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The role of informal learning spaces in promoting social integration and wellbeing in higher education

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The global mental health crisis, intensified by the post-pandemic context, calls for holistic approaches to wellbeing in higher education. While prior research highlights the relevance of physical learning environments for health, limited attention has been paid to how these spaces foster social and psychological outcomes. This study examines how informal learning spaces (ILS) contribute to student wellbeing through the mediating role of social integration, with a focus on students facing personal challenges (FPC). Drawing on Tinto's social integration model and the person−environment fit theory, this study explores two key questions: (1) Does social integration mediate the relationship between ILS availability/accessibility and student wellbeing? (2) Does FPC moderate the relationship between ILS and social integration? A cross-sectional survey was conducted with 932 university students from Austria, Germany, Italy, and Türkiye. Results showed that social integration mediates the relationship between ILS and wellbeing (β = 0.09). Moderation analysis indicated that the relationship between ILS and social integration was stronger for students FPC (β = 0.12), who reported significantly lower social integration when ILS were less accessible. Our findings present novel empirical evidence linking the physical learning environment to social integration and wellbeing, particularly for students facing personal challenges. These findings call for ILS to be intentionally designed as inclusive, welcoming, and supportive spaces that promote equity and wellbeing in higher education.

KEYWORDS

wellbeing, informal learning spaces, social integration, mental health, students facing personal challenges, physical learning environment, higher education

1 Introduction

In recent years, student wellbeing in higher education has become a focus of concern due to the increasing prevalence of mental health problems among university students (Brown, 2018; Khatri et al., 2024; Ribeiro et al., 2024). Students face a range of stressors, including academic, social, financial, cultural and environmental challenges, which can be overwhelming and detrimental to their wellbeing making them a 'high risk population' for psychological distress and mental disorders (Baik et al., 2019; Brett et al., 2023; Brown, 2018; Liu et al., 2022). The EUROSTUDENT 8 Survey conducted in 22 countries includes a special section focusing on mental health and wellbeing. Results indicate that student wellbeing is widespread concern: between 37 and 58% of students report poor wellbeing, with this being the majority experience in eight of the 22 nations examined. Younger students and those facing financial hardship

report significantly lower wellbeing compared to their older and financially stable peers. Among students reporting mental health issues, depression and anxiety are the most common diagnoses. In Austria 44% of the students report low sense of wellbeing (Cuppen et al., 2024). In a representative German survey, 15.9% of students reported experiencing impairments that hinder their studies, with mental illnesses accounting for the majority (65%) of these cases. In other words, around one in 10 students suffers from a mental illness that negatively impacts his or her academic success (Kroher et al., 2021). A cross-national study by Ochnik et al. (2021) found high prevalence rates of mental health problems among university students in the Czech Republic, Türkiye, Israel, Slovenia, Germany, Poland, Ukraine, Russia, and Colombia during the COVID-19 pandemic. Turkish students reported the second highest levels of stress (70%), and the highest levels of anxiety (51.3%) and depression (62.3%) of all countries surveyed.

In addressing these mental health challenges, universities recently are focusing on structural interventions for health-promoting learning environments, but interventions on physical environments are underexplored compared to pedagogical interventions (Konstantinidis, 2024; Olsson et al., 2024). Recent research has increasingly recognized that the physical learning environment, particularly informal learning spaces (ILS), can serve as a protective factor supporting student wellbeing (Agg and Khimji, 2021; Makaremi et al., 2024; Neves and Hillman, 2017; Pepper, 2024; Scannell et al., 2016; Stanton et al., 2016). Informal learning spaces refer to areas where students use without direct teacher oversight, usually beyond the structure of formal class time. These spaces include hallways, university libraries, communal lounges, cafés, outdoor settings, and digital space (Cerasoli et al., 2018; Ninnemann and Jahnke, 2018). According to Berman (2020) ILS not only support academic engagement but also foster social interaction and overall wellbeing. In response, universities have begun reimagining campus spaces to balance social and academic needs and meet the growing demands for personalized learning (Berman, 2020). A holistic approach to campus design—integrating physical, social, and pedagogical dimensions—has been emphasized by Beckers et al. (2016) and Papaioannou et al. (2023), reinforcing the need to consider both the physical and social environments in higher education as well as the role of built-in environments of student wellbeing.

There exists some research that has examined various dimensions of physical learning space and their impact on learner wellbeing. Some studies examined the role of natural elements and biophilic design in stress reduction, to promote restorative experiences and to improve wellbeing (Agg and Khimji, 2021; Liu et al., 2022; Peters and D'Penna, 2020; Ribeiro et al., 2024). Research on acoustic thermal comfort, furniture, availability of food and drink facilities and lighting has shown that these physical elements impact students stress level and wellbeing (Amasuomo and Amasuomo, 2016; Muhammad et al., 2014; Ricciardi and Buratti, 2018; Scannell et al., 2016).

Despite these insights, the specific role of ILS in supporting student wellbeing remains insufficiently explored, particularly in relation to availability, accessibility, and characteristics contribute to students' overall wellbeing and campus experience. While availability, accessibility and flexibility of ILS have primarily been investigated in relation to

learning experiences and student engagement (Beckers et al., 2016; Costa and Steffgen, 2020; Guney and Al, 2012; Wang and Han, 2021; Wu et al., 2021), connection to wellbeing outcomes remains underexplored. This study addresses this gap by investigating the role of ILS in supporting student wellbeing, with the aim of promoting the development of more inclusive and wellbeing-oriented learning environments.

1.1 Informal learning spaces

The influence of physical learning environments on various dimensions of learning, both in compulsory and post-compulsory education, is widely acknowledged across educational science, design, and architecture (Higgins et al., 2005; Melhuish et al., 2008; Sivunen et al., 2014). However, research specifically addressing spatial use in higher education remains limited and highly fragmented (Ellis and Goodyear, 2016). Wilson's (2009) Places for Learning Spectrum presents campuses as interconnected networks of diverse learning environments, emphasizing that learning occurs across a mix of spaces, activities, and technologies. His student-centered model spans a continuum from informal, self-directed settings to formal, teacher-led ones. It highlights three key components from the learner's perspective: physical spaces, learning communities (e. g., staff, peers), and learning modalities that support various outcomes. In this model, informal learning spaces (ILS) constitute the majority of spaces in higher education institutions. ILS are areas where students gather without teacher supervision, typically outside scheduled classes. These spaces often take the form of redesigned university libraries, student lounges, cafes, outdoor areas, and even virtual spaces. Research highlights that the effective design of these spaces should reflect learning principles and support the different modalities of learning (e. g. active learning, focused learning, and collaborative learning) by structuring ways students interact with resources, technology, staff, and peers (Clark et al., 2007; Dovey and Fisher, 2014; Skerlak et al., 2014).

The role of ILS can also be understood by applying the *Person–Environment (P–E) Fit Theory* (Gilbreath et al., 2011). P-E Fit Theory suggest that individuals experience greater wellbeing, satisfaction, and performance when there is a good fit between their personal characteristics, (needs, values, abilities) and the environment they are in (social context, physical space). ILS in this account can address students' social and academic needs (Pepper, 2024) that encourage peer interaction, reduce isolation, and foster informal social support and learning.

ILS are also central to the concept of the "sticky campus," which encourages students to spend more time on campus (Ellis and Goodyear, 2016). A "sticky campus" environment blends spaces for living, learning, and leisure (Berman et al., 2024). This concept integrates study, relaxation, eating, and socializing areas, prioritizing flexibility, and variety to support both academic and recreational needs (Acker and Miller, 2005; Berman et al., 2024; Groves, 2017). In this concept, ILS provide opportunities for students to connect, collaborate, and engage in self-directed learning beyond the formal curriculum (Chattaraj and Vijayaraghavan, 2021; Matthews et al., 2011). These spaces contribute significantly to the development of a sense of community and belonging, which are essential for students' social and emotional wellbeing (LeGrow et al., 2023).

Thus, ILS play a crucial, yet often underestimated, role in fostering social integration and enhancing the overall health and

wellbeing of students within higher education institutions, moving beyond the traditional focus on formal classroom settings (Halupka and Li, 2023; Konstantinidis, 2024). The growing importance of learning spaces and technologies has attracted attraction from researchers focused on the design and utilization of these spaces to optimize teaching, learning, and research outcomes (Papaioannou et al., 2023). To achieve this, understanding the design and effective use of ILS requires a holistic perspective that accounts for the interplay of physical, social, and psychological factors influencing student behavior and learning outcomes.

1.2 Availability and accessibility of ILS

In environmental psychology and architecture, rooms are predominantly assessed based on physical criteria, such as light, climate, acoustics, temperature, furniture, and size (Keser Aschenberger et al., 2022; Ninnemann, 2018). Overarching criteria relevant to the appropriation and use of learning spaces include availability and accessibility of the space as well as the quality of the facilities (Ninnemann, 2018). Although, no comprehensive model currently focuses solely on availability and accessibility of learning spaces, related conceptual frameworks exist. For example, Tomaševski's (2001) 4-A Model outlines key educational criteria—availability, accessibility, acceptability, and adaptability—primarily focused on human rights obligations in education. While originally designed to address access to schools and teachers, these criteria can be meaningfully applied to learning spaces. Availability is defined as the opportunity to use ILS in terms of sufficient existence of spaces and knowledge about ILS. Accessibility covers the possibility for actual usage of ILS, which might be hindered by barriers, such as restricted access, physical barriers, or lacking information about ILS.

Spatial Justice Theory by Soja (2010) emphasizes that space is socially produced and inherently related to power and inequality. He identifies that 'space is filled with politics and privileges, ideologies and cultural collisions, utopian ideals and dystopian oppression, oppressive power and the possibility for emancipation' (p. 103). He shows how the organization of space (physical, social, political) produces and reproduces inequalities, and how the design and distribution of learning spaces can either reinforce or reduce exclusion and marginalization. Applied to ILS, the theory urges institutions to consider how spatial arrangements affect access, inclusion, and wellbeing of diverse student groups. Sen's (1980, 1993, 1999) Capability Approach compliments this by shifting from resources to what individuals are actually able to do and be. Capability approach is a normative framework for evaluating individual wellbeing. It emphasizes what individuals are actually able to do and be (their capabilities) rather than merely the resources they possess or their subjective satisfaction (Walker and Unterhalter, 2007). Key concepts include capabilities (real opportunities to achieve valuable states of being and doing), functionings (the actual achievements, e. g., being literate, being healthy), and agency (the ability to pursue goals and values). Educational spaces, physical, social, and institutional, can either enhance or restrict students' capabilities. For example, access to space can enhance students' real freedoms to learn, participate, and thrive. Together, these perspectives position ILS not just as material settings, but as critical enablers (or barriers) of students' wellbeing,

agency, and educational outcomes—especially for those facing personal challenges (FPC).

Research showed that ILS can accommodate diverse types of learning activities. Beckers et al. (2016) identified four main learning configurations: autonomous learning, instructional learning, interactive/small group learning and network learning. These configurations yield to nine learning activities such as independent study, collaborative learning, attending classes, or social learning activities. Scott-Webber (2015) presents another model bringing together types of learning needs and activities and form of ILS, a two-by-two matrix with four quadrants—Private/Alone, Public/Alone, Private/Together, and Public/Together—each representing different learner behaviors and spatial needs. Private/alone spaces support individual focused work, public/alone spaces offer individual work alone in the presence of others, private/together spaces support group learning with analogue and digital co-creation capabilities and public/together offers open group learning with peers, faculty, or supporting public venues. Based on these frameworks, in this study we centered on focused (individual) learning activities and collaborative (group) learning activities. Focused learning activities are conducted individually and usually undisturbed. Examples are reading, writing and repetition or studying for exams alone. Collaborative learning activities are conducted in groups. These can be the following learning activities: group work, preparing a group presentation and repetition or studying for exams in groups (Beckers et al., 2016).

Empirical studies show that students' preferences for ILSs are closely linked to their learning activities, with convenience, proximity, and comfort being critical factors (Chin et al., 2021; Cui and Ahn, 2024; Harrop and Turpin, 2013; Ramsden, 2011). Quiet, secluded spaces are preferred for focused study, while open, flexible environments support collaboration, highlighting the importance for adaptable designs that accommodate diverse learning strategies and allow students to manage their own space effectively (Beckers et al., 2016; Guney and Al, 2012; Scoulas and De Groote, 2019; Shouder et al., 2014; Wang and Han, 2021). Building on this framework we hypothesize that availability and accessibility of ILS are significant predictors of student wellbeing.

1.3 Wellbeing

Wellbeing is a multidimensional construct encompassing biological, psychological, and social aspects. Diverse disciplines and contexts offer unique perspectives and insights that enrich our understanding of mental health and wellbeing (Hernández-Torrano et al., 2020). In the literature, two dominant conceptualizations of wellbeing have emerged, rooted in hedonic and eudaimonic traditions: subjective wellbeing and psychological wellbeing. Subjective wellbeing, rooted in the hedonic tradition, was described by Diener (1984) as consisting of three elements: frequent experiences of positive emotions, rare occurrences of negative emotions, and cognitive assessments of overall life satisfaction. On the other hand, psychological wellbeing is grounded in the eudaimonic tradition and includes six aspects of wellbeing: self-acceptance, autonomy, life purpose, positive relationships, personal growth, and mastery of one's environment (Ryan and Deci, 2001; Ryff, 1989). Furthermore, Keyes (1998) introduced the concept of social wellbeing, referring to

individuals' perceptions of the quality of their relationships with others. In addition to these definitions, the World Health Organization (WHO) offers a holistic definition of mental health and wellbeing as 'a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity' (World Health Organization (WHO), 2020, p. 1). In higher education, student wellbeing typically includes emotional wellbeing, which involves experiencing positive feelings and being satisfied with life; psychological wellbeing, which encompasses having a sense of purpose, personal growth, and self-fulfillment; and social wellbeing, which relates to the quality of relationships and a sense of belonging (Li, 2025). This study adopts the WHO's salutogenetic definition, focusing on the mental, emotional, and social aspects of wellbeing, and emphasizing enjoyment, happiness, and life satisfaction.

Student wellbeing and mental health have gained increased attention due to rising reports of mental health concerns, particularly depression and burnout (Brown, 2018; Khatri et al., 2024; Ribeiro et al., 2024). Numerous studies have employed the WHO-5 Item index to assess the wellbeing of students. For instance, Kuehner et al. (2020) reported an index of 57 in 2018 and of 56 in 2020 for German students. In 2021, Holm-Hadulla et al. (2021) reported a WHO-5 Item index of 37 for German students. Therefore, it is necessary to understand which factors drive wellbeing of students.

The body of research is growing, investigating the factors influencing student wellbeing. Broad models identify a variety of factors, grouping them into demographics, pre-university experiences, supportive college climate, social and academic interactions, and confidence and sense of belonging (Fink, 2014). Recently, studies have turned to structural approaches which are carried out by universities to find answers for policy advisors and instructors how to improve student wellbeing. Olsson et al. (2024) focused on structural interventions for health-promoting learning environments in higher education. They identified four categories of institutional intervention: (1) inclusion and diversity approaches, (2) adaptations to the physical environment, (3) teaching health-related skills and behaviors and (4) adaptations to pedagogical practices and teaching approaches. Only two studies looked at the physical environment (category 2), whereas nearly two-thirds of the interventions identified belonged to pedagogical practices and teaching approaches (category 4). Similarly, in an integrative review Konstantinidis (2024) identified four overarching factors: the instructor, course design, class climate, and available resources. In this review majority of the interventions belonged to the instructor, the course design or class climate with only a few studies addressing resource-related factors. There is a notable gap in understanding how structural approaches in the learning environment affect student wellbeing (Cooper et al., 2009). Furthermore, students mostly were favorable to the interventions to which they were exposed (Olsson et al., 2024), but evidence on the effectiveness of the interventions remains mixed (Konstantinidis, 2024; Olsson et al., 2024). Mostly, interventions improving competence/confidence and sense of belonging as well as supportive college climate are successful (Brooker and Vu, 2020; Fink, 2014), but there are no studies looking at the interplay between the physical environment as a resource and their effects on wellbeing, sense of belonging, connectedness, and supportive college climate. This study addresses this gap by exploring how ILS can improve social integration and wellbeing. In the next section the Social Integration Model by Tinto (1975) will be explained.

1.4 Social integration

Social integration, encompassing students' interactions with peers, faculty, and the broader university community, is a key determinant of student wellbeing and success in higher education. It fosters interpersonal connections, shared attitudes and values, and personal development of students (Berger and Milem, 1999). Tinto's (1975, 1993) Social Integration Model is foundational in this field, positing that students with higher levels of social and academic engagement reduce the risk of student dropout (Tinto, 1975). Tinto's (1993) model shifted attention from individual student characteristics to institutional factors, emphasizing the interactive relationship between students and their educational environments (Tinto, 1986, 1993).

While the model has evolved with later revisions (Tinto, 1993) and competing theories (Allen, 1999), academic and social integration remain central components. Empirical evidence consistently shows that the lack of academic and social integration leads to higher dropout rates of students (Bers and Smith, 1991; Klein, 2019; Tinto, 1975). Social integration not only mitigates dropout risks, but also enhances other positive outcomes such as student satisfaction and wellbeing. For example, Merola et al. (2019) demonstrated that students who feel socially integrated report greater overall satisfaction. Other research indicates that close social ties foster mental wellbeing. Zheng et al. (2004) revealed that international students reported higher subjective wellbeing when they felt socially integrated at their new university. Imaginário et al. (2013) likewise found out that all aspects of social integration in higher education, such as interpersonal relationships, emotional balance, and personal wellbeing, appear to have significant impact on students' subjective wellbeing.

In addition to physical characteristics, spaces that facilitate social connection and collaboration are essential elements of students' preferences for ILS (Berman, 2020; Webb et al., 2008). According to Neves and Hillman (2017), students expect effective learning spaces for social engagement and need more and better-quality ILS's that are accessible to all students. Research has shown that learning in collaborative settings, social connectedness and integration are crucial for student wellbeing (Chaudhry et al., 2024; Crawford et al., 2024; Pepper, 2024). ILS function as facilitators of social integration by providing areas where students can interact informally and build relationships, which promotes student wellbeing. For instance, McFarland et al. (2008) discovered that students who frequently use campus green spaces were more likely to experience social interactions with their peers and reported a high quality of life. The results of a qualitative study by Stanton et al. (2016) noted that spaces which encourage social engagement can reduce feelings of isolation and improve student wellbeing. A study by Pepper (2024) showed that students highlighted the importance of 'socially engaging environment' as the most crucial factor influencing their wellbeing, pointing out the crucial role of social interaction in maintaining mental health. As the research shows, the availability, accessibility, and quality of ILS that foster a sense of social connectedness and integration play a crucial role in student wellbeing in higher education. To summarize, social integration is proven to reduce dropout rates of students. Furthermore, social integration leads to other positive outcomes, especially fostering health, and wellbeing.

1.5 Facing personal challenges

Research indicates that disadvantaged students continue to face substantial challenges in accessing and succeeding in higher education, despite overall increase in enrolment rates (OECD, 2023; Palmisano et al., 2022). The European commission adopts a broader conceptualization of participants with fewer opportunities, describing them as individuals who, due to economic, social, cultural, geographical or health reasons—as well as those with migrant backgrounds, disabilities or other educational difficulties—face obstacles that prevent their full access to and participation in education (European Commission (EC), 2025). Students from lower socioeconomic backgrounds face structural, financial, and technological barriers which limit their access to and engagement in university life. Additional groups that experience difficulties in higher education include individuals with disabilities, students balancing work and study commitments, those with caregiving responsibilities, and individuals from migrant or transient backgrounds. These groups frequently experience reduced social integration, limited engagement in extracurricular activities, and increased time devoted to academic pursuits (Fernández-Batanero et al., 2022; Sachs and Schreuer, 2011). Such barriers not only limit educational participation but also exacerbate feelings of isolation, creating a compounding effect on wellbeing and academic success. To address these disparities higher education institutions must implement inclusive policies and strategies that promote equitable access and success for all students.

In line with the European Commission's broad definition, our study adopts an inclusive view of "students facing personal challenges" (FPC) identifying them as those facing at least one of the challenges. This framing allows us to better understand and address the multifaceted barriers these students encounter, particularly in relation to their access to ILS and the implications for their social integration and wellbeing.

1.6 Current study

Students' wellbeing is recognized as a critical outcome in higher education, influenced by a range of academic, social, and environmental factors. While the relation between wellbeing and social integration is well-established, the role of ILS in student wellbeing is underdeveloped. Building on the literature reviewed and gaps in the literature, we have theorized a model to explore how physical learning environments, particularly informal learning spaces (ILS), contribute to student wellbeing through social integration processes.

We adopt Tinto's (1975, 1993) Social Integration Model as a foundational framework. This model is well-established in higher education research and emphasizes that students who are more socially integrated into the academic community are less likely to dropout and more likely to succeed (Tinto, 1993). However, a key limitation of Tinto's framework is that it does not specify the mechanisms or environmental factors that can actively enhance social integration. In this context, we theorize that the availability and accessibility of ILS function as environmental factors facilitating social interaction and thus increasing social integration. This aligns with broader research indicating that supportive environments contribute to positive students' outcomes, including wellbeing and commitment (Beckers et al., 2016; Costa and Steffgen, 2020; Wang and Han, 2021).

By combining these theoretical streams, we hypothesize a mediated relationship, where social integration mediates the link between availability and accessibility of ILS and student wellbeing. This conceptual model is illustrated in Figure 1.

In addition, we extend the model by considering students facing personal challenges (FPC). This status was identified as facing challenges due to socio-economic, health related, or cultural barriers (European Commission (EC), 2025). We hypothesize that for students FPC, ILS can play an even more critical role in fostering social integration, as these spaces can provide essential opportunities for interaction and inclusion that might otherwise be limited. Therefore, we propose a moderation hypothesis, predicting that the relationship between availability and accessibility of ILS and social integration is influenced by students FPC status. This hypothesis is depicted in Figure 2.

Based on these models, following research questions and hypotheses guide the study:

1.6.1 Research question 1: mediation

Does social integration mediate the relationship between the availability and accessibility of ILS and students' wellbeing?

Hypothesis:

H1a (Direct Effect): The availability and accessibility of ILS are positively associated with students' social integration.

H1b (Direct Effect): Social integration is positively associated with students' wellbeing.

H1c (Indirect Effect): Social integration mediates the relationship between the availability and accessibility of ILS and students' wellbeing.

FIGURE 1
Conceptual model of mediation hypothesis.

FIGURE 2
Conceptual model of moderation hypothesis.

1.6.2 Research question 2: moderation

Does the relationship between the availability and accessibility of ILS and social integration differ according to FPC status?
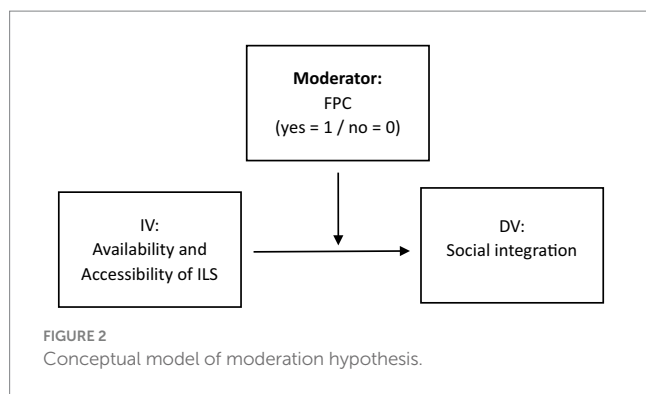
H2a (Main Effect): The availability and accessibility of ILS are positively associated with students' social integration.

H2b (Moderation Effect): The positive relationship between the availability and accessibility of ILS and social integration is stronger for students FPC compared to students without such personal challenges.

2 Method

This study employed a quantitative, cross-sectional survey design to investigate the relationships between the availability and accessibility of informal learning spaces (ILS), social integration, facing personal challenges (FPC) and students' wellbeing. The study aimed to test both mediation and moderation effects and was conducted within the framework of a European project with four partners from Austria, Germany, Italy, and Türkiye. A cross-sectional survey was selected as data collection method, as it is appropriate for understanding and assessing associations among variables at a single point in time and for testing hypothesized pathways (Creswell and Creswell, 2017).

2.1 Data collection and procedure

Data was collected through an online survey administered between May and July 2022. The survey was originally developed in English and translated in the language of the participating countries. Translation was done by the project team and then checked by the experts in the area for the accuracy. Data from four universities was included in the analyses. Participants were recruited through a combination of digital (e. g. circular e-mails, university newsletters, QR codes) and printed (e. g. poster, flyers, handouts) outreach strategies. In some cases, instructors involved in the project, distributed the survey during classes and encouraged students to share the link with peers.

Ethical approval for this study was obtained from Akdeniz University (Approval No: 174, date: 20.04.2022). The survey questions did not include any personally identifiable information. Prior to

participation to survey, participants were presented a consent form on the first page of the survey which outlined the voluntary nature of their participation, and the right to withdraw any time without consequences, and the confidentiality of their responses. Given the sensitive nature of questions particular care was taken to ensure anonymity. No IP addresses were collected through the online forms. The data was stored on the researchers' password-protected computers.

2.2 Sample

According to Fritz and MacKinnon (2007) a minimum sample size of $n = 558$ is required to detect mediation effects when assuming small-to-moderate effects. For moderation effects, which generally require larger sample sized due to range restrictions, Judd et al. (2014) emphasize the importance of including reliable variables to increase statistical power. Our sample meets these requirements.

A total of $N = 932$ students from four partner universities took part in the online survey: University for Continuing Education Krems in Austria (UWK), HTW Berlin University of Applied Sciences in Germany (HTW), Sapienza University of Rome in Italy (SAP), and Akdeniz University in Türkiye (AKD). Bigger universities (AKD and HTW) contributed a slightly larger sample size than the other universities (SAP and UWK). Sample characteristics are depicted in Table 1.

The majority of respondents identified as female (56.3%), followed by male (40.2%), with a small proportion identifying as diverse (0.4%) or choosing not to disclose their gender (3%). Most participants were between 21 and 25 years old (52.8%), with 18.6% under 20 and 28.6% older than 25. Regarding degree, 58% were enrolled in bachelor's programs, 32.6% in master's programs, 6.9% in associate's degree programs, and 1.5% were pursuing doctoral studies.

2.3 Measures

To examine the hypothesized relationship in our model, we used self-developed instruments to assess the availability and accessibility of ILS, and validated instruments to assess social integration and student wellbeing. We also included a variable to capture FPC status All subscales and items are listed in Appendix.

2.3.1 Availability and accessibility of ILS

The term availability refers to the extent to which informal learning spaces (ILS) are present, diverse, and known to students as usable options. This includes the quantity and variety of available spaces—such as quiet zones, collaborative areas, and social settings—along with adequate furnishings like seating and workstations. Availability also depends on transparent communication tools, such as signage, booking systems, and real-time occupancy updates. High availability empowers students to choose environments that best align with their specific learning needs (Ellis and Goodyear, 2016; Morieson et al., 2018; Wu et al., 2021).

Accessibility refers to how easily students can physically and psychologically reach and use ILS without facing barriers. It encompasses physical aspects like ramps and adaptable furniture, as well as organizational features such as opening hours, access regulations, and the provision of specialized equipment or

TABLE 1 Descriptive sample characteristics (*N* = 932).

Variable	Response categories	*f*	%
University	Akdeniz University, Türkiye	334	35.7
	HTW Berlin, Germany	327	35.1
	La Sapienza University of Rome, Italy	156	16.7
	University of Continuing Education Krems, Austria	115	12.3
Gender	Female	525	56.3
	Male	375	40.2
	Diverse	4	0.4
	Prefer not to say and no indication made	28	3.0
Age	Up to 20 years	173	18.6
	21–25 years	492	52.8
	26–30 years	135	14.5
	31–35 years	44	4.7
	36–40 years	34	3.6
	41–45 years	24	2.6
	46–50 years	18	1.9
	51–55 years	7	0.8
	56–60 years	5	0.5
	More than 61 years	0	0.0
Study degree	Associate's degree	64	6.9
	Bachelor	541	58.0
	Masters	304	32.6
	PhD	14	1.5
	No indication made	9	1.0
FPC	Students FPC	656	70
	Students not FPC	276	30

technologies. These features aim to ensure that students can find comfortable, functional spaces to study or collaborate (Devlin et al., 2012; Halupka and Li, 2023; Vidalakis et al., 2013). Equally critical is the perceived inclusivity of these spaces—whether they are experienced as safe, welcoming, and socially supportive by a diverse student population (Kassab et al., 2024; Morieson et al., 2018; THRIVE Project, 2025).

Since no standard instrument exists measuring ILS availability and accessibility, self-developed items were used. Separate scales were developed for focused (individual) and collaborative learning activities for Availability and Accessibility of ILS. Sample items are:

- *Availability (Focused)*: "If I want to study on my own, I know where I can go in my university."

- *Availability (Collaborative)*: "If I want to study together with my fellow students, I know where I can go in my university."
- *Accessibility (Focused)*: "Places for focused learning activities are open to all students at my university."
- *Accessibility (Collaborative)*: "Places for studying in groups are open to all students at my university."

Items were rated on a 5-point Likert scale (ranging from 1 = totally disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = totally agree). Full item list is presented in Appendix.

Reliability analyses indicated that all four scales demonstrated good internal consistency, with all Cronbach's Alpha coefficients $\geq$0.81. Descriptive statistics showed that students perceive similar levels of availability and accessibility for focused vs. collaborative learning activities with scale means ranging from $M_{CLAvail}$ = 3.33 an $M_{FLAccess}$ = 3.46. The assumption of normality was supported by visual inspection and sample size. High Pearson correlation coefficients were observed among the four scales (ranging from $r = 0.59$ to $r = 0.80$), indicating that students did not as strongly differentiate between types of ILS for different learning activities as we assumed. Further analyses on the impact of ILS for focused and collaborative learning activities show only small effects (see Geister et al., 2024). These suggest that students may visit the campus for a blend of focused and collaborative learning activities rather than a specific type of activity, which is in line with the concept of "sticky campus" (Berman et al., 2024) and flexible design and use of ILS supporting diverse learning needs (Guney and Al, 2012; Wang and Han, 2021).

Since we conceptualize availability and accessibility as overarching variable and to prevent multicollinearity, we merged all four scales. The resulting scale "Availability and Accessibility of ILS" consisted of 14 items with high reliability ($\alpha = 0.94$). An exploratory factor analysis supports a one-factor solution. All factor loadings on factor 1 are at least 0.68. Therefore, we proceeded with the summarized scale. The mean of this scale is M_{AvAcc} = 3.37, standard deviation is SD_{AvAcc} = 0.84.

2.3.2 Social integration

To measure social integration, we used the subscale peer-group interaction of the Institutional Integration Scale (IIS; Pascarella and Terenzini, 1980). The IIS, based on Tinto's (1975) theoretical framework, was developed to assess student self-reported levels of social and academic integration. French and Oakes (2004) showed evidence for high reliability for the peer-group interaction scale ($\alpha = 0.84$) and proved construct validity for differentiating between student and faculty integration as separate factors. Klein (2019) showed satisfying reliability ($\alpha = 0.72$), construct validity by factor analyses for subscales of social integration with peers and faculty and predictive validity for student dropout by the subscales. Paine (2008) used the IIS, again showing high reliability for the subscale peer-group interaction ($\alpha = 0.81$). In this study social integration with peers was measured using six items adapted from Paine's (2008) subscale peer group interaction (e.g., "My interpersonal relationships with students have positively influenced my intellectual growth.," "I have developed close personal relationships with other students").

All items were rated on a 5-point Likert scale (1 = totally disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = totally agree). In our study the six items show a satisfying reliability ($\alpha = 0.89$). The mean of social integration is M_{SI} = 3.57, standard

deviation is $SD_{SI} = 0.87$. Items for the Social Integration Scale, specifically for Peer Group Interactions, are listed in Appendix.

2.3.3 Wellbeing

The WHO 5-item index was used to assess students' subjective wellbeing. Participants rated how frequently they had experienced five wellbeing indicators over the past 2 weeks. Responses ranged from 0 (At no time) to 5 (All of the time) with a total score ranging from 0 (no wellbeing) to 100 (highest level of wellbeing) after multiplying the raw score by 4. It encompasses five items, which are related to the two facets of wellbeing (e.g., "I have felt active and vigorous.," "My daily life has been filled with things that interest me").

The WHO-5-item index is very well developed and shows excellent quality criteria. Interpretation objectivity is high: scores can be interpreted as follows: scores >50 no depression, scores between 30 and 50 slight depression and scores <30 medium depression (Blom et al., 2012). In a study with a German sample ($n = 2.456$) Brähler et al. (2007) showed high internal consistency ($\alpha = 0.92$), high split-half-reliability ($r_{tt} = 0.87$), and convergent validity by correlating the WHO-5 with EUROHIS-QOL ($r = 0.60$). Several studies support the validity of the WHO-5-item index as a sensitive and specific screening instrument for depression and a valid predictor for burnout (Blom et al., 2012; Krieger et al., 2014; Topp et al., 2015). Items for the Wellbeing scale are listed in Appendix. In our study the five items show a satisfying reliability ($\alpha = 0.89$). The mean of wellbeing is $M_{WB} = 50.75$, standard deviation is $SD_{WB} = 22.77$.

2.3.4 Facing personal challenges (FPC)

To measure different challenges students might have to deal with, participants were asked "Are there any personal challenges you are facing as a student?" Eleven categories were created based on European Commission (EC) (2025) framework of participants with fewer opportunities due to economic, social, cultural, geographical or health reasons. Our items included physical impairment, chronic illness, mental illness, learning difficulties, cultural and financial barriers, family responsibilities and an "other" option including a free text box was given. Multiple selections were allowed. Respondents were coded as FPC if they selected at least one of the 11 categories.

3 Results

This section presents the results of our study in three parts. First, we report the descriptive analyses of the key constructs, including students' perceptions of the availability and accessibility of informal learning spaces (ILS), perceived social integration and wellbeing and their self-reported personal challenges. Second, we address the first research question which examines whether social integration mediates the relationship the availability and accessibility of ILS and student wellbeing. Third, we explore the second research question, testing whether the strength of the relationship between ILS and social integration is moderated by facing personal challenges (FPC). The findings are based on mediation and moderation models using the PROCESS procedure (Preacher and Hayes, 2004). Together, these results provide insights into the role of informal learning environments in promoting student wellbeing and integration, with particular attention to students facing personal challenges.

3.1 Descriptive analyses

3.1.1 Facing personal challenges (FPC)

Figure 3 shows the distribution of self-reported challenges ($n = 932$). The most frequently cited challenges were the "need to work for living while studying" (34%) and "financial obstacles" (28%). Notably, 20% reported suffering from "mental diseases." Every other challenge is experienced between 3 and 11% of the participants. In the "other" option
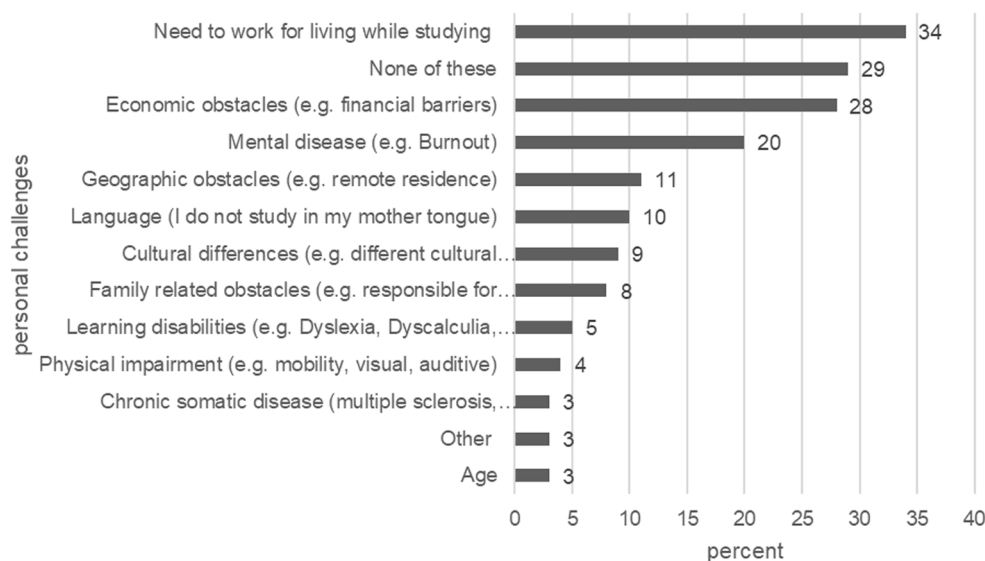
FIGURE 3
Personal challenges of students. Personal challenges to define students facing personal challenges ($n = 932$). Item: "Are there any personal challenges you are facing as a student?" Different answers were listed and could be tagged, multiple selection of challenges was possible.

25 students (3%) mentioned specific problems (e. g. anxiety, mobbing, or pressure to find a flat). Students reporting at least one of the 11 challenges were classified as FPC. This resulted in 70% of the sample being students FPC ($n = 656$) and 30% being students who are not FPC ($n = 276$).

3.1.2 Availability and accessibility of ILS, social integration and wellbeing

Means and standard deviations of key variables are shown in Table 2. The assumption of normality was supported by visual inspection and sample size. Pearson correlations revealed significant associations among the variables with small and medium effect sizes (see Table 2).

Table 3 presents the means and standard deviations of key variables grouped by FPC status. Descriptive analyses revealed differences across all key variables between student FPC and those who do not FPC. Students who do not FPC report slightly higher mean scores for availability and accessibility of ILS ($M = 3.47$, $SD = 0.87$) compared to the FPC group ($M = 3.32$, $SD = 0.82$). Similarly, students FPC report lower levels of social integration ($M = 3.49$, $SD = 0.89$) in comparison to students who do not FPC ($M = 3.78$, $SD = 0.79$). A notable difference was also observed in wellbeing scores. Students FPC reported lower levels of wellbeing ($M = 48.71$, $SD = 22.91$), while students who do not reported higher levels of wellbeing ($M = 55.66$, $SD = 21.69$).

3.2 Hypotheses testing

3.2.1 Research question 1: mediation

The first research question aimed to investigate the influence of availability and accessibility of ILS on social integration and wellbeing. It was hypothesized that social integration mediates the relationship between availability and accessibility of ILS and wellbeing (see Figure 1). To test for the mediating effect of social integration we used the Process Procedure proposed by Preacher and Hayes (2004). By bootstrapping, weaknesses of the mediation analysis described by Baron and Kenny (1986) are overcome. The results of the mediation model are presented in Table 4. The indirect effects of social integration (MV) calculated by bootstrapping are shown in Table 5.

The findings indicate that all direct effects in the model are significant (see Table 4). Hypothesis 1a is supported: the availability and accessibility of ILS (IV) is significantly associated with social integration (MV) ($\beta = 0.24$; $p < 0.001$, $R^2_{corr.} = 0.06$). Hypothesis 1b is also confirmed: Social integration (MV) is significantly related

TABLE 2 Descriptive analyses and correlations between key constructs.

Variable	Number of items	Mean	SD	1	2	3
Availability and accessibility of ILS	14	3.37	0.84	(0.94)		
Social integration	6	3.57	0.87	0.24**	(0.89)	
Wellbeing	5	50.75	22.77	0.25**	0.38**	(0.89)

Reliability of scale (Cronbach's Alpha) is written in brackets, *$p < 0.05$, **$p < 0.01$ (two-tailed).

TABLE 3 Means and standard deviations of key variables grouped by FPC status.

Variable	FPC		No FPC	
	Mean	SD	Mean	SD
Availability and accessibility of ILS	3.32	0.82	3.47	0.87
Social integration	3.49	0.89	3.78	0.79
Wellbeing	48.71	22.91	55.66	21.69

to student wellbeing (DV) with ($\beta = 0.35$; $p < 0.001$; $R^2_{corr.} = 0.18$). Furthermore, the direct effect of availability and accessibility of ILS (IV) on wellbeing (DV) is also significant ($\beta = 0.25$; $p < 0.001$, $R^2_{corr.} = 0.06$). Next, the indirect effects of the social integration as MV are analyzed. By this we test hypothesis 1c, which assumed that social integration mediates the relationship between the availability and accessibility of ILS and students' wellbeing. The bootstrapping procedure as proposed by Hayes (2022) was used (see Table 5).

There is a significant indirect effect of availability and accessibility (IV) on wellbeing (DV) mediated by social integration (MV) ($b = 2.31$, percentile bootstrap 95% CI [1.54, 3.17]). The completely standardized indirect effect of social integration (MV) was $\beta = 0.09$, Percentile Bootstrap CI [0.06, 0.12]. The CI does not include zero. Therefore, the data support the hypothesized mediation process (Hypothesis 1c).

3.2.2 Research question 2: moderation

The second research question investigated whether the availability and accessibility of ILS is more critical for students FPC compared to those who do not face personal challenges (no FPC). It was hypothesized that students experiencing personal challenges may rely more heavily on ILS to achieve social integration with their peers. To test this assumption, we established a conceptual model as seen in Figure 2 and a moderation hypothesis testing whether FPC status moderates the relationship between ILS availability/accessibility and social integration. To test the moderation hypothesis the Process Procedure for SPSS by Hayes (2022) was used with mean centered variables for all variables that define products. Results of this analysis are depicted in Table 6.

The results indicate an ordinal interaction, allowing for interpretation of both main effects and the interaction effect within the model. The first main effect shows higher availability and accessibility of ILS is significantly associated with increased social integration, whereas lower availability and accessibility corresponds with reduced social integration. The second main effect pertains to FPC status: students not facing personal challenges report higher levels of social integration compared to those who do.

Additionally, there is a small interaction effect between the availability and accessibility of ILS and FPC status: students who both face personal challenges and report low availability/accessibility of ILS exhibit the lowest levels of social integration. In other words, these two risk factors appear to have a compounding negative impact. Notably, when ILS availability and accessibility is high, the difference in social integration between FPC and non-FPC students is minimal. However, under conditions of low ILS availability/accessibility, the gap between the two groups becomes substantially wider (see Figure 4).

These findings suggest that the availability and accessibility of ILS is particularly vital for students facing personal challenges, to

TABLE 4 Mediation analysis: direct effects in the model.

Effect	Estimate (B)	SE	Standardized Estimate (Beta)	95% CI		t	p
				LL	UL		
Direct effect of availability and accessibility of ILS (IV) on social integration (MV)[1]							
Constant	2.73	0.12		2.50	2.96	23.50	<0.001
Availability and accessibility of ILS	0.25	0.03	0.24	0.19	0.32	7.53	<0.001
Direct effect of availability and accessibility of ILS (IV) on wellbeing (DV)[2]							
Constant	27.76	3.02		21.84	33.68	9.20	<0.001
Availability and accessibility of ILS	6.81	0.87	0.25	5.11	8.52	7.83	<0.001
Effects of availability and accessibility of ILS (IV) and social integration (MV) on wellbeing (DV)[3]							
Constant	3.54	3.60		−3.52	10.60	0.98	0.33
Availability and accessibility of ILS	4.31	0.84	0.16	2.65	5.96	5.12	<0.001
Social integration	9.18	0.81	0.35	7.59	10.78	11.31	<0.001

N = 904, SE = Standard Error, CI = confidence interval, LL = lower limit, UL = upper limit.
[1]Model Summary: $F_{(1, 902)}$ = 56.63, $p < 0.001$, $R^2_{adj.}$ = 0.06.
[2]Model Summary: $F_{(1, 913)}$ = 61.34, $p < 0.001$, $R^2_{adj.}$ = 0.06.
[3]Model Summary: $F_{(2, 901)}$ = 96.83, $p < 0.001$, $R^2_{adj.}$ = 0.18.

TABLE 5 Mediation analysis: indirect effect of social integration (MV) analyzed with bootstrapping.

Indirect effect	Effect	BootSE	Boot 95% CI	
			LL	UL
Indirect effect of social integration (MV)	2.31	0.42	1.54	3.17
Completely standardized indirect effect of social integration (MV)	0.09	0.01	0.06	0.12

Number of bootstrap samples for percentile bootstrap confidence intervals: 5,000, process procedure by Hayes (2022) version 4.2.

TABLE 6 Moderation analysis: direct effect of availability and accessibility of ILS (IV) on social integration (DV).

Effect	Estimate (B)	SE	95% CI		t	p
			LL	UL		
Constant	3.58	0.03	3.53	3.64	128.56	0.001
Availability and accessibility of ILS	0.24	0.03	0.18	0.31	7.35	0.001
FPC[a]	−0.25	0.06	−0.37	−0.13	−4.15	0.001
Interaction term (AvAcc * FPC)	0.12	0.07	−0.02	0.26	1.70	0.0894

N = 906, SE = Standard Error, CI = confidence interval, LL = lower limit, UL = upper limit,
Model Summary: $F_{(3; 902)}$ = 25.77, $p < 0.001$, $R^2_{corr.}$ = 0.08.
[a]FPC is coded 0 = no challenges (no FPC), 1 = facing at least one challenge (FPC).
Mean centered: all variables that define products (FPC, availability and accessibility of ILS).

promote social integration. In contrast, students without such challenges appear to be less affected by variations in ILS accessibility.

4 Discussion

This study contributes to the growing body of research on how informal learning spaces (ILS) influence student wellbeing in higher education. It offers an understanding of how the availability and accessibility of ILS are associated with social integration and wellbeing, especially for students facing personal challenges (FPC). Drawing on Tinto's (1975) model of social integration, our findings extend its theoretical scope by empirically demonstrating the mediating role of social integration between physical learning spaces and psychosocial outcomes.

4.1 Informal learning spaces and student wellbeing

Our findings are consistent with the hypothesized mediation mechanism: the positive effect of availability and accessibility of ILS on student wellbeing is mediated by social integration. ILS provide opportunities for peer interaction, exchange, and a sense of belonging which are crucial factors for fostering social integration. This in turn positively influences students' wellbeing.

The results corroborate with and extend the Social Integration Model proposed by Tinto (1975, 1993), which focuses on academic and social integration in relation to dropout. By including physical and spatial elements such as availability and accessibility of ILS, we contribute to a novel perspective. Our findings suggest that physical and spatial elements, can play a crucial role in mediating social integration, especially for students FPC.
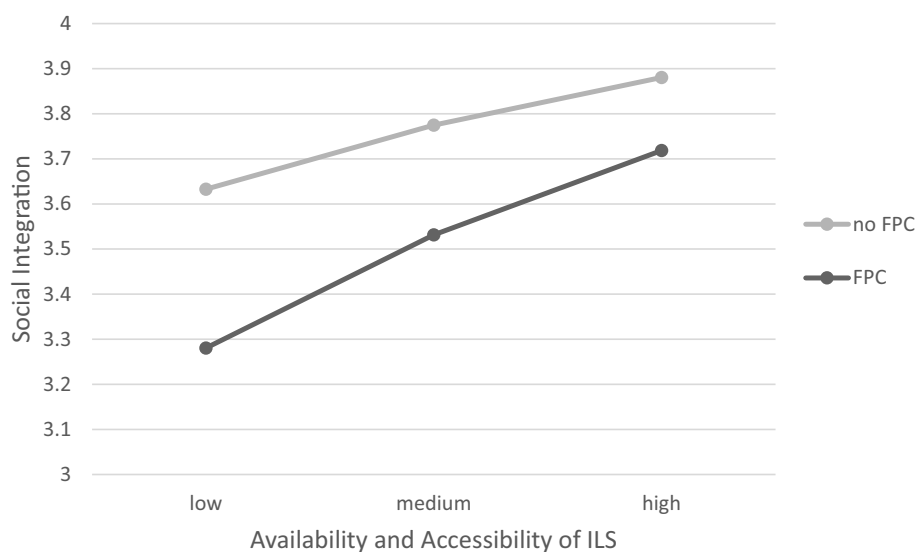
FIGURE 4
Simple slopes analysis to visualize the interaction effect. Simple slopes analysis to visualize the interaction effect. Values for Availability and Accessibility of ILS are mean-centered and categorized in three groups (low = −0.80, medium = 0.09, high = 0.76), Social Integration can range between 1 to 5, FPC as the moderator variable is discrete. β (FPC) = 0.28***, β (no FPC) = 0.16**.

Our results also contribute to the Person–Environment (P–E) Fit Theory (Gilbreath et al., 2011), which posits that wellbeing improves when individuals interact with environments that meet their needs. ILS support students' social needs by offering flexible, socially engaging environments (Pepper, 2024) that encourage peer interaction, reduce isolation, and foster informal social support. This psychosocial support helps to buffer stress and enhance mental health reinforcing the findings of earlier studies emphasizing the importance of social integration for student wellbeing (Imaginário et al., 2013; Zheng et al., 2004). Thus, our findings highlight recent calls for more inclusive, student-centered campus environments (Stanton et al., 2016). In face of increasing numbers of students facing mental health problems (Brown, 2018; Khatri et al., 2024; Ribeiro et al., 2024), it is especially important to know how to improve wellbeing and which measures are effective in supporting mental health.

Furthermore, our study addresses a notable research gap identified in recent reviews by Olsson et al. (2024) and Konstantinidis (2024): the lack of interventions targeting physical learning environments. While most structural wellbeing interventions target curriculum, pedagogy or support services, our findings demonstrate that well-designed and accessible ILS serve as crucial resources for fostering social integration and wellbeing. By showing how ILS (as physical resources) support social connectedness our study provides a tangible link between previously disconnected categories of structural interventions, positioning ILS as structural levers for promoting wellbeing and inclusion.

4.2 Vulnerable groups and role of inclusive ILS

The moderation analysis further reveals that the relationship between ILS and social integration is stronger for students facing personal challenges. These students, who experience structural,

health-related, or social disadvantages, report significantly lower levels of social integration when ILS are not available or accessible highlighting the disproportionate importance of such spaces for vulnerable groups.

The findings emphasize that environmental constraints can exacerbate personal challenges reinforcing social and psychological exclusion. This aligns well with theories of spatial justice (Soja, 2010) which highlight that campus environments can either reproduce or disrupt inequalities. Soja (2010) argues that the physical layout, accessibility, and inclusivity of spaces carry social meaning and affect students' opportunities for participation and belonging. Our findings confirm this theoretical perspective by showing that students with personal challenges are more sensitive to environmental barriers, thus benefit more from ILS. From the perspective of Sen's Capability Approach (Sen, 1993), ILS function as enabling resources that expand students' real opportunities to participate, connect, and flourish within the university environment. Our findings extend the concept of capabilities and suggest that accessible ILS enhance students' capabilities for social integration and wellbeing, particularly for students FPC, by creating equitable conditions for engagement and belonging.

Our results also support the P-E Fit Theory (Gilbreath et al., 2011) and the Social Fit Model (Walton and Cohen, 2007) suggesting that student wellbeing and belonging are contingent on how well environments accommodate individual needs and social identity. Students who perceive themselves as misaligned with dominant institutional norms or lacking the resources to access shared spaces may experience exclusion, which can negatively impact their academic and emotional wellbeing. Our study also corroborates with the results of Harrop and Turpin (2013) which emphasized the importance of creating learning environments that facilitate both academic participation and communication, recognizing the critical role of space in fostering a sense of belonging. Similarly, Beckers et al. (2016) demonstrated that students' preferences for learning spaces are

influenced by the potential for social integration, which subsequently affects their social integration.

Furthermore, our study highlighted that students with different challenges may use or have to use the facilities of the campus or university more. Evidence from Habashi et al. (2023) during COVID-19 pandemic illustrates how students from lower socioeconomic backgrounds, minorities, and first-generation college students depended more on campus facilities due to their inadequate home learning environments. This underscores the role of accessible ILS, especially for students with fewer technological and physical resources.

Additional studies highlight the structural barriers that underrepresented and disadvantaged students face in higher education. Trowler and Trowler (2010) emphasize that while engagement benefits all students, non-traditional and disadvantaged groups, such as those who are academically underprepared, from low-income backgrounds, racial and ethnic minorities, first-generation college students, LGBTQ+ individuals, students with disabilities, and international students, encounter significant barriers to meaningful engagement, often resulting in negative experiences as alienation, cultural dissonance, and isolation. However, when engagement is effectively nurtured, it can compensate, for these disadvantages and improve academic and personal outcomes.

Wong's (2024) framework of spatial belonging stresses the importance of inclusive educational environments that are accessible and welcoming, promoting a sense of belonging and connectedness among students, particularly for students from underrepresented groups. Fernandez et al. (2025) show that perceived social status, shaped by visible markers as clothing, accent, and activity participation, strongly influences students' sense of belonging. For those from lower-status backgrounds, ILS may either support or hinder this belonging depending on their inclusivity. This underscores the need for ILS to promote inclusive signals that affirm diverse student identities and alleviate feelings of uncertainty about belonging (Walton and Cohen, 2007). Meeuwisse et al. (2010) further reveal that while formal relationships foster belonging for ethnic minority students, informal peer connections more strongly enhance both belonging and academic performance for majority students.

Our study confirms and expands these findings by demonstrating that ILS play a significant role in fostering integration for students FPC. When access to ILS is limited, these students experience significantly lower levels of integration. On the other hand, when ILS are accessible, the integration gap between vulnerable and non-vulnerable students narrows. This interaction supports wellbeing as well as theories of spatial justice (Soja, 2010) and P-E Fit (Gilbreath et al., 2011) by showing that inclusive spatial design can mitigate structural disadvantages.

By linking physical environment, social integration and wellbeing, our study contributes new empirical evidence to the literature, underscoring the need for ILS to be intentionally designed as inclusive spaces that foster wellbeing, belonging and promote equity in higher education. It highlights how ILS act as equity mechanisms—buffering the disadvantages of limited home resources, digital inequality, or social exclusion.

4.3 Limitations

Despite the valuable insights offered by this study, several limitations should be acknowledged. First the cross-sectional design limits the ability to draw causal inferences. While the sample size is substantial and includes participants from four universities across four different countries, the findings may not be generalizable to other institutions or national contexts. Moreover, the study employed a voluntary participation, which precludes the use of random sampling and may include self-selection bias. In addition, the measurement of availability and accessibility of ILS was based on a self-developed instrument. Although the scale was carefully constructed and demonstrated strong internal consistency, it lacks prior validation in other research contexts. Future studies should seek to refine and validate this scale to enhance its robustness and comparability of findings. While mediation and moderation analysis were appropriate for exploring complex relationships among variables, the use of cross-sectional data limits the ability to confirm temporal or directional causality. Longitudinal or experimental designs are recommended to establish causal pathways and examine change over time. Finally, the study relied on self-reported data, which represents subjective perceptions of participating students and may be influenced by social desirability or recall bias. Future research could benefit from incorporating objective data (e.g., square meters of ILS per student) or observational data to measure availability and accessibility of ILS to triangulate findings.

4.4 Implications for practice and future research

The findings of this study highlight the importance of ILS as a structural resource for enhancing student wellbeing through social integration. Learning spaces can be seen as the "third teacher," environments that shape behavior, interaction, and learning outcomes. While ambience and comfort are important, our results emphasize the significance of organizational aspects such as availability, accessibility, and ease of use. ILS should be clearly marked, barrier-free, and accompanied by transparent guidelines for use to ensure all students can engage with them meaningfully. When students can easily locate and utilize these spaces, ILS are more likely to foster informal interactions, strengthen peer networks, and contribute positively to social integration and wellbeing. For universities, this underscores the need to intentionally design and manage ILS to serve not only academic functions but also social and emotional needs (Ninnemann et al., 2024). Three key areas of institutional focus, enhancing awareness, taking action, and strengthening communication, can contribute to this aim.

First, increasing awareness is essential to ensure students and staff understand the purpose and benefits of ILS. Institutions can integrate ILS into student orientation programs, promote them through visual and digital communication, and share success stories to illustrate their impact. Tools like the NIILS mapping platform can help make ILS more visible and accessible. Second, universities must take concrete action by forming task forces to guide ILS development, allocating funding for inclusive design, and supporting innovation through research and pilot projects. Engaging cross-functional teams, including students, staff, and designers, can help ensure ILS reflect diverse needs. Recognizing individuals and teams that contribute to ILS initiatives can further

embed these efforts institutionally. Finally, strengthening communication and networking is key to sustaining progress. Institutions should foster dialogue through online platforms, feedback channels, and regular events that bring together students, faculty, and external partners. Collaborating with alumni and industry stakeholders can expand support for ILS initiatives and ensure their long-term relevance. By aligning these strategies with broader goals of inclusion and wellbeing, universities can transform ILS into accessible, socially engaging environments that support academic and personal success for all students.

Future research could build on our findings by employing longitudinal, participatory and mixed-method designs to explore how students' sustained engagement with ILS influences their learning behavior and wellbeing over time. Comparative studies across different institutional and cultural contexts may further clarify how spatial and social factors interact with students' diverse needs. In addition, examining the role of digital and hybrid ILS would deepen our understanding how learning spaces can support inclusive and equitable learning outcomes especially for students who face challenges. Future research can also disaggregate the category of students FPC to identify how diverse groups (e.g., students with disabilities, first-generation students, migrants, older students) experience and utilize ILS.

5 Conclusion

Student wellbeing is declining globally, forcing higher education institutions to seek structural solutions that support mental health and academic success. Among these, informal learning spaces (ILS) represent a promising yet underexplored area. While recent reviews categorize structural interventions (see Konstantinidis, 2024; Olsson et al., 2024), the mechanisms by which physical environments influence wellbeing remain insufficiently understood.

This study integrates multiple streams of research (education, architecture, psychology, and business administration) to explain the link between physical spaces and health of students. It is demonstrated that availability and accessibility of ILS significantly enhance students' social integration, which in turn positively impacts their wellbeing. Our findings support Tinto's (1993) model of social integration and the person-environment fit theory (Gilbreath et al., 2011) as well as spatial justice (Soja, 2010), confirming that well-designed inclusive environments foster behaviors and relationships that fulfill students psychological and social needs and also creating a more just environment.

Crucially, our study shows that students facing personal challenges (FPC) benefit most from accessible ILS. These students, who often experience higher risks of exclusion, report markedly lower social integration when access to ILS is limited. When access improves, the integration gap between them and their peer narrows significantly. This highlights ILS as an effective equity-oriented strategy and aligns with calls for inclusion-focused campus interventions.

To translate these insights into practice, universities should invest not only in creating new ILS but also in upgrading existing ones. Equally important is ensuring transparency and awareness as students need to know where ILS are located and how they can

be used. When ILS are both accessible and socially engaging, they serve as structural levers that promote integration, reduce dropout risks, and foster academic and emotional resilience.

Data availability statement

The datasets generated and/or analysed during the current study are available from the corresponding author upon request.

Ethics statement

The studies involving humans were approved by Akdeniz University Research and Publication Ethics Committee Date: 20/04/2022 Number:174. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SG: Conceptualization, Investigation, Writing – review & editing, Formal analysis, Writing – original draft, Data curation, Methodology. FK: Methodology, Conceptualization, Writing – review & editing, Project administration, Investigation, Writing – original draft, Funding acquisition, Data curation. EÇ-Y: Writing – original draft, Formal analysis, Methodology, Writing – review & editing, Data curation, Investigation. SA: Writing – review & editing, Investigation, Data curation, Writing – original draft, Methodology.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2025.1637874/full#supplementary-material

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