Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Measuring university students' spatial belonging: scale development and validation

Qiaoxian Wu
South China Normal University
Zijin Wu
South China Normal University
Shiyong Wu
shiyong.wu@gpnu.edu.cn
Guangdong Polytechnic Normal University
Yuanqing Shen
South China Normal University

Research Article

Keywords:

Posted Date: July 1st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9827076/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Measuring university students' spatial belonging: scale development and validation

Qiaoxian Wu[1,#], Zijin Wu[1,#], Shiyong Wu[2,*], Yuanqing Shen[3,*]

[1] Faculty of Education (Shanwei), South China Normal University, Shanwei, China.
[2] Faculty of Education, Guangdong Polytechnic Normal University, Guangzhou, China.
[3] Education and Training Office, South China Normal University, Guangzhou, China.

*Corresponding author: Shiyong Wu, Email: shiyong.wu@gpnu.edu.cn; Yuanqing Shen, Email: 20081046@m.scnu.edu.cn.

[#]These authors contributed equally to this work.

Abstract

The importance of space in higher education has been increasingly emphasized by policymakers, educators, and students. The notion of spatial belonging focuses on the influence of multifaceted spaces on university students' sense of belonging. However, there has been a lack of a valid tool to measure spatial belonging. Furthermore, existing questionnaires mostly center on emotional or surrounding dimensions, ignoring the complexity and diversity of space types. This study sought to develop and validate a new scale to measure university students' spatial belonging. Based on the literature review, a 44-item scale was developed, and 25 items were retained after content validation by experts. Lastly, 24 items remained after removing a reverse item based on the target population's feedback. 602 participants were recruited from a Chinese university, and the data were analyzed using exploratory factor analysis, confirmatory factor analysis, and measurement invariance. A reliable and valid scale with 23 items across four dimensions: physical, digital, relational, and structural space was derived, providing researchers with a better understanding of the current state of spatial belonging among university students and offering higher education institutions a sound tool to utilize spaces to improve students' belongingness.

Introduction

As a complicated concept defined by many researchers (Gravett & Ajjawi, 2021), a sense of belonging is commonly acknowledged as an indispensable fundamental human need to feel welcomed, embraced, and connected (Baumeister & Leary, 1995; Maslow, 1943). Similarly, Mahar et al. (2012) considered an individual's subjective experience of feeling valued and esteemed as belongingness. This feeling is viewed as fluid, situated, and affected by multiple factors (Gravett & Ajjawi, 2021; Hunt et al., 2023). According to Lee et al. (2023), certain identities or social traits aid in forming a sense of belonging. Moreover, Francis et al. (2012) argued that public space further augments the positive facets of belongingness.

In educational settings, a shared understanding of students' sense of belonging refers to their perceptions regarding being included, respected, and supported by their peers, teachers, and surroundings (Goodenow, 1993). Participation in academic courses, organizations, and societies, along with interactions and connections with academic staff and like-minded peers, is instrumental in cultivating a sense of belonging (Cureton & Gravestock, 2019; Thomas, 2012). In addition, students' belongingness is also affected by abiotic factors, including the physical environment they live in, such as dormitories, classrooms, and cafeterias (Ahn & Davis, 2020), and the virtual spaces brought about by scientific and technological breakthroughs in teaching methods (Adel & Dayan, 2021). In a nutshell, students'

belongingness is associated with ‘proximity’, which includes people (students, professors), things (courses, activities), and objects (buildings, items). These elements jointly form a ‘space’ that can alter students’ sense of belonging, encompassing physical, digital, relational, and structural aspects (Wong, 2023).

Simultaneously, numerous studies have confirmed the effect of belongingness on students and higher education institutions. Sense of belonging is crucial in students’ external behavioral manifestations (Strayhorn, 2012) and internal psychological effects (Leary, 2010). It not only has a profound influence on mitigating pressure, overcoming difficulties, boosting well-being, enhancing self-esteem, and sustaining mental health but also links strongly to their determination to complete the curriculum and success in academics (Ahn & Davis, 2020; Kahu & Nelson, 2017; Winstone et al., 2020). Furthermore, belongingness is conducive to students’ retention (Ajjawi et al., 2019) and the quality of talent cultivation in postsecondary education. Thus, focusing on promoting a sense of belonging is a meaningful investigation crucial for both academic institutions and individual learners.

Then, when it comes to facilitating belongingness, measuring students’ current sense of belonging is essential. Based on the Theory of School Membership put forward by Wehlage et al. (1989), Goodenow (1993) created a traditional Psychological Sense of School Membership (PSSM) scale with 18 items. This scale measures adolescents’ belongingness in school from the dimensions of the emotion of the school environment, the relationship between faculty and students, and the engagement of activities. Most scholars recomposed the PSSM scale to assess college students’ sense of belonging in their countries (Bates, 2025; Pittman & Richmond, 2008; Wilson & Gore, 2013; Zumbrunn et al., 2014). For instance, Freeman et al. (2007) incorporated the university background into the PSSM scale and used two versions of customized PSSM scale to evaluate freshmen’s belongingness. One version is separated into three dimensions–overall school identity, instructor support, and peer acceptance–to examine a broad sense of belonging in college, while the other novel class sense of belonging scale was proposed to assess students’ experience of belonging in a particular class. Moreover, some scholars have endeavored to create scales that are appropriate for college students. Karaman and Cirak (2017) developed the Belonging to the University Scale, which consists of 14 items and three dimensions: identification, motivation, and expectations. The University Belonging Questionnaire designed by Slaten et al. (2017) breaks down belongingness into relationships between faculty and staff, university affiliation, and university support and acceptance dimensions. In the course of creating the Student University Belonging Scale, Samadieh et al. (2024) identified four factors areas: self-esteem, school atmosphere, peer relationships, and teacher interaction. In the empirical study, the scale exhibited strong validity and reliability.

Current research has validated numerous measurement instruments for assessing university students’ sense of belonging, thereby offering a reference for the quantitative advancement of this construct. However, rather than being developed and validated based on the features of university students and higher education, the majority of the scales now in use for assessing college students’ belongingness are modified from scales that have been validated in elementary and secondary school students. Given the substantial disparities in the sense of belonging experienced by students across various environments (Burt & Paysnick, 2014; Chen, 2012), the scale designed to assess the sense of belonging in university students—derived from samples of primary and secondary school students—may not be entirely suitable for the collegiate demographic. Consequently, it is imperative to concentrate the research on the university student demographic and create a sense of belonging scale tailored to their specific qualities.

Furthermore, although the existing mature scales also measure belongingness in multiple

dimensions, their theoretical foundations predominantly stem from conventional social and educational psychology, emphasizing interpersonal psychological perception and emotional attachment. They naively perceive the academic setting as a uniform backdrop, neglecting to sufficiently consider the dynamic aspects of belonging theory. Particularly in the context of increasingly complex and digitalized higher education environments, conventional metrics have not been able to keep up with the development of the connotation of belonging theory brought about by the advancement of the times, hindering the ability to accurately capture the sense of belonging experienced by university students through interactions across various spaces. As mentioned, belongingness is complex, dynamic, and impacted by multidimensional factors. Governments and higher education institutions have prioritized wider spatial flexibility in higher education research (Jokila et al., 2025). The space of higher education is varied, and its impact on students' belongingness is comprehensive. It is worthwhile to further investigate the impact of diverse higher education spaces on students' belongingness to deepen our understanding of the complexity of students' belongingness and shape it better. Therefore, creating a measure to assess how varied spaces affect students' sense of belonging is highly essential.

Based on the theories of Foucault's (1986) heterotopia, Lefebvre's (1992) spatial production, and Massey's (2005) spatial relations, Wong (2023) constructed a four-dimensional theoretical framework of spatial belonging, including physical, digital, relational, and structural dimensions. Spatial belonging highlights the cognition of space that exists in physical or digital form and is constrained by social relations and structures, as well as the impact of diverse spaces on students' sense of belonging. The emergence of spatial belonging expanded the exploration of the correlation between space and belongingness and made innovative contributions to the study of a sense of belonging. The novel spatial belonging conception offers a possibility for measuring the new spatial dimension of belongingness, which was absent from earlier assessments of a sense of belonging. Different spaces have varying effects on different students' sense of belonging since campus space is not neutral and exhibits varying popularity across student groups (Mulrooney & Kelly, 2020). Hence, higher education institutions can enhance different spaces to establish a non-discriminatory and supportive school environment for all students, particularly those from underrepresented backgrounds, in order to promote students' sense of belonging and educational equity by understanding the impact of diverse spaces on belongingness.

However, the conceptual framework Wong (2023) put forward is pending practical validation. This study aims to develop a reliable scale to measure university students' spatial belonging with four dimensions, based on Wong's (2023) spatial belonging theory and the procedure of developing and validating scales constructed by Hinkin et al. (1997). The spatial belonging scale (SBS) transcends the constraints of conventional scale theories by incorporating insights from spatial sociology and environmental psychology, so broadening the assessment of belongingness from an "interpersonal psychology" framework to a "spatial interaction" framework. It concurrently integrates previously overlooked components, including digital and structural spaces, remedying the inadequacies of current tools that inadequately emphasize the spatial dimension. Furthermore, the SBS can identify the specific spatial causes that contribute to levels of belongingness, broadening its utility beyond level evaluation to attribution analysis. Theoretically, this study will help to enrich the framework of spatial belonging, offer empirical support for the theory, deepen researchers' comprehension of space and belonging in higher education, compensate for the deficiency of the traditional school belonging scale to understand students' spatial belonging, provide an efficient and up-to-date tool for assessing students' spatial belonging, and catalyze understanding for further research. Practically, this will give colleges and universities a better understanding of what students need and want from higher educational institutions, which will help

college administrators offer tailored counseling programs for individuals with various characteristics and, to some extent, increase students' sense of participation and belonging, which in turn improve the management efficiency of colleges and universities, propel their growth, and make them more appealing and competitive. Below, the SBS development and validation are conducted in three phases. In the first phase, preliminary items are generated from the literature review, experts' suggestions, and the target population's feedback. In the second phase, exploratory factor analysis (EFA) is performed using the first half of the data collected to evaluate whether the SBS's component structure and assumed dimensions are consistent. In the third phase, the established scale is verified by conducting a confirmatory factor analysis (CFA) and reliability and validity analysis on the second half of the data and the entire data set. Finally, implications, limitations, and future directions are discussed.

PHASE 1: Items development

Identification of the domains and items generation

Domains Identification

Based on Wong's (2023) conceptual framework of spatial belonging, this study examines the impact of physical, digital, relational, and structural spaces on students' sense of belonging. The emergence of spatial belonging brought new demands on higher education institutions to address the disparity between the macro-planned spaces designed by universities and the concrete spaces perceived by students in order to better promote students' sense of belonging. Prior to Wong's (2023) framework of spatial belonging, scholars have explored the implications of different spaces on students' belongingness.

Firstly, physical space refers to the tangible, material environment that teachers and students interact with regularly, including physical structures such as teaching buildings, libraries, gymnasiums, and dormitory buildings (Wong, 2023). Whether teachers' teaching and instructing or students' studying, researching, exercising, and living rely on the existence of physical space, which offers the most direct and explicit influence on a sense of belonging. As Samura (2018) suggested, the physical space of a school provides a platform for students to strengthen their connections with each other and their relationships with faculty and staff. Therefore, the physical space of a campus plays an integral role in developing a sense of belonging for students (Ahn & Davis, 2020; Mulrooney & Kelly, 2020). Research has indicated that student satisfaction with campus spaces is influenced by its convenience, safety, and comfort (Kärnä et al., 2013), and that a personal sense of belonging is linked to satisfaction with public spaces (Francis et al., 2012). According to Antonsich (2010), the feeling of security and ease that one experiences in college can be interpreted as belongingness. Additionally, place attachment is the foundation of belonging (Scannell & Gifford, 2010). Emotions toward a particular location, thoughts about a place, and behavior of maintaining close contact with a specific location are the three components of place attachment. Gao and Liu (2021) concluded that a key dimension of students' sense of belonging in college is that their needs are met, and the frequency of space use is also related to a sense of belonging (Trawalter et al., 2020, 2021). The same conclusion can be confirmed in a study by Morieson et al. (2018). Focus groups and narrative models were employed to better comprehend students' use of space on campus. They discovered that students used available studios less and had a greater desire for informal space. Following that, they collaborated with students to renovate existing underutilized studios, and the results were noteworthy, with students developing a sense of belonging to the refurbished studios. The aforementioned research led the research team to measure students' sense of belonging to physical space from two perspectives: the features of campus physical space (comfort, safety, convenience, etc.) and

students' attachment to it (such as how often they use the space, how they feel about it, and whether they think it meets their needs). Furthermore, some scholars have investigated the relationship between green space and a sense of belonging within the physical space. Green space and a sense of belonging are linked, and studies demonstrate that high-quality green space promotes students' sense of belonging (Jennings & Bamkole, 2019; Thompson et al., 2023). In conclusion, the functional features (such as availability, safety, and comfortability) of physical space and the use experiences (such as willingness, satisfaction, and frequency) of students would significantly impact their sense of belonging.

Secondly, digital space refers to the virtual space for learning built using internet technology, including school websites, learning software, and other online platforms and tools (Wong, 2023). Currently, offline teaching is no longer the only way of learning, and blended learning has become an indispensable mode of student learning owing to the advantages of spanning time and space and saving costs. Mendoza and Venables (2023) claimed that the combination of online learning and offline learning provides additional possibilities for diverse student groups to engage in learning and activities. The flexibility of online learning also provides more opportunities for underrepresented groups to participate (Longhurst et al., 2020; Muse, 2003). As Cureton et al. (2020) argued, intermingling digital and non-digital elements is vital in students' lives, presenting plenty of opportunities for young people to enhance their belongingness. However, other scholars argue that digital learning may harm the development of a sense of belonging. Relationships between students and staff are crucial to cultivating students' sense of belonging (Johnson, 2012; Kantanis, 2000; Meehan & Howells, 2017). Nonetheless, the rise of online education has made it more challenging to establish relationships between students and teachers (Mulrooney & Kelly, 2020). Besides, the non-neutrality of digital space can expose students to multi-layered digital divides, ranging from device access and usage skills to ultimate benefits (Wei et al., 2011). This structural inequality regularly triggers feelings of exclusion among students, preventing them from truly identifying and belonging to digital learning spaces. Overall, a thorough investigation of the effects of digital space on students' sense of belonging is warranted, both in terms of its advantages and disadvantages. In addition, Wong (2023) posited that digital space influences students' sense of belonging regarding learning and social engagement, with the functionalities of digital platforms, including anonymity, also impacting students' experiences. Research showed that students' familiarity with the online platform's interface may affect their sense of belonging, and that platform connectivity issues also lead to students' discontent (Cole et al., 2021; Mendoza & Venables, 2023; Teo, 2010). Furthermore, as technology advances, students are making connections with the school by progressively using digital spaces to engage with teachers and other students (Guthrie & Meriwether, 2018). Thomas et al. (2014) emphasized that students' belongingness in online courses may be strengthened by their participatory communication on online platforms. Kavoura and Stavrianea (2015) also found that users who forge connections with others on social media have an enhancement in trust and a heightened sense of belonging within the online community. Hence, the sense of belonging in the digital space can be classified into three categories: satisfaction with the functions of digital general platforms (such as interface, anonymity, and hardware and software support), sense of belonging to learning platforms (such as online courses), and sense of belonging to social platforms (such as online official account).

Thirdly, relational space refers to the quality of relationships between people, including student-to-student, teacher-to-student, and student-to-object relationships, which are vital in shaping a sense of belonging (Wong, 2023). Hoffman and Morrow (2002) proposed that college belonging is an individual's cognitive appraisal, which shapes emotions and behaviors, meaning that a sense of belonging arises when an individual develops the perception of feeling cared for and accepted (Gao & Liu, 2021). According to

Baumeister and Leary (1995), who researched the impact of relationships on belonging, relationships formed through social interactions in educational settings play an instrumental part in determining belonging. Student-to-object relationship refer to the emotional bond and sense of meaning that students form with specific objects on campus that have symbolic or emotional significance. This relationship extends beyond the objects' physical functional features, emphasizing social, emotional, and symbolic responsibilities as transmitters of memory, identity, and group affiliation. These objects allow for a deeper psychological engagement between students and the campus space, which has a significant impact on the establishment of students' belongingness. Some researchers explored the connection between teacher-student engagement and belongingness. For example, Hoffman and Morrow (2002) suggested that students' access to supportive and frequent interactions with teachers in academic and social settings had a positive effect on the formation of their sense of belonging. Positive peer interactions or staying in the same space with their peers can make students feel supported in unfamiliar and complex environments, prompting them to engage in activities more proactively, which in turn affects the development of a sense of belonging (Johnson, 2007; Webb et al., 2008). As stated by Thomas (2012), belongingness can be fostered by forming supportive peer relationships and engaging in meaningful interactions between teachers and students. Supportive peer relationships can be obtained by participating in activities organized by university clubs or societies. Hurtado and Carter (1997) found that active participation in extracurricular activities encourages students to establish a sense of belonging. Castle and Grant (2023) further highlighted that cultivating emotional bonds with others through activities—rather than merely participating in activities—is the fundamental element in creating belongingness. A sense of belonging is relational in nature (Kahu & Nelson, 2017), and the emotional link to a space resulting from communication with people and objects is an important part of belonging (Bennett, 2014; Peters et al., 2016). Consequently, the sense of belonging within the relational space manifests in the cognitive dimension as the perception of care and acceptance from teachers and peers, in the emotional dimension as a preference for communication and interaction with teachers and peers, and in the behavioral dimension as proactive interaction with teachers and peers and active participation in activities.

Lastly, structural space aims to understand the impact of social structures, consisting of organizational forms and relationships in society and dominant discourses of perceptions, beliefs, and values that are dominant in society, on an individual's experience of space (Wong, 2023). Thomas (2015) outlined that students may feel excluded from these spaces, or they may not feel like they belong when placed outside the standard student image of higher education on dimensions such as gender and social class. Scholars have explored the relationship between social structures and belonging across fields. The space of higher education is influenced by both external and internal policies, and the structural space shaped by them has an impact on students' sense of belonging (Wong, 2023). From the outside, the social structure's stratification influences university rankings, and the dominant discourse of elitism impacts the reputation of universities (Baltaru et al., 2022; Shamash, 2019). Lucas (2001) reported that the privileged class changed their perspective on the prestige of universities to preserve their own and their children's advantages in the increasingly prevalent situation of university degrees. The elite class is established and perpetuated in part by British universities, which typically recruit most of their students from the upper and upper-middle classes and play a crucial role in choosing talent for high-paying positions (Shamash, 2019). Gao and Liu (2021) demonstrated how students' sense of belonging is influenced by university's ranking, accomplishments, and reputation. At the internal level, the educational disparity is a reflection of how dominant discourse and societal structure impact schools inside spaces. According to Hurtado and Carter (1997), students from minority groups felt far less like

they belong than students from dominant cultures. The research of Johnson (2012) on women of color majoring in STEM further confirmed this conclusion. Johnson discovered that this group's belongingness was weakened by the STEM education environment's dominant culture, which prioritizes white men, leaving them feeling excluded. Meanwhile, McDonald (2024) examined how belonging is constructed and experienced through the dimensions of gender and class by focusing on the experiences of two first-generation working-class college girls as they transitioned from secondary school to their first year of college. The findings emphasized that the first-in-family girls from the middle class experienced complex negotiation of belonging in and across physical and discursive spaces within higher education, positioning themselves as out of place or inauthentic. Soja (2013) indicated that structural space can become an opportunity to fight inequality. Therefore, higher education institutions can exercise their autonomy to create a welcoming space for all students, particularly those from marginalized groups, thereby enhancing students' sense of belonging (Wong, 2023). In a nutshell, factors that external social hierarchy reflects in university like the school's ranking, accomplishments, and reputation and that internal governance model like whether the school's structural space is equitable and diverse can be used to analyze students' belongingness in structural space.

Items generation

Since there are no readily available scales to measure spatial belonging, this study used an inductive approach to generate scale items. The initial scale items for this study were based on the aforementioned literature review and team group discussions on the effects of different spaces on the sense of belonging. The literature review provided the framework and content support for the scale, particularly Wong's (2023) theoretical framework of spatial belonging, which framed the four dimensions of the scale. A team of two graduate students familiar with the academic belongingness literature then generated sixty items through independent thinking, comprising themes such as campus space, student engagement, student-faculty interaction, relationships with faculty and staff, peer relationships, facility convenience, university attachment, and school identity, and compiled them in order. Subsequently, team members examined, debated, and adjusted each item individually to guarantee readability, conciseness, and theoretical accuracy. Duplicate and irrelevant items were eliminated through team negotiation, and lastly, forty-four items remained primarily for the whole SBS, with eleven items for each of the four dimensions.

Content validity

Evaluation by experts

After forty-four items were generated, two experts in educational psychology were invited to review the list. Despite being chosen for convenience, the two specialists had extensive knowledge of belonging. To determine the scale's content validity, the research team first shared the theory of spatial belonging with experts and requested them to evaluate the items' relevance to the concepts of spatial belonging using the provided theoretical framework. Next, the experts were prompted to evaluate these items' face validity, clarity, and simplicity. Lastly, the experts were requested to identify unclear items and offer specific phrasing recommendations. Based on the purpose of the study and referring to the experts' suggestions, the research team rephrased some items and deleted unclear and redundant items. For example, the item pertaining to "social connections" was rephrased to broaden their scope—extending beyond single platforms (such as WeChat Moments) to encompass a wider range of social media—thereby more comprehensively capturing students' online social experiences. The item concerning "collective activities" was also rephrased, shifting the focus from describing the richness of the activities themselves to emphasizing the individual's sense of integration within them, thereby enhancing the

item's relevance to the construct of belongingness. Furthermore, the item related to "school pride" was rephrased to concretize the abstract concept of "construction and development" into an emotional response toward "university achievements", thereby enhancing the clarity and specificity of these items. Furthermore, certain items were eliminated owing to conceptual overlap. For instance, items intended to directly measure the affective bond between "students and objects"—such as "A specific spot on campus where I frequently spend time makes me feel a strong sense of closeness"—were eliminated because they conceptually overlapped with the dimension of physical space (e.g., "Certain buildings at the school make me feel comfortable"), making discriminant validity difficult to establish. Experts highlighted that respondents are more likely to understand "a sense of closeness" as a preference for the physical comfort provided by the setting, rather than as a purely subjective symbol. To ensure discriminant validity, we removed such items. Eventually forming a scale containing twenty-five items.

Evaluation by the target population

Five students were invited to participate in a group discussion in this study to discover more about their perceptions and understandings of the scale items. The five students from freshman, sophomore, junior, senior and first-year graduate students, two of whom were female and three of whom were male, joined in a nearly hour-long group discussion. After reading the four dimensions of the twenty-five-item scale individually, students were asked to clarify any aspects they did not fully comprehend or left perplexed. By sorting through the discussion results, the research team obtained direct feedback and suggestions from the target group to help identify and eliminate ambiguous items. The reverse-coded item was removed after being recognized as confusing during the student feedback session. Finally, a twenty-four-item scale, as shown in Table 1, was obtained by reworking the expression of the items and removing the reverse item. All items were filled in by rating on a five-point Likert scale from 1 (not at all) to 5 (fully) to reflect their true feelings. The first half of the collected data will be tested for the scale's psychometric properties in the next step.

Table 1. The items of the scale

Physical Space	
Item 01	The university facilities can meet my diverse needs
Item 02	The environment or infrastructure of the university gives me a sense of security
Item 03	I like to stay in several areas at the university (such as libraries, study rooms, laboratories, dormitories, sporting fields, pavilions, green spaces, and others)
Item 04	I regularly use facilities or venue space provided by the university (such as libraries, study rooms, laboratories, dormitories, sporting fields, pavilions, green spaces, and others)
Item 05	The university facilities are easy to access and use (such as libraries, study rooms, laboratories, dormitories, sporting fields, pavilions, green spaces, and others)
Item 06	Some of the buildings at the university make me feel comfortable
Digital Space	
Item 07	I am satisfied with the interface, functionality, and anonymity of the online learning platform provided by the university
Item 08	The learning database resources offered by the university are convenient for my study
Item 09	I enjoy discussions with my professors, instructors, or peers in the online course
Item 10	I like to leave a message or comment on the university's official platforms (such as official accounts, forums, and others)
Item 11	My social media moment updates from friends (such as WeChat, QQ, and others) make me feel connected to my university

Item 12	Our university provides high-quality equipment and technical assistance for the use of the online platform.
Relational Space	
Item 13	I feel accepted and understood by my university mates
Item 14	I can integrate into the collective activities of the university
Item 15	Even during the holidays, I also stay in touch with my professors, instructors, or peers at the university
Item 16	Professors or instructors are concerned about my learning and development
Item 17	I enjoy interacting with university staff (such as professors, instructors, security guards, dormitory staff, and cafeteria staff)
Item 18	I participate actively in activities organized by the university, faculty, or clubs
Structural Space	
Item 19	Everyone has equal access to all resources
Item 20	I am satisfied with the university's ranking
Item 21	I feel pleased when people praise my university
Item 22	Our university manages students in a democratic way
Item 23	Our university provides support for students from diverse backgrounds
Item 24	I am excited about the university's achievements

PHASE 2: Construct the Scale—Study 1

Participants

To obtain a clearer construct structure and minimize confounding effects from external differences in the stages of scale development, this study employed a relatively homogeneous sample from a single university. This phased sampling approach is supported by Jager et al. (2025), who demonstrate that homogeneous convenience samples can lower estimation bias and improve internal validity when probability sampling is not practical. The study gathered 602 students, of whom 175 were male (29.07%), and 427 were female (70.93%), at a university in southern China. At the degree level, 475 students (78.90%) were undergraduates, and 127 students (21.10%) were graduate students (16.78% were master's students and 4.32% were doctoral students). The researchers chose to divide the dataset into two sections for analysis since the sample size (n = 602) was sufficient enough, meeting the requirement of at least five times the number of items (n = 24) (Bentler & Chou, 1987). The ratio in this split between the scale's items and the responses in each half was approximately 10:1, frequently employed in certain component analysis research (Costello & Osborne, 2005). Of the 301 participants in Study 1, 90 (29.90%) were men, and 211 (70.10%) were women. Similarly, the statistics for Study 2 were as follows: a total of 301 participants, 28.24% male and 71.76% female (Table 2).

Table 2. Demographics of participants in Study 1 and Study 2

	Study 1 sample (number = 301)	Study 2 sample (number = 301)
Variable	Number (%)	Number (%)
Gender		
Male	90 (29.90%)	85 (28.24%)
Female	211 (70.10%)	216 (71.76%)
Grade		
Undergraduate	235(78.07%)	240 (79.73%)

Graduate	66 (21.93%)	61 (20.27%)

Procedure

Between May and June 2024, when students became familiar with the campus and fostered a certain sense of belonging after attending higher education institutions for approximately two terms, participants were given access to an online survey via the Wenjuanxing Questionnaire Platform (the Chinese equivalent of Qualtrics). The university's Science Ethics Select Committee reviewed and approved the work. A consent form was displayed so that participants could learn about the risks and benefits of participating in this study. They would access the formal questionnaire once clicking the "agree" button. Eventually, 634 students agreed to take part in this poll. Since this study employed an online survey and each question had to be compulsorily completed before the questionnaire could be submitted, there were no missing data. The researchers implemented a conservative data screening method to identify the valid questionnaires, removing questionnaires with a completion time below the 5th percentile (50 seconds) or exhibiting straight-line responding ($\geqslant$10 identical consecutive answers). After examining each one separately, 32 randomly completed responses (with brief reaction durations and nearly identical answer choices) were removed, and 602 genuine surveys ultimately remained.

Data analysis

The quantitative data was analyzed using several statistical software. Descriptive analysis, internal consistency analyses, and EFA were conducted using IBM SPSS statistics version 25. CFA was performed using Amos Graphics version 24, and measurement invariance analysis was performed using Mplus Editor version 7.4. The significant level for each statistical test was set at $p < 0.05$. The percentage data in this paper have been rounded to two decimal places, so the sum of individual portions and the total may have a reasonable error of $\pm$ 0.01%.

Results

The first half of the dataset was tested for differentiation and correlation using extreme group analysis and item-total correlation analysis. The item analysis was performed, and the results revealed that the p-values of the t-tests for equivalence of the means of the individual item in the extreme group test method were less than 0.05, indicating a significant difference and that there was a high level of differentiation between the individual item. Item-total score correlation scores varied from 0.52 to 0.70, showing that each question item was strongly associated with the total score. Cronbach's alpha (α) was then used to assess the correlation between the scale items to measure internal consistency, and the results showed a high degree of internal consistency between the items in this study ($\alpha = 0.93$).

Regarding EFA, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used to determine whether the twenty-four items were suitable for extracting principal components. Most scholars recognize a KOM value of 0.7 as a commonly used threshold for confirming suitability when extracting principal components. This study's KMO value was 0.93, and Bartlett's test of sphericity yielded a significant result ($p < 0.05$), demonstrating that the data was suitable for principal component analysis. After principal component extraction, components with eigenvalues greater than one should be maintained as principal components for future analysis (Watkins, 2018). The findings indicated that four factors have eigenvalues above one, implying that the twenty-four items fulfilled the expected four principal components with high significance. The total variance contribution of these four principal components was 62.62%, explaining the data's main variance. All items in each dimension had factor

loadings greater than 0.4. However, item 20 did not meet the condition that secondary loadings differ from primary loadings by 0.2, implying that this item is significantly related to more than one factor and thus unsuitable for categorization into a single factor. Considering the scale's clarity and construct validity, this item was removed based on Lessiter et al.'s (2001) findings, and the remaining twenty-three items were subjected to the same EFA test.

In the second test, the KMO result was 0.93, and Bartlett's test of sphericity p-value is also less than 0.05. During the principal components analysis, both the eigenvalues larger than one and the gravel plot supported the extraction of the four principal components (Figure 1), which together explained 63.48% of the variance. All items met the requirement of at least 0.2 difference between the first and second loading values and had loadings above 0.5. The common degree of each item was greater than 0.4; the extracted common factors were, therefore, effective in explaining the variables. The variance explained by the first single factor was less than 40% (Podsakoff et al., 2003); thus, there was no significant common method bias in the data. The scale developed through exploratory component analysis includes twenty-three items as follows:

- Factor 1: Physical space (6 items, $\alpha = 0.89$; 17.09% variance explained)
- Factor 2: Relational space (6 items, $\alpha = 0.87$; 16.24% variance explained)
- Factor 3: Structural space (5 items, $\alpha = 0.88$; 15.08% variance explained)
- Factor 4: Digital space (6 items, $\alpha = 0.84$, 15.08% variance explained)

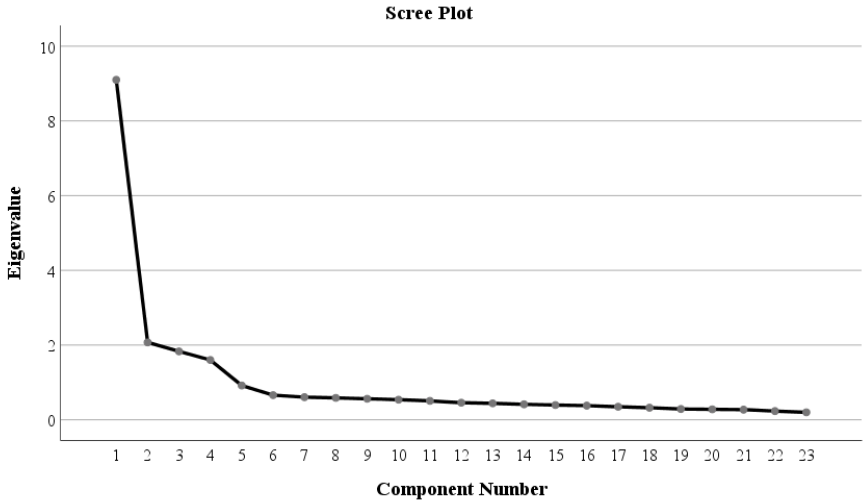


Figure 1. The scree plot of Study 1

CFA was used to determine whether the four-component model obtained from EFA was suitable. The researchers first utilized widely used fit indices to test model fit (Schreiber et al., 2006) and then included correction indices to account for any potential missing cross-factor loadings. These criteria comprised the following: Cardinal Ratio Degrees of Freedom (CMIN/DF, good fit < 2), Comparative Fit Index (CFI, good fit ≥ 0.95), Tucker-Lewis Index (TLI, good fit ≥ 0.95), Incremental Fit Index (IFI, good fit ≥ 0.95), Root Mean Square Error of Approximation (RMSEA, good fit < 0.06), and Standardized Root Mean Square Residuals (SRMR, good fit < 0.08). According to the results in Table 3 and Figure 2, the model fit estimates displayed excellent structure. The convergent and discriminant validity were then further investigated in this study. Standardized Factor Loadings (SFL), Composite Reliabilities (CR), and mean squares were extracted to analyze the level of correlation between items in the same component. The standardized factor loading coefficients for twenty-three items were greater than 0.5, with most above 0.7. CR and Average Variance Extracted (AVE) values were calculated using the Exps calculator.

The results in Table 4 showed that all AVE values exceeded 0.5, and CR values were above the acceptable level of 0.7, indicating good convergent validity (Hair et al., 2010). The discriminant validity was then evaluated by comparing the AVE square root values with the correlation coefficients. The results revealed that the four factors' AVE square root values were higher than their correlation coefficients with the other factors (Table 5), indicating good discriminant validity (Fornell & Larcker, 1981a, 1981b).

Table 3. Model fit of Study 1

CMIN/DF	CFI	IFI	TLI	RMSEA	SRMR
1.49	0.97	0.97	0.97	0.04	0.04

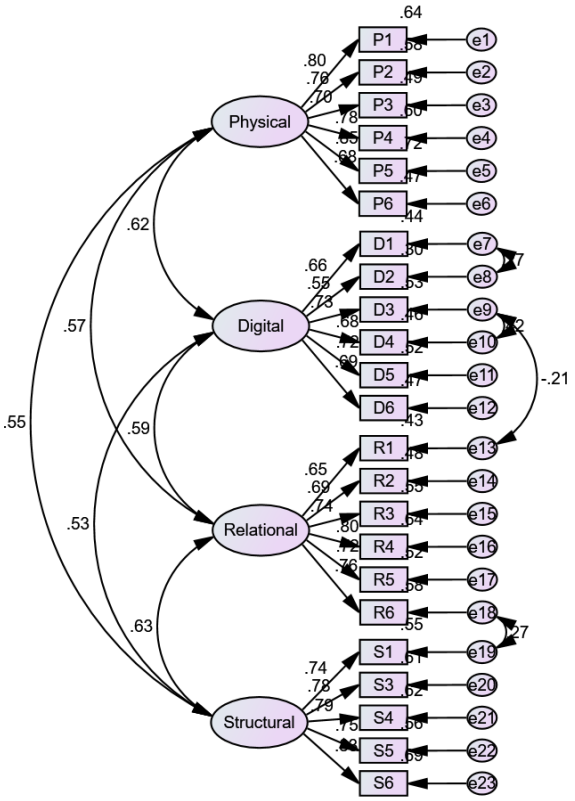


Figure 2. Results of confirmatory factor analysis–Study 1 model

Table 4. Convergent validity of Study 1 model

Path	SFL	P	CR	AVE
Physical 1	0.80			
Physical 2	0.76	***		
Physical 3	0.70	***	0.89	0.58
Physical 4	0.78	***		
Physical 5	0.85	***		
Physical 6	0.68	***		
Digital 1	0.68		0.86	0.51

Path	SFL	P	CR	AVE
Digital 2	0.65	***		
Digital 3	0.73	***		
Digital 4	0.79	***		
Digital 5	0.72	***		
Digital 6	0.69	***		
Relational 1	0.65			
Relational 2	0.69	***		
Relational 3	0.74	***		
Relational 4	0.80	***	0.87	0.53
Relational 5	0.72	***		
Relational 6	0.76	***		
Structural 1	0.74			
Structural 3	0.78	***		
Structural 4	0.79	***	0.88	0.61
Structural 5	0.75	***		
Structural 6	0.83	***		

SFL: standardized factor loading, SE: standard error.

Table 5. Discriminant validity of Study 1 model

Variables	Structural	Relational	Digital	Physical
Structural	(0.78)			
Relational	0.63***	(0.73)		
Digital	0.53***	0.59***	(0.71)	
Physical	0.55***	0.57***	0.62***	(0.76)

The square roots of AVE are presented in parentheses, and the other values represent the correlation between the latent factors, *** $p < .001$.

PHASE 3: Validating the Scale

Study 2

The current research team conducted the same test on the second half of the dataset to validate the four-factor model developed in the previous study. First, the extreme group analysis and item-total correlation analysis showed good discrimination ($p < 0.05$, $0.54 < r < 0.69$). The scale's internal consistency was desired, as demonstrated by Cronbach's alpha coefficient of 0.93.

The principal components of the twenty-three factors were then extracted using EFA. The data was appropriate for factor analysis, as shown by the KMO test value of 0.92 and Bartlett's test of sphericity p-value was less than 0.05. Regarding the principal component analysis, the eigenvalues greater than one and the gravel plot (Figure 3) underpinned the extraction of the four principal components, which collectively explained 61.33% of the variance. The factor loadings for all items were statistically significant. Since the commonality of each item and the variance explained by the extracted common factors were acceptable, the extracted common factors effectively explained the variables, and the data did not suffer from serious common method bias. The scale obtained through EFA contained twenty-three items as follows:

- Factor 1: Physical space (6 items, α = 0.89, 16.76% of variance explained)
- Factor 2: Relational space (6 items, α = 0.86, 15.61% variance explained)
- Factor 3: Digital space (6 items, α = 0.85, 15.13% variance explained)
- Factor 4: Structural space (5 items, α = 0.85, 13.83% variance explained)

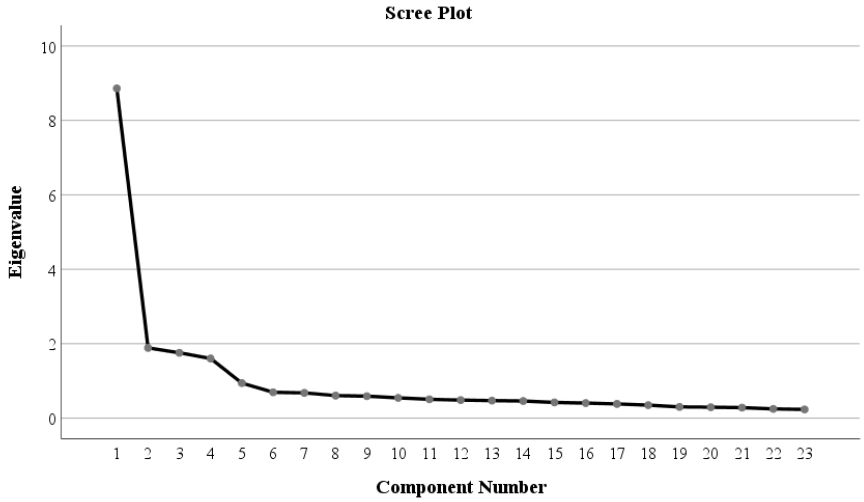


Figure 3. The scree plots of Study 2

The model's fit for the second batch of data was evaluated using CFA. The results were as follows: CMIN/DF = 1.56, CFI = 0.96, IFI= 0.96, TLI = 0.96, RMSEA = 0.04, and SRMR = 0.04. The findings demonstrated that all values were above permissible bounds; thus, the model fits the data well. Figure 4 depicts the scale structure. Convergent and discriminant validity were successfully attained in this investigation, as shown in Table 6 and Table 7. The standardized factor loading coefficients for twenty-three items ranged from 0.62 to 0.82, indicating good convergent validity. All AVE values were above 0.5, and all CR values were above the 0.8 level. The square root AVE values for all four factors were greater than their correlation coefficients with the other factors, indicating good discriminant validity.

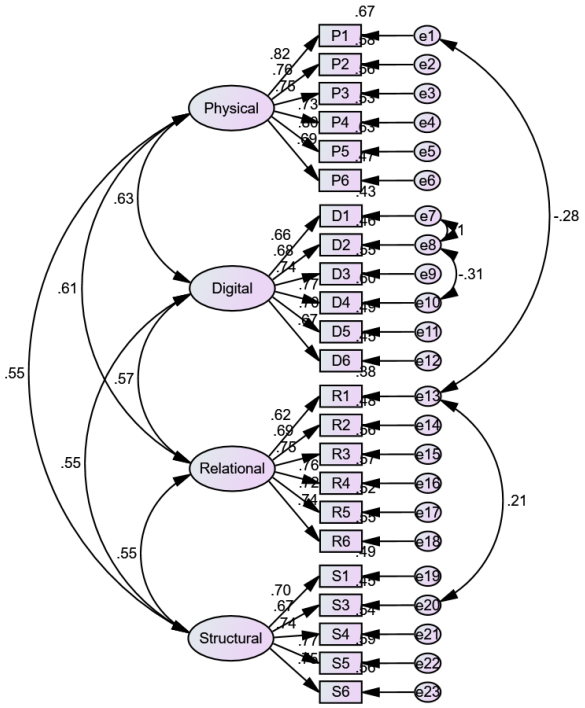


Figure 4. Results of confirmatory factor analysis of Study 2 model

Table 6. Convergent validity of Study 2 model

Path	SFL	P	CR	AVE
Physical 1	0.82		0.89	0.58
Physical 2	0.76	***		
Physical 3	0.75	***		
Physical 4	0.73	***		
Physical 5	0.80	***		
Physical 6	0.69	***		
Digital 1	0.69		0.86	0.51
Digital 2	0.68	***		
Digital 3	0.74	***		
Digital 4	0.77	***		
Digital 5	0.71	***		
Digital 6	0.67	***		
Relational 1	0.62		0.86	0.51
Relational 2	0.69	***		
Relational 3	0.75	***		
Relational 4	0.76	***		
Relational 5	0.72	***		
Relational 6	0.74	***		
Structural 1	0.70		0.85	0.53
Structural 3	0.67	***		

Path	SFL	P	CR	AVE
Structural 4	0.74	***		
Structural 5	0.77	***		
Structural 6	0.75	***		

Table 7. Discriminant validity of study 2 model

Variables	Structural	Relational	Digital	Physical
Structural	(0.73)			
Relational	0.55***	(0.71)		
Digital	0.55***	0.57***	(0.71)	
Physical	0.55***	0.61***	0.63***	(0.76)

The square roots of AVE are presented in parentheses, and the other values represent the correlation between the latent factors, *** $p < .001$.

Study 3

Using the same process, the model results obtained after study 2 were validated again, using the entire dataset ($n = 602$) to ensure the model's validity. After excluding item 20, the item-total correlation analysis for the twenty-three items ranged from 0.54 to 0.69, and the extreme group analysis showed good discrimination across the items. With a Cronbach's alpha value of 0.93, the model's internal consistency was estimated to be satisfactory. The KMO and Bartlett's test of sphericity pointed out that the model was appropriate for extracting principal components (KMO = 0.94, $p < 0.05$). Based on the gravel plot (Figure 5) and eigenvalues of more than one, four principal components were identified, cumulatively accounting for 62.18% of the variance. All items had loadings greater than 0.6 and satisfied the requirement of a difference of 0.2 between the primary and secondary loadings. Each item had a common measure of more than 0.4, and the variation explained by the factor was less than 40%. As a result, there was no significant common method bias in the data. The following twenty-three items were included in the final scale generated from the exploratory factor analysis:

- Factor 1: Physical space (6 items, $\alpha = 0.89$, 16.80% explained variance)
- Factor 2: Relational space (6 items, $\alpha = 0.87$, 15.91% variance explained)
- Factor 3: Digital space (6 items, $\alpha = 0.85$, 15.14% variance explained)
- Factor 4: Structural space (5 items, $\alpha = 0.87$, 14.32% variance explained)

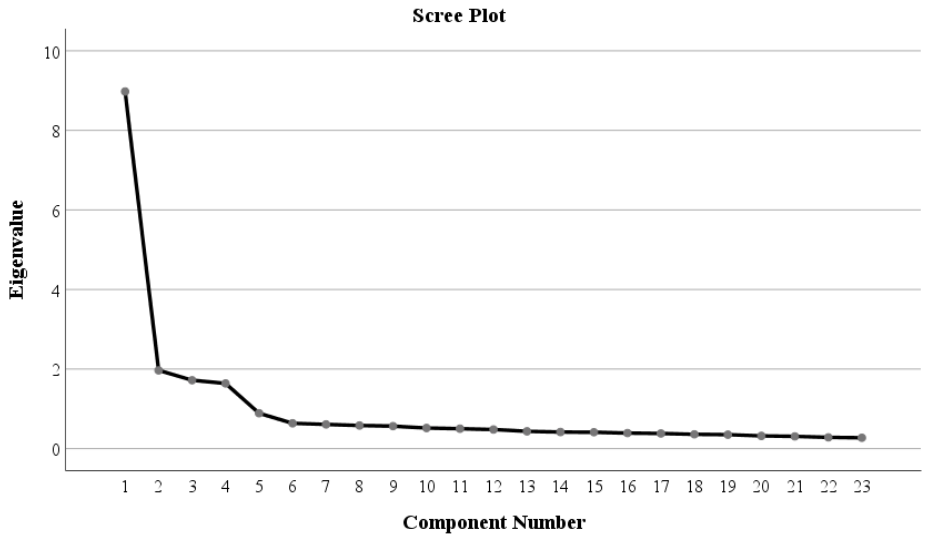


Figure 5. The scree plots of Study 3

CFA was used to assess the effect of the model constructed in Study 2 across the entire dataset. The results were as follows: CMIN/DF = 1.77, CFI = 0.98, IFI = 0.98, TLI = 0.97, RMSEA = 0.04, and SRMR = 0.03. These values were within acceptable limits, indicating a good fit between the model and the entire dataset. Tables 8 and 9 show that convergent and discriminant validity were achieved well in this study. The standardized factor loading coefficients for twenty-three items ranged from 0.64 to 0.83, with CR values over 0.8 and AVE values above 0.5. In addition, the AVE square root values for all four factors were greater than their correlation coefficients with other factors, indicating good discriminant validity.

Finally, invariance was measured to ensure the results' consistency when the model measured the concept of spatial belonging across gender conditions, including configural invariance, metric invariance, scalar invariance, and residual invariance tests. The results showed that configural, metric, and scalar models passed the chi-square test of variance, meaning that the model did not differ significantly. The chi-square difference P value of the residual invariance model was significant, meaning there was a significant difference between the scalar and residual models (Table 10). Therefore, the residual invariance model was not established, and the test was stopped. The metric and scalar invariance models have $|\Delta CFI| < 0.01$ and $|\Delta RMSEA| < 0.015$ (Chen, 2007). Therefore, it can be speculated that the SBS arrived at the intended scalar test, demonstrating good invariance in measuring spatial belongingness across gender groups.

Table 8. Convergent validity of Study 3 model

Path	SFL	P	CR	AVE
Physical 1	0.79		0.89	0.57
Physical 2	0.74	***		
Physical 3	0.73	***		
Physical 4	0.76	***		
Physical 5	0.83	***		
Physical 6	0.69	***		
Digital 1	0.67		0.86	0.51
Digital 2	0.68	***		
Digital 3	0.72	***		
Digital 4	0.76	***		
Digital 5	0.75	***		
Digital 6	0.69	***		
Relational 1	0.64		0.87	0.52
Relational 2	0.70	***		
Relational 3	0.75	***		
Relational 4	0.77	***		
Relational 5	0.72	***		
Relational 6	0.75	***		
Structural 1	0.72		0.87	0.57
Structural 3	0.73	***		
Structural 4	0.76	***		
Structural 5	0.76	***		
Structural 6	0.79	***		

Table 9. Discriminant validity of Study 3 model

	Structural	Relational	Digital	Physical
Structural	(0.75)			
Relational	0.59***	(0.72)		
Digital	0.54***	0.58***	(0.71)	
Physical	0.56***	0.60***	0.63***	(0.76)

The square roots of AVE are presented in parentheses, and the other values represent the correlation between the latent factors, *** $p < .001$.

Table 10. Measurement invariance tests across gender

	X^2	df	RMSEA	CFI	TLI	$\triangle X^2$	△df	*p*-value	△RESEA	△CFI
Configural	19.48	15	0.05	0.99	0.98					
Metric	25.41	19	0.05	0.98	0.97	5.94	4	0.204	0.00	-0.01
Scalar	29.97	23	0.05	0.98	0.98	4.56	4	0.336	0.00	0.00
Residual	68.51	27	0.10	0.88	0.88	38.54	4	0.000	0.06	-0.10

Discussion

This paper aimed to develop and validate a scale to measure university students' sense of spatial belonging. Following a review of the literature and discussions with the research team, the study generated forty-four items in the beginning. Then, some of these were removed or modified in response to suggestions from experts after they assessed the scale's surface and content validity, bringing the total number of scales down to twenty-four in this stage. Additionally, target group feedback from five university students was followed to ensure the scale items were clear, and all twenty-four items were finally retained. According to Żyłka and Ocieczek (2022), even though the items were not deleted during the target group feedback stage, it may effectively decrease the possibility that participants will misunderstand some items during formal experiments and that this will influence their responses. As a result, three-phase studies were then conducted to revise and validate these twenty-four items.

The findings from the three studies consistently indicated that the scale had a stable four-factor structure and sound psychometric properties. In Study 1, twenty-four items were grouped into four principal components. However, item 20—"I am satisfied with the university's ranking"—was rejected because the difference between the primary and secondary loadings was less than the 0.2 threshold. Furthermore, philosophically, it incorporates students' structural evaluation of the school's objective reputation, as well as the consequent internalized subjective relational experience, blurring the theoretical distinction between the structural and relational dimensions. Students' satisfaction with rankings is initially a structural affirmation of the school's resources and prestige, this perception quickly transforms into identity recognition and emotional pride within the academic community (Huang et al., 2014), imbuing the items with relational dimension content as well. This sense of identification leads to statistical cross-loading via three distinct processes. First of all, high school rankings are frequently associated with higher-quality academic and professional activities. Students' satisfaction with rankings implies an expectation of participating in such high-quality activities, potentially increasing their enthusiasm for participating in campus activities. Besides, high rankings typically indicate an exceptional faculty. Students' consent of rankings reinforces their prior trust and respect for instructors' professional ability, building the emotional groundwork for positive teacher-student relationships. Finally, the shared experience of high rankings shapes significant in-group preferences and a sense of honor within the student body. This identification, based on collective identity, effectively promotes acceptance and connection among peers, making it easier to form student-student relationships. Hence, eliminating this

item was based on the criteria of measurement rigor and conceptual clarity. This decision may improve the construct validity of the scale and provide a more accurate measurement instrument for future research. In Study 2, the four-factor model with twenty-three items was further validated, and the data results reached an acceptable level. In Study 3, the scale demonstrated good internal consistency and model fit, and the gender invariance test indicated strong invariance. Some scholars have suggested that establishing full measurement invariance through strict invariance is considered difficult to achieve due to the highly restrictive nature of the test (Byrne et al., 1989; Widaman & Reise, 1997), and achieving strong invariance is adequate to enable significant cross-group comparisons of latent means(Steyn & De Bruin, 2020; Van de Schoot et al., 2012)**.** Thus, the research team concluded that the scale that achieved strong invariance had good cross-gender invariance. Eventually, this study yielded a four-dimensional scale with twenty-three items, demonstrating good reliability, validity, and gender invariance.

This study is the first attempt to develop and validate a scale to identify university students' spatial belonging. Today, the massification of higher education has remarkably altered students' sense of belonging. Calderon (2018) pointed out that by 2030, the number of undergraduate students worldwide will increase to 380 million. Higher education institutions do, however, have limited material resources. The available resources are challenging in meeting the demand for physical space brought on by the quick increase in the student population. Students' sense of belonging is weakened by the consequent decline in per capita material resources, such as green space, teaching facilities, and libraries. Meanwhile, the expansion of higher education has changed the relational space, affecting students' belongingness. According to Burd (2018), students frequently experience feelings of loneliness and isolation due to the growth of higher education enrollment since their connections with teachers and peers become much dispersed. Besides, the growth of virtual digital space prompted by scientific and technological advancements changes students' sense of belonging. On the one hand, online teaching models provide more participation opportunities for underrepresented groups (Longhurst et al., 2020), which boosts their sense of belonging. On the other hand, students being unfamiliar with the platform interface, connection and time issues, and lack of teaching skills are detrimental to cultivating students' sense of belonging (Cole et al., 2019; Lakhal et al., 2020). Furthermore, as higher education is becoming more widely available, numerous students from various socioeconomic backgrounds can access it, increasing the number of students from these groups on campuses. Students from different social classes, especially those in disadvantaged positions, are impacted by the non-neutrality of campus space. They may feel less like they belong if not included in the objectified "typical" student image (Burke & McManus, 2011). As a result, their sense of belonging is impacted by the reforms in campus structure space brought about by the massification of higher education (Thomas, 2015).

In a nutshell, higher education's physical, digital, relational, and structural spaces are altered by the times, which influences students' sense of belonging. Many education and psychology academics have also acknowledged the significance of belonging for college students (Beatson et al., 2023; Buckley et al., 2023; Hausmann et al., 2007; Hurtado & Carter, 1997; Zumbrunn et al., 2014) as a potent structure that impacts adolescents (Slaten et al., 2017). However, as of right now, there is no tool that could accurately assess how those four spaces affect students' belongingness. Therefore, this study has the significance of bridging the theory-practice gap by developing and validating a highly measurable and feasible scale of spatial belonging.

Implications

Theoretically, this study further enriches the framework of spatial belonging. Space and belonging

have a complicated relationship that numerous scholars have investigated (Bennett, 2014; Morieson et al., 2018; Rieth, 2023; Samura, 2018; Temple, 2018; Thompson et al., 2023; Trawalter et al., 2021); however, it was not until the theoretical framework of spatial belonging proposed by Wong (2023) that the relationship between diverse higher education spaces and students' sense of belonging was creatively proposed. Since the emergence of the concept of spatial sense of belonging, the existing scales have been unable to comply with the new requirements brought about by the development of the theory. The SBS developed in this paper tested the framework of spatial sense of belonging in a real university environment and provided empirical evidence for the conceptual framework of spatial sense of belonging, which meets the new requirements of the spatial sense of belonging theory–focusing on the subtle differences in the impact of different campus spaces on the sense of belonging.

Practically, the SBS could assist higher education institutions in enhancing their attractiveness and adherence to students. The impact of the massification of higher education and breakthroughs in science and technology on students' sense of belonging demands immediate action. Higher education institutions, particularly in the aftermath of the epidemic, are under pressure to strike a balance between online and offline teaching and learning, which also means how to deal with the link between physical and digital places. Compared with various other scales, the SBS is anticipated to supply higher education institutions with a competitive edge. In particular, the SBS successfully assesses students' sense of belonging in all four spatial dimensions, allowing higher education institutions to comprehend how various spaces impact students' sense of belonging. It also permits them to identify any inconsistencies or shortcomings between their conceptualized and students' perceived spaces and then adjust the corresponding spaces to promote students' sense of belonging. In conclusion, the SBS can benefit our comprehension of students' spatial belonging and encourage a variety of endeavors in postsecondary educational institutions to create a well-rounded environment for students' sense of belonging.

Limitations and Future Directions

First and foremost, this study was carried out at a specific university campus in southern China, limiting the external validity of the findings. Student characteristics, campus spatial culture, and institutional environment differ between universities in different countries and regions, which may influence how a sense of spatial belonging is manifested and how scale items are interpreted, thereby affecting the stability of the scale's structure. Future research should further validate the applicability of this scale across different cultural and institutional contexts and examine whether there are differences in participants' understanding of the scale items. Additionally, the gender ratio in this study was unbalanced. While this ratio is somewhat consistent with the changing gender ratio in Chinese higher education, and the measurement invariance test indicates scalar invariance across genders, the tiny male subsample size may restrict its statistical power. This may limit the stability of model parameter estimation and the statistical capacity to detect invariance at all possible levels. As a result, the current findings in the male population require further validation to ensure their reliability. The scale's development and validation are continuous processes (Cronbach, 1971), future research must maintain a gender balance between men and women to validate the results of this research. Thirdly, the online survey format made it difficult to fully ensure the quality of the questionnaire (Deutskens et al., 2004). Even though the researchers checked each response independently, the authenticity of the participants' responses could not be completely guaranteed. Besides, this study relied on self-report data collection, which, while effective for evaluating subjectively perceived factors, may be influenced by social expectation bias and common method bias. Although the data showed that common method bias did not

affect this study, future research may utilize data from multiple sources to further improve the reliability of the results. Subsequently, this study utilized data from both the front and back parts of the dataset for scale validation. Although the samples from each part of the dataset satisfied the requirement and the fit of the dataset to the four-factor model could be validated repeatedly, using an entirely independent sample for CFA is typically a more exacting validation. In further investigations, it would be more effective to validate the scale using a newly collected dataset. In addition, the cross-sectional methodology employed in this study made it challenging to gain insight into the dynamics of changes in the sense of spatial belonging of individual students. A longitudinal study could be performed on a specific group in the future to look into the positive effects of altering the four spaces on students' sense of spatial belonging. Last but not least, the current scale fails to directly measure the "student-object" interaction because the measurement items conceptually overlap with—and are difficult to distinguish from—the physical space dimension. The structural-spatial dimension of this scale measures students' perceptions of institutional responses rather than directly measuring individual experiences of external social structures (such as class or gender). Future research could focus on developing specialized items to test their discriminant validity relative to the existing dimensions, as well as evaluating the scale's overall psychometric properties after these additional items are included.

Conclusion

The concept of spatial belonging is conducive to exploring the impact of diverse spaces on students' sense of belonging. Informed by the theoretical framework of spatial belonging, this study developed and validated a four-dimensional scale with twenty-three items to measure university students' spatial belonging within the Chinese higher education context. The SBS had good psychometric properties in terms of internal consistency, convergent validity, discriminant validity, and measurement invariance, demonstrating the robustness and stability of the questionnaire. The SBS can be applied to empirical studies on university students' spatial belongingness, assisting higher education institutions in promoting students' sense of belonging through space management and improvement. This study can be further updated and validated by covering diverse populations in different cultural settings.

Declarations

Acknowledgments: The authors would like to express their deep gratitude to all those who have offered their help and guidance during this study. Your contributions have been essential to the success of this work.

Author Contributions: Conceptualization: S.W. and Q.W.; Methodology: Z.W. and Y.S; Software: Q.W. and Z.W.; validation: S.W. and Y.S.; formal analysis: Q.W and Z.W.; data curation: Z.W. and Y.S.; writing—original draft preparation: Q.W. and Z.W.; writing—review and editing: S.W. and Y.S.; funding acquisition: S.W. All authors have read and agreed to the published version of the manuscript.

Funding Statement: This research was funded by the Guangdong Basic and Applied Basic Research Foundation [grant number: 2023A1515010813].

Availability of data and material: The data supporting this study's findings are available from the corresponding author with the permission of South China Normal University upon request.

Ethics approval: The study was approved by the College of Vocational and Technical Education, South China Normal University Human Research Ethics Committee [reference number: 20250001].

Informed Consent Statement: Informed consent was acquired from all participants who were included in the study.

Conflicts of Interest: The authors declare no conflicts of interest to report regarding the present study, including business or family interests.

References

Adel, A., & Dayan, J. (2021). Towards an intelligent blended system of learning activities model for New Zealand institutions: An investigative approach. Humanities and Social Sciences Communications, 8(1). https://doi.org/10.1057/s41599-020-00696-4

Ahn, M. Y., & Davis, H. H. (2020). Sense of belonging as an indicator of social capital. International Journal of Sociology and Social Policy, 40(7/8), 627-642. https://doi.org/10.1108/ijssp-12-2019-0258

Ajjawi, R., Dracup, M., Zacharias, N., Bennett, S., & Boud, D. (2019). Persisting students' explanations of and emotional responses to academic failure. Higher Education Research & Development, 39(2), 185-199. https://doi.org/10.1080/07294360.2019.1664999

Antonsich, M. (2010). Searching for Belonging – An Analytical Framework. Geography Compass, 4(6), 644-659. https://doi.org/10.1111/j.1749-8198.2009.00317.x

Baltaru, R., Manac, R., & Ivan, M.-D. (2022). Do rankings affect universities' financial sustainability? – financial vulnerability to rankings and elite status as a positional good. Studies in Higher Education, 47(11), 2323–2335. https://doi.org/https://doi.org/10.1080/03075079.2022.2061447

Bates, L. E. Z. (2025). Exploring Gender Typicality and Sense of Belonging Among University Students in Gender-Imbalanced Disciplines [Dissertation/Thesis].

Baumeister, R. F., & Leary, M. R. (1995). The Need to Belong: Desire for Interpersonal Attachments as a Fundamental Human Motivation. Psychological Bulletin 117(3), 497-529. https://doi.org/10.1037/0033-2909.117.3.497

Beatson, N., Lange, P., Tharapos, M., O'Connell, B., Smith, J., Scott, S., & Greatbanks, R. (2023). An examination of self - efficacy and sense of belonging on accounting student achievement. Accounting & Finance, 64. https://doi.org/10.1111/acfi.13160

Bennett, J. (2014). Gifted Places: the inalienable nature of belonging in place. Environment and Planning D Society and Space 32(4), 658-671. https://doi.org/DOI:10.1068/d4913p

Bentler, P. M., & Chou, C.-P. (1987). Practical issues in structural modeling. Sociological Methods & Research, 16(1), 78-117. https://doi.org/10.1177/0049124187016001004

Buckley, J., Robinson, B., Tretter, T., Biesecker, C., Hammond, A., & Thompson, A. (2023). Belonging as a gateway for learning: First - year engineering students' characterizations of factors that promote and detract from sense of belonging in a pandemic. Journal of Engineering Education, 112. https://doi.org/10.1002/jee.20529

Burd, C. (2018). Student Perceptions of the Context of Mass Higher Education [Master's thesis, The University of Western Ontario]. Electronic Thesis and Dissertation Repository. https://ir.lib.uwo.ca/etd/5500

Burke, P., & McManus, J. (2011). Art for a few: Exclusions and misrecognitions in higher education admissions practices. Discourse: Studies in the Cultural Politics of Education, 32, 699-712. https://doi.org/10.1080/01596306.2011.620753

Burt, K., & Paysnick, A. (2014). Identity, Stress, and Behavioral and Emotional Problems in Undergraduates: Evidence for Interaction Effects. Journal of College Student Development, 55, 368-384. https://doi.org/10.1353/csd.2014.0036

Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. Psychological Bulletin, 105(3), 456-466. https://doi.org/10.1037/0033-2909.105.3.456

Calderon, A. (2018). Massification of higher education revisited. RMIT University.

Castle, S., & Grant, R. (2023). Belonging, identity and place: Middle-class Tasmanian rural young people in urban university. Journal of Rural Studies, 103. https://doi.org/10.1016/j.jrurstud.2023.103139

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. Structural Equation Modeling: A Multidisciplinary Journal, 14(3), 464-504. https://doi.org/10.1080/10705510701301834

Chen, R. (2012). Institutional Characteristics and College Student Dropout Risks: A Multilevel Event History Analysis. Research in Higher Education, 53. https://doi.org/10.1007/s11162-011-9241-4

Cole, A., Lennon, L., & Weber, N. (2019). Student perceptions of online active learning practices and online learning climate predict online course engagement. Interactive Learning Environments, 29, 1-15. https://doi.org/10.1080/10494820.2019.1619593

Cole, A. W., Lauren, L., & and Weber, N. L. (2021). Student perceptions of online active learning practices and online learning climate predict online course engagement. Interactive Learning Environments, 29(5), 866-880. https://doi.org/10.1080/10494820.2019.1619593

Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Practical Assessment, Research, and Evaluation, 10(7). https://doi.org/10.7275/JYJ1-4868

Cronbach, L. J. (1971). Test Validation. In R. Thorndike (Ed.), Educational Measurement (2nd ed. ed., pp. 443). American Council on Education.

Cureton, D., & Gravestock, P. (2019). 'We Belong': differential sense of belonging and its meaning for different ethnicity groups in higher education. . Journal of Learning and Teaching in Higher Education, 12(1). https://doi.org/ https://doi.org/10.21100/compass.v12i1.942

Cureton, D., Jones, J., & Hughes, J. (2020). The postdigital university: Do we still need just a little of that human touch? Postdigital Science and Education, 3(1), 223-241. https://doi.org/10.1007/s42438-020-00204-6

Deutskens, E., Ruyter, K. D., Wetzels, M., & Oosterveld, P. (2004). Response Rate and Response Quality of Internet-Based Surveys: An Experimental Study. Marketing Letters, 15(1), 21-36. https://doi.org/10.1023/B:MARK.0000021968.86465.00

Fornell, C., & Larcker, D. F. (1981a). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18(1), 39-50. https://doi.org/10.2307/3151312

Fornell, C., & Larcker, D. F. (1981b). Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of Marketing Research, 18(3), 382-388. https://doi.org/10.2307/3150980

Foucault, M., & Miskowiec, J. (1986). Of other spaces. Diacritics, 16, 22-27.

Francis, J., Giles-Corti, B., Wood, L., & Knuiman, M. (2012). Creating sense of community: The role of public space. Journal of Environmental Psychology, 32(4), 401-409. https://doi.org/10.1016/j.jenvp.2012.07.002

Freeman, T., Anderman, L., & Jensen, J. (2007). Sense of Belonging in College Freshmen at the Classroom and Campus Levels. Journal of Experimental Education - J EXP EDUC, 75, 203-220. https://doi.org/10.3200/JEXE.75.3.203-220

Gao, F., & Liu, H. C. Y. (2021). Guests in someone else's house? Sense of belonging among ethnic minority students in a Hong Kong university. . British Educational Research Journal, 47(4), 1004-1020. https://doi.org/ doi: 10.1002/berj.370

Goodenow, C. (1993). The Psychological Sense of School Membership among adolescents: Scale development and educational correlates. Psychology in the Schools 30(1), 79 – 90. https://doi.org/https://doi.org/10.1002/1520-6807(199301)30:1<79::AID-PITS2310300113>3.0.CO;2-X

Gravett, K., & Ajjawi, R. (2021). Belonging as situated practice. Studies in Higher Education, 47(7), 1386-1396. https://doi.org/10.1080/03075079.2021.1894118

Guthrie, K., & Meriwether, J. (2018). Leadership Development in Digital Spaces Through Mentoring, Coaching, and Advising. New Directions for Student Leadership, 2018, 99-110. https://doi.org/10.1002/yd.20291

Hair, J., Black, W., Babin, B., & Anderson, R. (2010). Multivariate Data Analysis: A Global Perspective. Pearson.

Hausmann, L., Schofield, J., & Woods, R. (2007). Sense of Belonging as a Predictor of Intentions to Persist Among African American and White First-Year College Students. Research in Higher Education, 48, 803-839. https://doi.org/10.1007/s11162-007-9052-9

Hinkin, T. R., Tracey, J. B., & Enz, C. A. (1997). Scale Construction: Developing Reliable and Valid Measurement Instruments. Journal of Hospitality & Tourism Research, 21, 100 - 120. https://doi.org/10.1177/109634809702100108

Hoffman, M., & Morrow, J. (2002). Investigating "Sense of Belonging" in First-Year College Students. College Student Retention Research Theory and Practice 4(3), 227-256. https://doi.org/DOI:10.2190/DRYC-CXQ9-JQ8V-HT4V

Huang, L.-L., Chen, S.-W., & Chien, C.-L. (2014). The Effect of University Ranking on Learning Satisfaction: Social Identities and Self-identity as the Suppressor and Mediators. Asian Journal of Social Psychology. https://doi.org/10.1111/ajsp.12064

Hunt, R., King, G., & Barnes, C. (2023). Storying student belonging in UK higher education. Journal of Geography in Higher Education, 48(4), 615-632. https://doi.org/10.1080/03098265.2023.2266995

Hurtado, S., & Carter, D. F. (1997). Effects of College Transition and Perceptions of the Campus Racial Climate on Latino College Students' Sense of Belonging. Sociology of Education, 70(4), 324-345. https://doi.org/10.2307/2673270

Jager, J., Xia, Y., Putnick, D. L., & Bornstein, M. H. (2025). Improving generalizability of developmental research through increased use of homogeneous convenience samples: A Monte Carlo simulation. Developmental Psychology, 61(10), 1991-2007. https://doi.org/10.1037/dev0001890

Jane Lessiter, J. F., Edmund Keogh, Jules Davidoff. (2001). A Cross-Media Presence Questionnaire: The ITC-Sense of Presence Inventory. Presence Teleoperators & Virtual Environments, 10(3), 282–297. https://doi.org/10.1162/105474601300343612

Jennings, V., & Bamkole, O. (2019). The Relationship between Social Cohesion and Urban Green Space:

An Avenue for Health Promotion. International Journal of Environmental Research and Public Health, 16(3). https://doi.org/10.3390/ijerph16030452

Johnson, D. R. (2012). Campus Racial Climate Perceptions and Overall Sense of Belonging Among Racially Diverse Women in STEM Majors. Journal of College Student Development, 53(2), 336-346. https://doi.org/10.1353/csd.2012.0028

Johnson, D. R., Soldner, M., Leonard, J. B., Alvarez, P., Inkelas, K. K., Rowan-Kenyon, H., Longerbeam, S. (2007). Examining Sense of Belonging Among First-Year Undergraduates From Different Racial/Ethnic Groups. Journal of College Student Development, 48(5), 525 – 542. https://doi.org/https://doi.org/10.1353/csd.2007.0054

Jokila, S., Filippou, K., & Jolkkonen, A. (2025). Space as an un/equalizer in times of technology and crisis in higher education. Higher Education Research & Development, 44. https://doi.org/10.1080/07294360.2024.2429437

Kahu, E. R., & Nelson, K. (2017). Student engagement in the educational interface: understanding the mechanisms of student success. Higher Education Research & Development, 37(1), 58-71. https://doi.org/10.1080/07294360.2017.1344197

Kantanis, T. (2000). The role of social transition in students' adjustment to the first-year of university. Journal of Institutional Research, 100-110.

Karaman, O., & Cirak, Y. (2017). The Belonging to the University Scale. Acta Didactica Napocensia, 10, 1-20. https://doi.org/10.24193/adn.10.2.1

Kärnä, S., Julin, P., & Nenonen, S. (2013). User satisfaction on a university campus by students and staff. Intelligent Buildings International, 5. https://doi.org/10.1080/17508975.2013.778810

Kavoura, N., & Stavrianea, A. (2015). Following and Belonging to an Online Travel Community in Social Media, its Shared Characteristics and Gender Differences. Procedia - Social and Behavioral Sciences, 175. https://doi.org/10.1016/j.sbspro.2015.01.1231

Lakhal, S., Mukamurera, J., Bédard, M.-E., Heilporn, G., & Chauret, M. (2020). Features fostering academic and social integration in blended synchronous courses in graduate programs. International Journal of Educational Technology in Higher Education, 17, 5. https://doi.org/10.1186/s41239-020-0180-z

Leary, M. R. (2010). Affiliation, Acceptance, and Belonging: The Pursuit of Interpersonal Connection. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), Handbook of social psychology (5th ed. ed., pp. 864–897). John Wiley & Sons, Inc. https://doi.org/10.1002/9780470561119.SOCPSY002024

Lee, J., Brooks, R., & Abrahams, J. (2023). Students, community and belonging: an investigation of student experience across six European countries. Higher Education Research & Development, 43(4), 906-921. https://doi.org/10.1080/07294360.2023.2269886

Lefebvre, H. (1992). The production of space. Economic Geography, 68, 317-319.

Longhurst, G. J., Stone, D. M., Dulohery, K., Scully, D., Campbell, T., & Smith, C. F. (2020). Strength, Weakness, Opportunity, Threat (SWOT) Analysis of the Adaptations to Anatomical Education in the United Kingdom and Republic of Ireland in Response to the Covid-19 Pandemic. Anatomical Sciences Education, 13(3), 301-311. https://doi.org/10.1002/ase.1967

Lucas, S. R. (2001). Effectively Maintained Inequality: Education Transitions, Track Mobility, and Social Background Effects. American Journal of Sociology, 106, 1642-1690.

Mahar, A. L., Cobigo, V., & Stuart, H. (2012). Conceptualizing belonging. Disability and Rehabilitation, 35(12), 1026-1032. https://doi.org/10.3109/09638288.2012.717584

Maslow, A. H. (1943). A theory of human motivation. Psychological Review, 50(4), 370–396.

Massey, D. (2005). For Space. SAGE Publications, Inc.
McDonald, S. (2024). 'I don't feel like I belong': first-in-family girls' constructions of belonging and space during the transition from secondary school into university. Gender and Education, 36(2), 183-197. https://doi.org/10.1080/09540253.2024.2308037
Meehan, C., & Howells, K. (2017). 'What really matters to freshers?': evaluation of first year student experience of transition into university. Journal of Further and Higher Education, 42(7), 893-907. https://doi.org/10.1080/0309877x.2017.1323194
Mendoza, A., & Venables, A. (2023). Attributes of Blended Learning Environments Designed to Foster a Sense of Belonging for Higher Education Students. Journal of Information Technology Education: Research, 22, 129-156. https://doi.org/10.28945/5082
Morieson, L., Murray, G. M., Wilson, R., Clarke, B., & Lukas, K. (2018). Belonging in Space: Informal Learning Spaces and the Student Experience. Journal of Learning Spaces, 7(2).
Mulrooney, H. M., & Kelly, A. F. (2020). The university campus and a sense of belonging: what do students think? New Directions in the Teaching of Physical Sciences(15). https://doi.org/10.29311/ndtps.v0i15.3590
Muse, H. E. (2003). The Web-based community college student: An examination of factors that lead to success and risk. The Internet and Higher Education, 6(3), 241-261. https://doi.org/10.1016/s1096-7516(03)00044-7
Peters, K., Stodolska, M., & Horolets, A. (2016). The role of natural environments in developing a sense of belonging: A comparative study of immigrants in the U.S., Poland, the Netherlands and Germany. Urban Forestry & Urban Greening, 17, 63-70. https://doi.org/10.1016/j.ufug.2016.04.001
Pittman, L., & Richmond, A. (2008). University Belonging, Friendship Quality, and Psychological Adjustment During the Transition to College. Journal of Experimental Education - J EXP EDUC, 76, 343-362. https://doi.org/10.3200/JEXE.76.4.343-362
Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5), 879-903. https://doi.org/10.1037/0021-9010.88.5.879
Rieth, B. C. (2023). The Stories of Space and Student Sense of Belonging.
Samadieh, H., Kareshki, H., Amir, S., & Hejazi Moughari, E. (2024). Development and Validation of the Students' Sense of Belonging to University Scale. 14, 38-71. https://doi.org/10.22054/jem.2024.74464.3474
Samura, M. (2018). Understanding Campus Spaces to Improve Student Belonging. About Campus: Enriching the Student Learning Experience, 23(2), 19-23. https://doi.org/10.1177/1086482218785887
Scannell, L., & Gifford, R. (2010). Defining Place Attachment: A Tripartite Organizing Framework. Journal of Environmental Psychology, 30, 1-10. https://doi.org/10.1016/j.jenvp.2009.09.006
Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review. The Journal of Educational Research, 99(6), 323-338. https://doi.org/10.3200/JOER.99.6.323-338
Shamash, R. (2019). (Re)production of the Contemporary Elite Through Higher Education: A Review of Critical Scholarship. Berkeley Review of Education, 8. https://doi.org/10.5070/B88134482
Slaten, C. D., Elison, Z. M., Deemer, E. D., Hughes, H. A., & Shemwell, D. A. (2017). The Development and Validation of the University Belonging Questionnaire. The Journal of Experimental Education, 86(4), 633-651. https://doi.org/10.1080/00220973.2017.1339009

Soja, E. W. (2013). Seeking Spatial Justice. University of Minnesota Press. https://books.google.com/books?id=NkfEeomy-IUC

Steyn, R., & De Bruin, G. (2020). An investigation of gender-based differences in assessment instruments: A test of measurement invariance. SA Journal of Industrial Psychology, 46. https://doi.org/10.4102/sajip.v46i0.1699

Strayhorn, T. L. (2012). College Students' Sense of Belonging: A Key to Educational Success for All Students. Routledge. https://doi.org/10.4324/9780203118924

Temple, P. (2018). Space, place and institutional effectiveness in higher education. Policy Reviews in Higher Education, 2(2), 133-150. https://doi.org/10.1080/23322969.2018.1442243

Teo, T. (2010). A structural equation modelling of factors influencing student teachers' satisfaction with e-learning: Colloquium. British Journal of Educational Technology - BRIT J EDUC TECHNOL, 41. https://doi.org/10.1111/j.1467-8535.2010.01110.x

Thomas, K. (2015). Rethinking belonging through Bourdieu, diaspora and the spatial. Widening Participation and Lifelong Learning, 17(1), 37-49. https://doi.org/10.5456/wpll.17.1.37

Thomas, L. (2012). Building student engagement and belonging in Higher Education at a time of change: a summary of findings and recommendations from the What Works? Student Retention & Success programme.

Thomas, L., Herbert, J., & Teräs, M. (2014). A sense of belonging to enhance participation, success and retention in online programs. 1838-2959, 5, 69-80. https://doi.org/10.5204/intjfyhe.v5i2.233

Thompson, C. A., Pownall, M., Harris, R., & Blundell-Birtill, P. (2023). Is the grass always greener? Access to campus green spaces can boost students' sense of belonging. International Journal of Sustainability in Higher Education, 24(8), 1841-1857. https://doi.org/10.1108/ijshe-11-2022-0349

Trawalter, S., Hoffman, K., & Palmer, L. (2020). Out of Place: Socioeconomic Status, Use of Public Space, and Belonging in Higher Education. Journal of Personality and Social Psychology, 120. https://doi.org/10.1037/pspi0000248

Trawalter, S., Hoffman, K., & Palmer, L. (2021). Out of place: Socioeconomic status, use of public space, and belonging in higher education. Journal of Personality and Social Psychology, 120(1), 131-144. https://doi.org/10.1037/pspi0000248

Van de Schoot, R., Peter, L., & Hox, J. (2012). A checklist for testing measurement invariance. European Journal of Developmental Psychology, 9(4), 486-492. https://doi.org/10.1080/17405629.2012.686740

Watkins, M. W. (2018). Exploratory Factor Analysis: A Guide to Best Practice. Journal of Black Psychology, 44(3), 219-246. https://doi.org/10.1177/0095798418771807

Webb, K. M., Schaller, M. A., & Hunley, S. A. (2008). Measuring Library Space Use and Preferences: Charting a Path Toward Increased Engagement. portal: Libraries and the Academy, 8(4), 407-422. https://doi.org/10.1353/pla.0.0014

Wehlage, G. G., Rutter, R. A., Smith, G. A., Lesko, N., & Fernandez, R. R. (1989). Reducing the Risk: Schools as Communities of Support. Falmer Press. https://doi.org/10.1177/019263658907351311

Wei, K.-K., Teo, H., Chan, H., & Tan, B. (2011). Conceptualizing and Testing a Social Cognitive Model of the Digital Divide. Information Systems Research, 22, 170-187. https://doi.org/10.1287/isre.1090.0273

Widaman, K. F., & Reise, S. P. (1997). Exploring the measurement invariance of psychological instruments: Applications in the substance use domain. In The science of prevention: Methodological advances from alcohol and substance abuse research. (pp. 281-324). American

Psychological Association. https://doi.org/10.1037/10222-009
Wilson, S., & Gore, J. (2013). An Attachment Model of University Connectedness. The Journal of Experimental Education, 81, 178-198. https://doi.org/10.1080/00220973.2012.699902
Winstone, N., Balloo, K., Gravett, K., Jacobs, D., & Keen, H. (2020). Who stands to benefit? Wellbeing, belonging and challenges to equity in engagement in extra-curricular activities at university. Active Learning in Higher Education, 23(2), 81-96. https://doi.org/10.1177/1469787420908209
Wong, B. (2023). Exploring the spatial belonging of students in higher education. Studies in Higher Education, 49(3), 546-558. https://doi.org/10.1080/03075079.2023.2243285
Zumbrunn, S., McKim, C., Buhs, E., & Hawley, L. (2014). Support, belonging, motivation, and engagement in the college classroom: A mixed method study. Instructional Science, 42. https://doi.org/10.1007/s11251-014-9310-0
Żyłka, K., & Ocieczek, A. (2022). Attitudes of Polish adolescents towards energy drinks. Part 1. Development, validation and reliability testing of a scale to identify attitudes towards energy drinks. Annals of Agricultural and Environmental Medicine, 29. https://doi.org/10.26444/aaem/150273