultimately, these findings challenge the assumption that technology access alone ensures equitable participation. Instead, belonging emerges when technology choices explicitly accommodate language as a mediating factor, through

asynchronous options, collaborative tools, and supported processing time, transforming potential barriers into bridges for international graduate student success.

This study's findings extend beyond international students to multiple populations navigating technology-mediated learning, including domestic multilingual students, learners with processing time disabilities, first-generation students, and minoritized students. The core insight is that technology mediates belonging, requiring intentional design. Future research should examine whether language processing, technology affordances, and belonging operate similarly for domestic students facing similar challenges, testing which aspects transfer to which populations under what conditions.

STRENGTHS AND LIMITATIONS

This study presents several strengths. First, the interviewer's positionality as an international graduate student herself (first author) likely contributed positively to participants' willingness to share openly, given the shared experiential ground between interviewer and participants. This insider positionality afforded us a richness of disclosure that may be more difficult to achieve across greater social distance, supporting depth and authenticity in the data collected. Second, the balanced gender representation across participants strengthens the case for generalizability across gender, reflecting the study's deliberate efforts to equalize representativeness of international graduate students in the United States learning environment. Third, by directly asking participants to define belonging in their own terms at the outset of each interview, the study remained anchored in IGS perspectives throughout, supporting representation, inclusivity, and the co-construction of meaning rather than imposing predetermined definitions. Fourth, the use of a structured rotating coder design, in which each of the three coders analyzed every transcript independently before collaborative reconciliation, strengthens the credibility and rigor of the thematic analysis.

Despite these strengths, several limitations warrant consideration. The study was conducted at a single U.S. research university, which may limit transferability to institutions with different demographic profiles, resource structures, or international student support systems. Additionally, the sample necessarily reflects students who were enrolled and persisting at the time of the interviews, introducing a survivor bias that excludes the perspectives of students who may have withdrawn or disengaged. As with all qualitative interview data, findings rely on self-report, meaning that participants' accounts reflect perceived rather than observed technology use and belonging experiences. The relatively small sample size, while appropriate for qualitative inquiry, cautions categorical generalization.

REFERENCES

Ahn, M. Y., & Davis, H. H. (2023). Students' sense of belonging and their socio-economic status in higher education: a quantitative approach. *Teaching in Higher Education*, *28*(1), 136–149. https://doi.org/10.1080/13562517.2020.1778664

Allen, K.-A., Slaten, C., Lan, M., Craig, H., May, F., & Counted, V. (2024). Belonging in higher education: A twenty-year systematic review. *Journal of University Teaching and Learning Practice*, *21*(5), 1–55. https://search.informit.org/doi/10.3316/informit.T202409130001599144557008 3

Annink, A. (2017). Using the research journal during qualitative data collection in a cross-cultural context. *Entrepreneurship Research Journal*, *7*(1). Article 20150063. https://doi.org/10.1515/erj-2015-0063

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Cleveland-Innes, M., Garrison, D. R., & Vaughan, N. (2018). The community of inquiry theoretical framework: Implications for distance education and beyond. In M. G. Moore & W. C. Diehl (Eds.), *Handbook of Distance Education* (4th ed.). Routledge. https://doi.org/10.4324/9781315296135

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, *61*(2), 228–239. https://doi.org/10.1080/14703297.2023.2190148

Dulfer, N., Gowing, A., & Mitchell, J. (2025). Building belonging in online classrooms: relationships at the core. *Teaching in Higher Education*, *30*(4), 1024–1040. https://doi.org/10.1080/13562517.2024.2349993

García, H. A., Garza, T., & Yeaton-Hromada, K. (2019). Do we belong? A conceptual model for international students' sense of belonging in community colleges. *Journal of International Students*, *9*(2), 460–487. https://doi.org/10.32674/jis.v9i2.669

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, *2*(2–3), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Gopalan, M., & Brady, S. T. (2020). College students' sense of belonging: A national perspective. *Educational Researcher*, *49*(2), 134–137. https://doi.org/10.3102/0013189X19897622

Han, Y., Chang, Y., & Kearney, E. (2022). "It's Doable": International graduate students' perceptions of online learning in the U.S. during the pandemic. *Journal of Studies in International Education*, *26*(2), 165–182. https://doi.org/10.1177/10283153211061433

Institute of International Education. (2025, November 17). *Academic levels of international students, 2024/25*. Open Doors. https://opendoorsdata.org/data/international-students/academic-level/

Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, *103*, Article 102274. https://doi.org/10.1016/J.LINDIF.2023.102274

Koo, K. K., & Jiang, M. (2022). What Does It Mean to Take Online Classes as an International Student During COVID-19? *Online Learning Journal*, *26*(4), 209–230. https://doi.org/10.24059/olj.v26i4.3495

Lowenthal, P. R., & Dunlap, J. C. (2018). Investigating students' perceptions of instructional strategies to establish social presence. *Distance Education*, *39*(3), 281–298. https://doi.org/10.1080/01587919.2018.1476844

Martin, F., Sun, T., & Westine, C. D. (2020). A systematic review of research on online teaching and learning from 2009 to 2018. *Computers and Education*, *159*. Article 104009. https://doi.org/10.1016/j.compedu.2020.104009

Olivier, C., & Weilbach, L. (2024). Enhancing online learning experiences. A systematic review on integrating GenAI chatbots into the Community of Inquiry framework. In R. van de Wetering, R. Helms, B. Roelens, S. Bagheri, Y. K. Dwivedi, I. O. Pappas, & M. Mäntymäki (Eds.), Lecture notes in computer science. Vol. 14907. Disruptive innovation in a digital world (pp. 77–89). Springer. https://doi.org/10.1007/978-3-031-72234-9_7

Parrish, C. W., Guffey, S. K., Williams, D. S., Estis, J. M., & Lewis, D. (2021). Fostering cognitive presence, social presence and teaching presence with integrated online–team-based learning. *TechTrends*, *65*, 473–484. https://doi.org/10.1007/s11528-021-00598-5

Peacock, S., Cowan, J., Irvine, L., & Williams, J. (2020). An exploration into the importance of a sense of belonging for online learners. *The International Review of Research in Open and Distributed Learning*, *21*(2), 18–35. https://doi.org/10.19173/irrodl.v20i5.4539

Pedler, M. L., Willis, R., & Nieuwoudt, J. E. (2022). A sense of belonging at university: Student retention, motivation and enjoyment. *Journal of Further and Higher Education*, *46*(3), 397–408. https://doi.org/10.1080/0309877X.2021.1955844

Strayhorn, T. L. (2018). Sense of belonging and graduate students. In *College Students' Sense of Belonging* (2nd ed.). Routledge. https://doi.org/10.4324/9781315297293

Strayhorn, T. L., & Johnson, J. (2025, April 25). *A blueprint for college students' sense of belonging*. The EDU Ledger. https://www.theeduledger.com/opinion/article/15744068/a-blueprint-for-college-students-sense-of-belonging

Swain, C. (2022). International students and sense of belonging: Transitioning cultures and finding a fit in higher education. [Doctoral dissertation, University of Utah]. ProQuest Dissertations & Theses Global. https://libezproxy.syr.edu/login?url=https://www.proquest.com/dissertations-theses/international-students-sense-belonging/docview/2743526842/se-2

Szeto, E. (2015). Community of Inquiry as an instructional approach: What effects of teaching, social and cognitive presences are there in blended synchronous learning and teaching? *Computers & Education*, *81*, 191–201. https://doi.org/10.1016/j.compedu.2014.10.015

Thomas, L., Herbert, J., & Teras, M. (2014). A sense of belonging to enhance participation, success and retention in online programs. *The International Journal of the First Year in Higher Education*, *5*(2). https://doi.org/10.5204/intjfyhe.v5i2.233

Tinto, V. (1998). Learning communities: Building gateways to student success. *The National Teaching and Learning Forum*, *7*(4), 1–11. http://soeweb.syr.edu/hed/tintospeech.html

Zheng, B., Niiya, M., & Warschauer, M. (2015). Wikis and collaborative learning in higher education. *Technology, Pedagogy and Education*, *24*(3), 357–374. https://doi.org/10.1080/1475939X.2014.948041