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Universal Design in University Environments. Are the New Buildings More Inclusive? A Tool for Equal Design Assessment

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Abstract.
This study explores the application of Universal Design (UD) principles to university environments, aiming to improve the experiences of students and staff by fostering inclusivity in educational and social spaces. The research began with a literature review and employed the 'Design for All A.U.D.I.T.' tool, developed by Politecnico di Milano. This tool was adapted to evaluate six buildings across two universities in Milan: Politecnico di Milano and Statale University. The buildings ranged from the most recent to medium-aged and the oldest on each campus. The assessment focused on three main categories—physical, social, and sensory-cognitive quality—across eight key areas, including outdoor environments, entrances, halls, horizontal and vertical circulation, restrooms, classrooms, and study/leisure spaces. A binary scoring system was used to calculate the satisfaction of requirements, previously weighted by experts. The evaluation revealed that newer buildings generally scored higher on average (77%) compared to those from the 1960s (62%) and historical ones (67%). Despite higher scores, newer constructions often prioritized educational spaces over social and leisure areas, resulting in a lack of student gathering spaces. Significant issues included poor entrance design, inadequate wayfinding strategies, and a lack of inclusive classroom features, although restroom facilities consistently demonstrated good accessibility. The most recent building at Politecnico di Milano scored highest overall but struggled in leisure and study rooms, as did the new building at Statale University. This research highlights both the current state and potential for improvement in university architecture through the lens of UD. The study underscores that innovative design does not always equate to user satisfaction and provides an objective tool to aid decision-makers in enhancing the accessibility and inclusivity of university spaces, ultimately improving the well-being of all users.

Keywords. Inclusive Design; Design for All; University; Built environment; Performance assessment; Case studies

1.Introduction

Inclusion, accessibility, and disability are increasingly important themes globally and in Europe, highlighted by initiatives like the Sustainable Development Goals (SDG) and the Recovery Fund, which emphasize creating inclusive spaces for everyone's well-

being (mission 5 PNRR). Studies show that well-designed spaces positively impact quality of life and well-being [1,2].

Universal Design (UD) aims to create products, environments, and services usable by all without the need for adaptation, making spaces accessible and inclusive [3]. Similar to the Design for All strategy [4], UD addresses the needs of diverse people, regardless of abilities, age, gender, culture, or social background, improving quality of life for everyone [5,6].

It is crucial to define strategies and evaluation parameters to support the creation of UD-compliant spaces [7], especially in public buildings like schools, universities, healthcare facilities, and cultural sites, setting an example for physical and sensory accessibility [8].

Universities should embody educational and social advancement, providing equal opportunities for all. Inclusive teaching criteria must account for all possible difficulties, including socio-environmental, cultural, or familial challenges [9]. However, many universities still lack accessibility for students with disabilities. In Italy, only a third of universities are truly accessible. The National Agency for the Evaluation of the University and Research System (ANVUR) in a report on 90 universities highlighted ongoing accessibility improvements, but many still fall short in providing services like transportation (28%) and sign language translation (55.6%) [10].

The main issue is the lack of clear guidelines and tools to help designers and decision-makers create accessible and inclusive educational environments [11,12]. Current tools, like the Plans for the Elimination of Architectural Barriers (PEBA), often only meet minimum regulatory requirements and do not address all variables needed for truly equitable and salutogenic spaces [13,14].

This study aims to identify UD design and strategic actions to support the creation of accessible university spaces and to develop a tool for evaluating existing university buildings' inclusivity.

2. Method

The research methodology included three main phases: 1) analysis of the state of the art and identification of a method; 2) development of an analysis method appropriate for the university context; 3) application and testing of the method through empirical research to conduct a comparison of six universities in the city of Milan, Italy.

The analysis of the state of the art was conducted on the themes of UD in relation to university spaces and evaluation tools through a literature review [12]. The literature review identified three highly relevant tools: “Design for All A.U.D.I.T.” [15-16] from Politecnico di Milano, isUD Certification by IDeA Center [6], and Clear Code Architecture by PMMT Architecture. Unlike the latter two, which focus only on building areas, DfA AUDIT aligns with UD Principles and includes three macro categories to achieve inclusive environments, not only accessible. This comprehensive approach justified its selection as the most suitable tool for evaluating Inclusive Design. Therefore, this tool, originally designed for various public buildings like hospitals, was specifically adapted for university environments by simplifying it to three main categories, removing healthcare-specific indicators, and including those relevant to academic settings. The performance evaluation is carried out using qualitative and quantitative scientific indicators, providing a guide for decision-making and strategic processes, both for new projects and renovations. The Healthcare version of the tool is now available as an online

platform called Wideclusive® [1]. The inclusion analysis through this tool is based on three main categories: physical quality, sensory-cognitive quality, and social quality [17].

The second phase of the research involved adapting the tool to analyze each of these aspects in relation to eight typical university building environments: external environment, entrances, atrium, horizontal and vertical circulation, restrooms, classrooms, and study/leisure spaces. For each of these environments, checklists of indicators (design actions and/or strategies) were developed, considering the three main categories: physical accessibility, wayfinding, and social inclusion and well-being.

In the final phase, the new version of "DfA AUDIT for University" was tested on six case study buildings from two of Milan's most prestigious universities, Politecnico di Milano and the University of Milan (Statale). For each university, three buildings were considered: one recent (built within the last 5 years), one from the mid-20th century (1960s), and one historic, to understand if there is a correlation between the construction year and the quality of the spaces, given the increasing focus on accessibility and inclusion and the related funding.

3. Results

The DfA AUDIT for University tool was structured and organized to facilitate an objective analysis and identify effective design strategies to enhance the accessibility and inclusivity of university environments. This tool evaluates not only the individual building but also the surrounding area and associated services, providing a comprehensive overview of the services offered.

For the pilot case studies, the tool involved on-site inspections with detailed analysis sheets, including photos and graphics. Each building was assessed using indicators across three categories, highlighting strengths and weaknesses. Data collection was carried out by a Master's student in architecture and a UD researcher from the Architecture Department, ensuring objectivity and usability of the indicators. An associate professor reviewed the process, when doubts occurred and data analysis was performed in Excel, with verification by a senior UD professor.

3.1 Design for All AUDIT Tool for University Inclusion

DfA AUDIT is an evaluation system designed to analyze university spaces in line with Universal Design principles [15,16]. It is based on objective and quantifiable indicators to assess environments, focusing on three fundamental categories: physical quality, sensory-cognitive quality, and social quality. These categories are detailed as follows:

- **Physical-Spatial Quality**: Refers to the environment's ability to promote easy, comfortable, functional, and safe use of space for every user.
- **Cognitive-Sensory Quality**: Relates to the environment's capacity to support orientation, understanding of services, and user comfort, influencing the senses and cognition.

[1] The tool is now available via a digital platform named Wideclusive ® (https://www.wideclusive.com/en/home), developed by the research group Design and Health Lab of Politecnico di Milano also registered trademark. The name "Design for All A.U.D.I.T." is used to refer to previous scientific articles.

- **Social Quality**: Focuses on the environment's ability to enhance well-being and inclusion, considering emotional stimuli and social interaction among users.

Rating	Categories	Hall [To be evaluated once per building]	Value	Scores
50%	Physical quality *Total score:* *3 out of 4*	Entrance and hall doors have a clear span of at least 85 cm, preferably 100 cm.	Yes	3
		There are seating areas, with seats of different sizes, some with armrests, some without, with backrests, without backrests.	No	0
	Sensorial - Cognitive quality *Total score:* *2 out of 7*	Lifts, stairs and toilets are visible from the entrance or indicated by signs visible from the entrance.	No	0
		The orientation system includes visual, tactile and/or acoustic directional signs at all main entrances, indicating the location of primary destinations.	No	0
		There is a map or signage indicating the main functions of the building (e.g. classrooms and offices on each floor).	Yes	2
	Social quality *Total score:* *3 out of 5*	The windows provide outward views accessible to all (e.g. sitting or standing).	Yes	1
		There are artistic elements such as images, exhibition spaces and installations, aimed at enhancing the perception of the space.	Yes	1
		There is a reception desk for students and external persons (e.g. teachers, guests, parents, etc.), with a desk accessible to all (e.g. height between 70cm and 110cm).	No	0
		The seating configuration allows for the creation of spaces of privacy for individuals or for small groups (e.g. by shifting seats, arrangement, soundproofing). (If seats are not present = value absent).	Yes	1

Figure 1. Example extracted checklist for the building hall.

The tool examines these aspects across different sections representing university building environments, from external to internal spaces, including: outdoor environment; entrance; hall; horizontal circulation; vertical circulation; restrooms; classrooms; study and leisure areas. Each environment is represented by a checklist (Fig.1), providing an objective analysis that goes beyond the minimum regulatory requirements for overcoming architectural barriers, offering design strategies aimed at improving the life of all university users, from students to staff. For numerous environments such as classrooms or restrooms, at least one environment per floor or at least three of the same environments within the building is evaluated.

The scoring system employs a binary method where the value of each indicator is derived from the presence or absence of various requirements (Yes, No, N/A). Quality assessment results from meeting the defined requirements for each environment, with scores ranging from 1 to 3 to reflect the impact on achieving the specific indicator. The overall score for each category is determined by a weighted sum of the scores obtained for each criterion. For instance, in figure 1, the percentage 50% is the sum of the scores of the achieved indicators divide by the sum of all the scores of the indicators. Once applied, the tool provides a percentage evaluation of criteria satisfaction. Scores are provided for the quality of the entire building, each building environment, and each of the three categories.

3.2 The application of the tool in university buildings: physical, social and sensory-cognitive quality.

Compared to University A, the **historic building** has a rectangular plan with three floors and achieved a total satisfaction rate of 77% thanks to its green surroundings, shaded seating, bike racks, reserved parking, and public transport within 300 meters. Its physical quality scored 73% due to limitations from the building's historic adaptation. Despite ramps and added accesses, vertical circulation is hindered by secondary staircases. Internal signage is good, but external signage is poor and hard to identify,

reducing the cognitive quality to 79%. Social quality scored 81% due to lockers, vending machines, green spaces, and study rooms, though it lacks designated waiting and meeting areas.

The **1960s building**, with nine floors, earned a total score of 67%, with numerous bike racks, wide sidewalks, accessible parking, and good public transport. However, the interior sensory quality scored 62% due to inadequate, often improvised signage. Social quality scored 81% thanks to a bar area and external seating, but internal meeting spaces are empty and neglected.

The most **recent building** at University A, with four floors, achieved an overall satisfaction score of 80%, driven by an excellent sensory-cognitive quality of 90%, thanks to well-designed signage, restrooms, and equipped classrooms. However, the social quality was lower at 76%, due to a lack of gathering and waiting spaces.

At University B, the **historic building**, with four floors and several inner courtyards, scored 59%, with penalties in all categories, especially in sensory-cognitive quality (52%) due to poor, often improvised signage. Social and physical quality also scored low (64% and 63%) due to a lack of seating and waiting spaces both indoors and outdoors. Despite this, the building is well-connected to transportation and offers parking and bike racks.

The **1960s building**, with three floors, scored the lowest at 57%, with significant penalties in all quality categories. Social quality was particularly low at 48% due to inadequate seating and waiting areas. The campus entrance opens onto a crowded, tree-lined sidewalk with no seating, and the atrium lacks seating. Signage for services like stairs, elevators, or classrooms is missing, with only improvised signs in corridors.

The **newest building** at University B, with nine floors, achieved a total score of 74%, excelling in physical quality (83%) and sensory quality (79%). It features ample signage, bike parking, excellent public transport, and well-organized horizontal circulation with map screens. However, social quality was penalized at 48% due to a lack of designed meeting spaces, limited to basic waiting area seating.

In addition to category evaluations, the tool also provides detailed analyses for each environment. The table below shows an example of percentage values for different areas within one of the buildings along with their corresponding overall averages (Table 1).

Table 1. Example of evaluation results in relation to different environments (historic building, University B).

Building areas	Scores for areas	Total score
Outdoor environment	60%	59%
Entrance	40%	
Hall	44%	
Horizontal circulation	78%	
Vertical circulation	65%	
Restrooms	85%	
Classrooms	41%	
Study and leisure areas	62%	

3.3 Comparison of case studies

It is interesting to note that more recent constructions scored higher on average (77%) compared to buildings from the 1960s (62%) and historic buildings (67%), challenging the notion that innovation always leads to better results. The comparison chart (Fig. 2) shows that the highest score was achieved by the newest building at

University A, inaugurated in 2021, where cutting-edge design strategies were implemented, resulting in high scores in almost all areas. However, the building scored one of the lowest in the study and leisure areas.

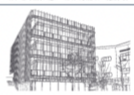
			Physical quality	Social quality	Sensory-Cognitive quality
University A	Historic building		73%	81%	79%
	1960s building		64%	81%	62%
	Recent building		76%	69%	90%
University B	Historic building		63%	64%	52%
	1960s building		55%	48%	64%
	Recent building		83%	48%	79%

Figure 2. Comparison matrix of evaluation results.

The more recent buildings have achieved higher performance levels, confirming that the progress of Universal Design is not only cultural and ideological but also practical. However, it is notable that buildings from the 1960s scored lower than even older structures.

Among the positive aspects identified in the analysis, the restrooms are increasingly designed to provide maximum accessibility, with attention to the height of fixtures and aids, allowing adequate space and sanitary conditions. Classrooms are positive for their amount of light and internal comfort, equipped with outlets and technological aids. However, they often lack accessible stations for students with motor, visual, or auditory disabilities.

Recent buildings tend to prioritize educational spaces at the expense of social and leisure areas, neglecting student gathering spaces. This issue is particularly evident in newly constructed buildings (scores of 11% and 8%), which are important for the social and psychological well-being of students and staff. Interestingly, this is one of the most well-tended aspects in less recent buildings, such as the historic building of University A and the 1960s building of University B.

Another important point to note is the lack of attention to signage, exemplified by the 1960s building at University A. Despite recent renovations, it has significant limitations in internal circulation due to the almost total absence of wayfinding systems. Additionally, building atriums are often bare and lack installations that would make them more livable spaces, such as seating in various configurations to allow small group gatherings or privacy.

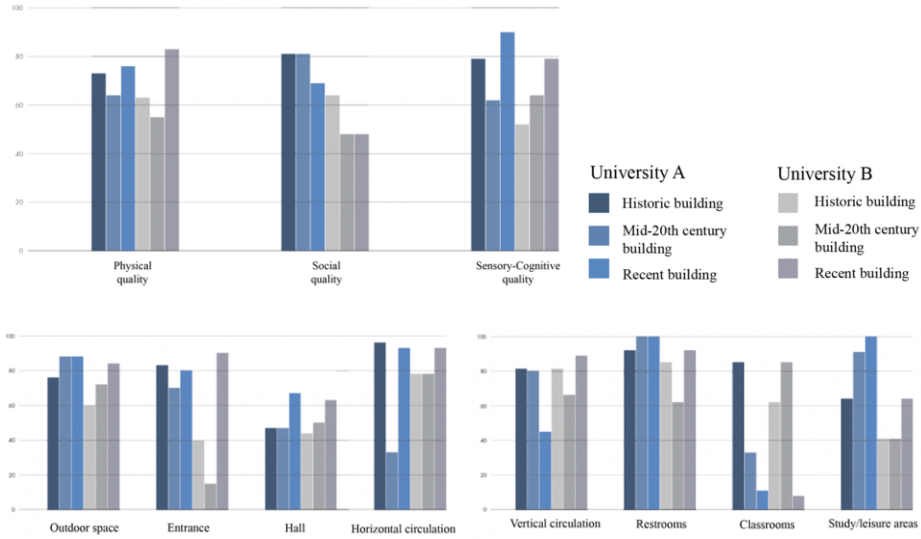


Figure 3. Graphs of the summary results and comparison of the evaluations of the 6 case studies.

4. Conclusions

The primary objective of this research was to examine the application of UD strategies in the university environment. The study applied a university accessibility and inclusion assessment tool based on UD to six case studies from two universities in Milan. The application demonstrated that the "DfA AUDIT for University" tool can empower decision-makers with effective design strategies, enhancing inclusivity in both external and internal campus spaces. This tool is proposed to improve inclusive university environments, increasing the number, proportion, and well-being of people with and without disabilities who can access and use university spaces, allowing them to participate in all activities inclusively. Additionally, it provides objective data on UD regarding physical, sensory, cognitive, and social quality, enhancing the social impact of usable and inclusive universities. Finally, it can serve as a benchmarking and decision-making support system to compare accessibility and inclusion across different international universities and offer design strategies to improve overall quality for everyone. The application's strength lies in its ability to provide a quick, cross-cutting evaluation of UD using objective data, with site audits taking just 2 hours per building after collecting drawings and permits. Weaknesses identified in the audits were primarily in the "outdoor spaces" and "entrance outside" sections, where many buildings lacked clear distinctions. The tool will be updated to combine these sections and include clearer indicators.

The limitations of this study primarily concern the number of case studies, which should be increased to validate results across various educational contexts. Therefore, the tool will be tested in future research concerning the following uses: both as a design support tool and an analysis tool to evaluate the degree of inclusion.

The next step in the research will be to assess all universities in Milan, then expand the evaluation nationally and internationally. This will further test the tool, comparing accessibility and inclusion among different universities and providing design strategies to enhance the quality of spaces for all. Later on, it would be interesting to analyze the

inclusion of university buildings in relation to inclusive pedagogy, such as the Universal Design for Learning (UDL) approach.

This research examines spatial inclusion in university environments through the lens of UD, shedding light on the current state of university architecture and its potential for improvement. By offering an objective mapping tool, this study aims to empower decision-makers and designers to enhance the accessibility and inclusivity of university spaces, ultimately improving the well-being of all users.

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