ORIGINAL RESEARCH ARTICLES

Universal Design: an Embedded Case Study on the Approach towards the Inclusion of Students with Physical Disabilities in Higher Education in India

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ABSTRACT

Purpose: *Research on students with physical disabilities in higher educational institutions (HEIs) often focuses on students' abilities rather than on environmental barriers. Architectural barriers are notably the major roadblock for students with physical disabilities. This study explored the architectural barriers faced by students with physical disabilities in India, and the environmental requirements for social participation and inclusion.*

Method: *Using a qualitative approach, an instrumental embedded case study was employed to explore the need for Universal Design to promote the inclusion of students with physical disabilities in higher educational institutions. The study participants were 6 students with physical disabilities, between 22 and 30 years of age, and their teachers (n=5). Data was collected through semi-structured interviews and a participatory observational accessibility assessment. It was analysed using categorical aggregation followed by cross-case analysis through constant comparisons of similarities and differences of themes.*

Results: *Two-thirds of the participants reportedly experienced barriers to participation in the built and social environments. Most barriers originated from the institute's built environment design and from activities conducted on the premises. Students using wheelchairs or walking frames experienced significantly more participation barriers than those using crutches or sticks. The areas that need the most improvement are the indoor spaces (such as corridors and classrooms) and opportunities for vertical movement.*

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Conclusion: *Failure to make adequate modifications in the built environment for students with physical disabilities results in restricted participation or exclusion from opportunities to participate in and out of the classroom. The study findings can have implications across future research, architectural design practices, higher educational institutes, and policies to promote inclusion, optimal participation, and social interaction of students with physical disabilities within higher educational institutions.*

Key words: *architectural barriers, built environment, participation, universal design, physical impairment, accessibility, India*

INTRODUCTION

India has one of the world's largest higher education systems (Ramprasad & Subbaiyan, 2017), with over 30 million students (Federation of Indian Chambers of Commerce and Industry, 2012). Nevertheless, the scope needs to be raised to a higher level to meet the global demand. In the last decade, the Indian government has attempted to address barriers to higher education (Ministry of Human Resource and Development –MHRD, 2018) including making higher educational institutions accessible for students with disabilities. India has been a signatory member of the United Nations Convention on Rights of Persons with Disability since 2007 (Ministry of Social Justice and Empowerment, 2020) and is mandated to facilitate inclusive infrastructure at all levels of education (UNCRPD, 1995). Soon after the inception of the Rights of Persons with Disability (RPWD) Act (2016), the process was fast-tracked. Persons with disabilities have a right to accessible infrastructure and information (RPWD, 2016). The Indian government envisions accessibility as the key to inclusion and equal access for persons with disabilities, and considers a barrier-free environment the first step towards fulfilling their right to participate in all areas of community life (Accessible India Campaign, 2017).Although the Accessible India Campaign promotes accessibility for all, it is limited to the accessibility of public buildings, transport, and information (Accessible India Campaign, 2017), overlooking higher educational institutions (higher education colleges and universities). Consequently the infrastructure of these institutions often remains the same - with inaccessible built environments for students with physical disabilities (Ali, 2020).

Disability is a socially constructed phenomenon based on prevailing misconceptions and stigma (Shakespeare, 2006). Social norms are often constructed by able-bodied, higher-class people who overlook the need of

persons with disabilities and can create a barrier (Garbutt & Saltiel, 2020). Such societal perspectives may reinforce higher education authorities' and institutions' attitudes towards providing limited services and infrastructural support for students with physical disabilities. Although Indian higher educational institutions have an affirmative policy of reservation for enrolment of students with physical disabilities, most built environments are not disability-friendly (Ali, 2020). So, while students with physical disabilities are enrolled in higher educational institutions, access and use of these institutions' built environment such as classrooms, library, hostel, and dining hall, are challenging. This inaccessibility could be the main reason behind the drop-out of students with physical disabilities before completing higher education (Lippman, 2015). Thus, there is an urgent need to make higher educational institutions accessible and inclusive. Although higher educational institutions in India are making architectural modifications (e.g., accessible ramps and washrooms), creating a conducive built environment that supports meaningful participation of students with physical disabilities seems a distant dream. There is still a massive gap in making the built environment accessible.

Higher Education and Infrastructural Barriers

Research on students with physical disabilities in higher educational institutions often focuses on students' abilities rather than the institution's infrastructural support (Jamieson, 2003). Each student should avail of these facilities equally and easily, irrespective of their abilities (RPWD, 2016).

In India, several advocacy groups are working to improve school education for students with physical disabilities. However, these efforts have not translated to effect change by removal of barriers to higher education for students with physical disabilities (Jameel, 2011). The barriers, notably, are inaccessible infrastructural facilities, limited accessible transportation facilities, negative attitudes towards persons with disabilities, and lack of required support services (RPWD, 2016).

Design professionals, such as architects, planners, and developers, can unintentionally create a disabling environment with infrastructural barriers because they lack awareness about students with physical disabilities' accessibility design needs (Imrie & Hall, 2003). Barriers in the built environment include inappropriate stair heights, slippery surfaces, sharp edges, and the absence of ramps, handrails, and textured/guiding surfaces of lifts. These barriers restrict the mobility of students with physical disabilities and affect their cognition and

social and emotional well-being. Ultimately, this negatively impacts students with physical disabilities' enrolment, performance, and timely completion of academic degrees in higher education, thus limiting their prospects for employment, social participation, and improved quality of life (Mutanga, 2018).

As per the RPWD (2016), government and local authorities shall endeavour that all their funded educational institutions provide inclusive education to students with physical disabilities, including:

- Admit them without discrimination and provide equal education and opportunities for sports and recreation activities;
- Make buildings, campus, and various facilities accessible, providing reasonable individual accommodations;
- Provide the necessary support, individualised or otherwise, in environments that maximise academic and social development consistent with the goal of full inclusion.

The statements above affirm that infrastructural accessibility and supports are critical to promoting students with physical disabilities' full inclusion in higher educational institutions. The academic and social development of students with physical disabilities must be maximised by the institutions providing physical environments that promote inclusion. This inclusion could be made possible by following the Universal Design principles that aim to optimise the use of the diversity of human needs and the plurality (age, gender, height, abilities)(Centre for Universal Design, 2020).

Theoretical Understanding of Universal Design

Universal Design (UD) and its principles address exclusion from infrastructure (Iwarsson & Stahl, 2003).Universal Design promotes diversity, maximises use, and enhances usability, space functionality, and physical environment (Centre for Universal Design, 1997). Globally, Universal Design has seven principles: UD1) Equitable use; UD2) Flexibility in use; UD3) Simple and intuitive; UD4) Perceptible information; UD5) Tolerance for error; UD6) Low physical effort; and, UD7) Size and space for approach and use (Centre for Universal Design, 1997). These principles mandate that infrastructures are usable by people of all ages and abilities, to the greatest extent possible, without needing adaptation or specialised design (Centre for Universal Design, 2020).

In India, Universal Design has five principles based on the design need and country context (see Table 1).

Table 1: Universal Design India Principles with description (Khare & Mullick, 2012)

S. No.	Principles	Description
1	Equitable	The design is fair and non-discriminating to diverse users in the Indian context.
2	Usable	The design is operable by all users in the Indian context.
3	Cultural	The design respects the cultural past, and the changing present assists all users in the Indian context.
4	Economic	The design respects affordability and cost considerations for diverse users in the Indian context.
5	Aesthetics	The design employs aesthetics to promote social integration among users in the Indian context.

Agarwal and Steele (2016) argue that a commitment to universal access is needed at every level of the project - planning, design, implementation, and operation - with the concepts institutionalised in the same way as health and safety. This theoretical understanding supported the findings and discussions to achieve the current study's objectives.

Objectives

- To explore the environmental requirements for participation of students with physical disabilities to promote inclusion.
- To explore the architectural barriers faced by students with physical disabilities in higher educational institutions.

METHOD

Study Setting

The research site was an architectural institute in Central India.

The site is divided into five zones- 1) Academic (lecture halls, library, and labs), 2) Administration (administrative offices), 3) Residential (hostels, residential accommodation for staff and faculty), 4) Recreational (outdoor and indoor play area, gymnasium), and, 5) Movement (horizontal and vertical).

Study Design

This qualitative study employed an instrumental embedded case study of an architectural institution, as the instrumental case allowed for exploring barriers associated with the institute's built environment (Stake, 1995). Moreover, the instrumental case provided insights into the students with physical disabilities' participation experience in the built environment (Stake, 2006). An interpretative paradigm was used, including participants in the co-creation of meaning associated with the data because it allowed for the capture of participants' perspectives on their participation experiences and focus on the meaning that illuminates the case (Stake, 2006).

Study Sample

A sample must be selected purposefully to ensure the richness of information collected from the case (Flyvbjerg, 2006). Using purposive sampling, participants (6 students with physical disabilities and 5 teachers) were recruited from different departments, based on pre-determined eligibility criteria, to explore their interaction with the institute's built environment (see Table 2).

Table 2: Eligibility Criteria

Inclusion criteria	Exclusion criteria
Students with physical disabilities	
Types of impairment: physical (congenital)	Acquired temporary impairment due to accidents or other
Age: 22-32 years	
Must be enrolled in the institution during data collection	
Teachers	
Must be teaching in any of the departments within the institute	Visiting faculty or guest faculty were excluded because of their limited interaction and teaching experience with students
Must have taught in the institute for more than five years	

Data Collection

Multiple measures were used to collect data as it is suitable for instrumental cases (Yin, 2018). Data was collected by the primary researcher using the following methods:

- Interviews - Face-to-face, audio-recorded semi-structured interviews with open-ended questions were conducted with the research participants.

Interviews were in English (participants' preferred language) and lasted for an hour. Interview questions mainly focused on experiences of students with physical disabilities in interacting with the built environment and spaces inside the campus. Tables 3 and 4 provide the full interview protocol.

Table 3: Interview Protocol 1

Interview Protocol: Students with Physical Disabilities
• Could you please tell me about yourself? • Could you tell me about your experience in accessing: i) Classrooms? ii) Library? iii) Hostel (Students' residence)? • What are the challenges you face in your daily movement within the campus? (Probe: please elaborate) • Is there any physical barrier that, according to you, mainly hampers your learning process in the institute? If yes, what is it? Kindly elaborate. • What may ease your accessibility in different important buildings on the campus? • What difference to your life will it make if the buildings are modified and accessible? • Have you spoken to the authorities in the institute about it? If yes, what was their response? If no, why? • What are your thoughts on the modifications done (ramps, handrail, textured guiding path, elevators, or lifts) helping you? If yes, how? If not, why? **Exams and Curriculum:** • What has been your experience inside the classroom? • How has been your experience with the course curriculum? • How has your experience been while appearing for the exams? Has there been any concern? If yes, please elaborate. **Social Life:** • What games do you play and how do you participate in the sports activities on campus? • What are your talents and hobbies? Do you showcase it and participate in cultural activities, and what challenges did you face? • How has your socialisation been with: a) Peers? b) Teachers? c) Staff? • What are the attitudes of teachers towards you? • What are the attitudes of peers towards you? • How do they solve your issues/problems? • What are the attitudes of academic staff towards you? • Your final thoughts or do you wish to share something else that we missed? Kindly share.

Table 4: Interview Protocol 2

Interview Protocol: Teachers
• Could you please tell me about yourself? • Are you aware of the students with physical disabilities in the institute? • How has your experience been so far in teaching students with physical disabilities? • Do you think students with physical disabilities face any challenges within the campus? Kindly elaborate. • How much did these challenges affect students with physical disabilities' learning? • What challenges do you face in teaching students with physical disabilities? (Probe: modification adopted or done by you, if any) • How do you make students with physical disabilities comfortable or accepted by the teachers? (Probe: so that their learning process is not affected). • Have you shifted any classes due to students with physical disabilities' accessibility issues? • Have you made any modifications to the students with physical disabilities' curriculum? Please specify. • Have you made any modifications and adaptations to the exam? • Do you follow UGC and MHRD rules for students with physical disabilities? • Your last thoughts or if you want to share something we missed while discussing.

Field notes **-** Field notes are an important data source to corroborate the research findings and improve the data's credibility (Phillippi & Lauderdale, 2018). The primary researcher made field notes after each interview, categorising them with respective interview transcripts and then referring to them while coding, analysing, and interpreting data.

- Participatory observational accessibility assessment - A participatory accessibility assessment of the buildings was conducted using 'Harmonised Guidelines and Space Standards for Barrier-Free Built Environments for Persons with Disabilities and Elderly Persons' (Ministry of Urban Development –MoUD, 2016)

Along with the students with physical disabilities, the primary researcher conducted accessibility assessments of buildings frequently visited by students with physical disabilities. The students participated actively in the process and used their walking aids during a month-long evaluation to highlight the barriers they faced while navigating university spaces. They shared their personal stories, and observational assessment notes were taken on-site by the researcher.

Data Analysis

Data was analysed by substantiating the findings from multiple sources and theoretical frameworks using the following three steps:

Data management - Interviews were transcribed verbatim using Microsoft Word and managed in Atlas-Ti. Field notes from each interview were also embedded as comments throughout the transcripts during further analysis and triangulation (Larsen, 2018).

Primary categorical aggregation of data by participants - Participants were involved in primary categorical data aggregation (similarities and differences of categories) from the interview transcripts suitable for instrumental cases as it allows for exploring meaning closely (Stake, 2006). The observational accessibility assessment allowed the primary researcher and participants to co-create meanings related to architectural barriers.

Categorical aggregation of data by the researcher - After primary categorical aggregation, the researcher looked for the similarity and differences of categories across and within cases, reflecting on the main categories from each case to explore how different architectural barriers and ease of movement vary across the cases (Lauckner et al, 2012). Furthermore, discussions with team members helped to group all the categories pertinent to the research questions.

Cross-case analysis through constant comparisons allowed the researchers to draw meaning from interpreting the data (Stake, 1995, 2006). Furthermore, each case's key issues were identified (through the UD and UDIP – Universal Design India Principles) and re-examined to extract common problems that may be addressed differently across the embedded cases (Lauckner et al,2012). Data triangulation was conducted from interviews, field notes, and accessibility assessment notes to reduce the likelihood of misinterpretation and improve credibility (Stake, 2006; Yin, 2018). To achieve confirmability and dependability, an audit trail was maintained and member checks conducted with the participants (Lauckner et al, 2012).

Ethical Considerations

Ethical approval was obtained from the Social Work Research Ethics Board, Tata Institute of Social Sciences, Mumbai, and from the institute participating in the research. Written informed consent was obtained from participants.

RESULTS

Characteristics of the Participants

This study had 11 participants (6 students with physical disabilities and 5 teachers). The median age for students with physical disabilities and teachers was 28.5 and 46 years respectively. Sixty percent of the teachers were female, but there were no female students with disabilities. Table 5 describes the participants' characteristics.

Table 5: Characteristics of the Participants

Characteristics	**Value**
Number of participants, n	11
Students with physical disabilities (n)	6
Teachers (n)	5
Median age in years (range)	31 (24-54)
Students with physical disabilities (n)	28.5 (24-31)
Teachers (n)	46 (37-54)
Gender, female n (%)	
Students with physical disabilities (n)	0%
Teachers (n)	60%
Type of impairment	**Physical**
Type of assistive device user (n)	5
Wheelchair (n)	1
Walking frame (n)	2
Walking stick (n)	1
Crutches (n)	1
*One of the students with a physical disability was not using any assistive device	

Analysed data produced four key categories of architectural barriers that limited ease of movement and participation for students with physical disabilities, and provided insights about the environmental requirements to promote their participation. They were:

1) Seasonal barriers in infrastructure,

2) Limited vertical movement inside the building,

3) The designed built environment as a barrier, and,

4) Absence of inclusive space for participation and recreation.

Seasonal Barriers in Infrastructure

The research participants reported specific seasonal barriers that limit their participation in academic and recreational activities. Eight out of eleven participants mentioned that there is rainwater on the floor during monsoon, making the surface dangerously slippery and accident-prone, and making the space unusable by students with physical disabilities and others.

> *"The flooring surface is slippery, and during monsoon, the corridor has water, and it is difficult to walk over it. Often, even people without disabilities have fallen and got hurt"* (Student using a walking frame).

UD5 emphasises creating a safe and secure built environment for users (Ormerod & Newton, 2005). Additionally, the research participants reported falling in the corridor because of errors in the flooring design, such as a slight difference in flooring level, with the same colour material making the difference unnoticeable and therefore an accident hazard.To deal with this, Ormerod and Newton (2005) emphasised incorporating safety aspects into design as it provides a cue for inclusive design dimensions, alerting the designer to incorporate warnings for potential hazards.

Additionally, the choice of flooring material is not anti-skid, creating a safety hazard every morning after cleaning. Others without disabilities have reportedly also slipped on the floor. Although the authorities are aware, it is costly to change the entire flooring. The current study found that integrating accessibility provisions from the outset increases the total cost by 0.93%. This finding resonates with the United Nations (2019) suggestion that incorporating full-access features from the beginning is estimated to increase the total construction cost by 1%, while design adaptation after project completion can increase it by 5% or more.

Another barrier is the ramp in front of the library which has a ratio of 1:9 (accessible ramp slope should be 1:12) (MoUD, 2016), making it an accident zone. Participants have reported incidents of falling while using it.

"Even the ramp nearby the library has a steep slope, and I fear using it very often. I do not go to the library" (Student using a walking frame).

In this case, the built environment's effect on user operation was not considered

(Lundstrom et al,2016). Similarly, according to Imrie and Hall (2003), due to the design professionals' insensitivity to disability and disability-related needs, they may create an environment that limits participation of students with physical disabilities.

Limited Vertical Movement inside the Building

Vertical movement is limited as the building has no provision for a lift or ramp. The building has two floors, and building legislation does not permit installing a lift in buildings with fewer than four floors. However, this should not be an excuse to keep buildings inaccessible; a ramp could connect the lower and upper levels. Design professionals' lack of awareness about disability and disability-related needs is a significant reason behind this.

> *"The authorities made the buildings considering the immediate user's need, except us; they missed the opportunity of creating an inclusive and encouraging learning environment. Constructing a ramp costs almost equal to constructing a staircase, and the ramp is not only used by us but all"* (Student using a walking frame).

Due to this limitation in vertical movement, students with physical disabilities miss opportunities for equal participation and learning. The limited vertical movement contradicts the Equality and Usable principle of UD and UDIP, increasing dependency on others and leading to self-isolation by students with physical disabilities, as well as lowering self-esteem.

> *"The printing shop is on the first floor and not accessible to us. We need bulk printing of design sheets and reports. Even though my assignments are ready, I depend on my friends for printing and submission. Mostly, I delay my submission waiting for my friend to complete his assignments and get print"* (Student using a wheelchair).

Apart from forced dependency, these architectural barriers create a compromised learning environment for students with physical disabilities, denying their equal participation in the institute.

The Designed Built Environment is a Barrier

Apart from their design studios, the areas most used by the students were the library, Graphics lab, and Geographic Information System (GIS) labs. However, the research participants highlighted the space limitations inside these designed spaces. The design and layout of the furniture inside these areas do not cater to all users. They are inaccessible to those using a wheelchair, walking frame, crutches, or even walking sticks, forcing the students with physical disabilities to remain in their respective hostel rooms and study. This situation contradicts the

principles of equitable use (UD1), flexibility in use (UD2), and size and space for approach and use (UD7) (Centre for Universal Design, 1997).

In higher educational institutions, students spend significant time in formal learning environments such as classrooms and laboratories (Ramprasad & Subbaiyan, 2017).There are crucial software classes inside Graphics or GIS labs, and students with physical disabilities are often forced to sit in front, with no space to use the computers inside the studio.

> *"Initially, I thought they were making sitting arrangements for me inside the labs, but it continued. I have reported it several times to the authorities, but no development has occurred. I prefer learning software online. I feel excluded sitting in front of a chair as the space is not enough to move with ease. I believe they have designed these spaces as a barrier"* (Student using crutches).

Studies have established the relationship between indoor classroom environments and student outcomes (Puteh et al, 2012). In the case of furniture arrangement inside the Graphics or GIS labs, participants indicated that the layout does not allow the same means of use for all users, impacting students with physical disabilities' academic performance. Choi et al (2014) highlight the crucial role of classroom furniture in meeting students' various pedagogical requirements and learning styles. Other studies also highlight the influence of comfortable classroom conditions on students' academic achievement or learning performance (Waldrip & Fisher, 2003). Hutchinson (2003) also highlights that seating arrangement and postural comfort impact the learning processes because they have a bearing on concentration and motivation. In the current study, students using a wheelchair or walker could not use the labs like their peers. It is interesting to note how participants experience and explain the built environment as a designed architectural barrier. Students with physical disabilities feel excluded, and they see the facilities provided to them as ambiguous. Education is non-negotiable, and the institute should provide access to education on an equal basis to all (UNCRPD, 1995).

Absence of Inclusive Space for Participation and Recreation

The campus lacks spaces that encourage social interaction and recreation among the students. Although there are certain areas like canteens, corridors, and common rooms (for reading and working together in small groups) inside hostels, these spaces are sporadically planned, and some are not accessible to an

individual using a wheelchair or even a walking frame.

> *"Once you meet socially, automatically everybody becomes like a family, and then you don't need any forced conversation. Inclusive spaces where community life can happen do not require effort from a single person. It can happen effortlessly, and it should happen effortlessly"* (A teacher).

These narratives indicate that such inclusive spaces within the campus may encourage students with physical disabilities to participate, interact, and promote healthy community life. The results of the current study mirror other research on how the physical environment influences the way people feel, see, and interact with one another, and these factors influence an individual's performance (Jensen, 2005). Another study highlights that spatial design influences how people interact and participate (Lippman, 2015). Therefore, campus developers must understand how learning principles can guide space design (Jamieson, 2003) through the Universal Design approach, supporting community life and social interaction.

DISCUSSION

This study adds to the existing knowledge about higher education learning environments, mainly regarding barriers in the built environment, from the perspectives of students with physical disabilities. Through the Universal Design approach, the study assesses the existing architectural barriers within an institution of architecture and planning in India. This study can change the planning and design perspective of the design professionals, faculty, staff, and peers within an architectural institute (Imrie & Hall, 2003). It focuses not only on the classroom's indoor environment and participation of students with physical disabilities (Puteh et al, 2012) but also extends the existing research to the built environmental factors influencing participation outside classrooms.

Globally, equitable educational access is a characteristic of international universities and higher education institutions (Patricia et al, 2003); however, attending to equity issues in higher education is challenging (Mutanga, 2018). Research suggests that globally, students with disabilities are less likely to progress to higher education (Mutanga, 2018) because of the barriers they face from primary education onwards. Even those few students who make it to higher education continue to face challenges (Mutanga, 2018); one major challenge is access to higher educational institutions' built environments (Ali, 2020; Gupta,

2022). These challenges arise because of the improper conceptualisation of inclusion and limited understanding of disability and related design needs within higher education institutions (de Haan, 2001; Gupta, 2022; Gaurav et al, 2023). Design professionals often conceptualise inclusion as 'one size fits all.' With this thinking, the designers and service providers assume that inequalities can be overcome by providing the same opportunities to the excluded population without considering their diverse needs. People are different, and their needs differ regarding age and ability. Designers who fail to recognise this human diversity eventually create disabling environments (Imrie & Hall, 2003). Disabling the environment impacts the participation of students with physical disabilities by imposing barriers that other students do not face.

Accessible infrastructure is a precondition for independent living, and full and equal participation in higher education by persons with disabilities (Agarwal & Steele, 2016). The Indian higher education sector has experienced tremendous growth, and the enrolment rates have been high (Federation of Indian Chambers of Commerce and Industry, 2012). With a need to have more higher education institutions to accommodate students, and particularly students with physical disabilities, educational administrators and architects should focus on designing built environments of these institutions while keeping in mind disability needs and involving students with physical disabilities(Ramprasad & Subbaiyan, 2017; Gupta, 2022; Gaurav et al, 2023).

Over the past decade in India, evolving building legislations show that a lack of awareness, combined with traditional stereotypes, continue to pose significant hurdles in effectively enforcing an accessible built environment. A Universal Design approach can maximise the use of space and products respective to an individual's diverse needs (Centre for Universal Design, 1997); this approach can also bridge the gap between students with physical disabilities and inaccessible university spaces. Universal Design is the ultimate balance of aesthetics and usability (Imrie & Hall, 2003). Steinfeld and Danford (1999) indicate that environmental factors and perceiving accessibility as an association between a person and the environment are crucial in determining an individual's degree of independent living and the status and identity in society of individuals with disabilities. Universal Design has been able to replace the term 'accessibility' with the term 'usability' by introducing an activity component in design (Steinfeld, 1994). Usability is the efficient, effective, and comfortable use of the design, product, or environment (Iwarsson & Stahl, 2003). With an emphasis on the

usability of the environment, Universal Design maximises the use to all, to the greatest extent possible, without any adaptations to the product or environment (Centre for Universal Design, 1997). Through this approach of maximising use to a broader spectrum of people, Universal Design also promotes democracy and equity.

Implications

The study findings can have implications across future research, architectural design practices, higher educational institutions, and policies to promote inclusion, optimal participation, and social interaction of students with physical disabilities within higher education institutions. Table 6 highlights the potential implications of the research findings.

Table 6: Implications of Research Findings

Domain	The implication of research findings
Future research	• Research could explore perspectives of students with disabilities (other than physical ones) for a broader understanding of participation restrictions due to architectural barriers. • Research can explore the participation experiences of students with disabilities pre- and post-built environment modification. • Research could investigate the potential of UD within the building bylaws governing built environment modifications in low- and middle-income countries. Article 04 of CRPD (2016) also highlights promoting Universal Design in developing standards and guidelines.
Practice	• Findings of the current research can scientifically inform the college authorities about the inherent challenges in the institute's built environment. • Findings of the current research highlight the hazardous built environment characteristics in HEIs resulting from design professionals' negligence towards disability-related design needs. Hence, a capacity-building or disability awareness programme for the designers could be developed.
Policy	Building on the research findings, the authors conducted accessibility assessments of fourteen government-funded universities in Maharashtra, India, and prepared and submitted a report to the government. The research-informed results successfully brought policy-level changes, and the fourteen universities reserved 3% of their entire budget to make their campuses disability-friendly (I-Access Rights Mission, 2020).

Limitations

The study had some limitations as well. Representation of female students with physical disabilities is low, so their voices and perspectives are missing regarding participation restriction due to architectural barriers. Since this study was limited

to architectural barriers, gathering perspectives on attitudinal and social barriers would provide a thorough understanding of factors influencing the participation of students with physical disabilities in higher educational institutions. Also, the study participants' fear of answering specific questions about the university administration's response to their design needs limits the understanding of how these issues are addressed by the administrations.

CONCLUSION

Disability and architecture are closely related where the built environment can perpetuate the exclusion of persons with disabilities. Failure to provide adequate built environmental modifications results in students with physical disabilities' restricted participation or exclusion from the participation opportunities in higher educational institutions. The situation demands an understanding that supports inclusion. While individual cases and experiences can be unique, the root of exclusion lies in the societal and organisational structures which perpetuate a disabling environment in higher education institutions. Additionally, understanding disability plays a crucial role in shaping the attitudes of architects, designers, engineers, teachers, staff, and friends within the university setting. There is an urgent need to modify the existing built environment of higher education institutions with a Universal Design approach, provide supportive services to accommodate all, and nurture a healthy, inclusive teaching and learning environment within higher educational institutions.

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