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Barriers on campus: accessibility challenges for wheelchair users

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Abstract

The accessibility of campus buildings and infrastructure in the context of wheelchair users remains an ongoing challenge. Despite the growing attention towards inclusive education for students with disabilities, the practical application of inclusive education practice remains fragmented at universities in Malaysia. Students with mobility disabilities, especially wheelchair users, are facing huge challenges related to time and navigation efficiency on university campuses. This reality prompted an examination of selected facilities through quantitative measurements as well as qualitative data gathered via simulation experiments and surveys involving volunteer participants. Sixteen volunteers took on the role of wheelchair users to directly experience navigation-related difficulties. In this study, the participants were given tasks normally completed by students on campus, first as non-wheelchair users and secondly as wheelchair users. For each task, distance and time data were collected and then compared with data collected. References to the Malaysian MS 1184:2014 (Universal Design and Accessibility in the Built Environment) standard were also made. The findings highlighted several areas where accessibility can be improved for wheelchair users. These areas include improving ramps, layout of toilets, and elevators' design. This study provides insights into the implementation of a seamless and inclusive experience for all students. Priority areas for improvement of infrastructure are highlighted, with recommendations aimed at strengthening accessibility in higher education institutions to cultivate an inclusive learning environment welcoming of all students.

Keywords:

Campus accessibility;
Wheelchair users;
Built environment;
Inclusive campus design;
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1. Introduction

The accessibility of educational institutions for students with disabilities has become a global concern. As universities strive for inclusiveness, the physical environment plays a significant role in ensuring that students, particularly those who use wheelchairs, can fully participate in academic and campus activities. Although institutions of higher learning have made progress, challenges remain in providing accessible infrastructure that meets the needs of all students. Conducted on a private university campus in Malaysia, this study focuses on evaluating the

wheelchair accessibility of selected buildings, specifically areas commonly used by students, such as lecture halls, libraries, and student activity centers.

Despite the growing attention towards inclusive education for students with disabilities, the practical application of inclusive education practice remains fragmented at universities in Malaysia. Barriers, such as poorly designed ramps, inadequate restroom dimensions, and lack of accessible transport options, continue to affect students with disabilities. Reports indicate that these infrastructural barriers persist despite the introduction of the 2019 Inclusive University Policy (The Star, 25 Aug 2025). Moreover, enrolment remains very low, with only 0.55% of public university students in 2022 being persons with disabilities, reflecting weak policy implementation and the need for stronger inclusive practices (The Malaysian Insight, 22 Jul 2024; Ipoh Echo, 28 Jul 2024). Hence, this study aims to address this gap by assessing the current accessibility features for wheelchair users at the university and providing some recommendations based on the findings. Utilizing the Malaysian Standard Code of Practice for General Design and Accessibility in the Built Environment, Department of Standards Malaysia (2014) or MS 1184:2014 (Universal Design and Accessibility in the Built Environment), this study examines adherence to the standard guidelines and identifies the barriers to wheelchair users while navigating around the campus. In addition, this study is aligned with Sustainable Development Goal 4, which advocated for inclusive and equitable quality education (United Nations Children's Fund (UNICEF) Malaysia, 2023).

2. Literature review

Students with mobility disabilities, especially wheelchair users, face huge challenges related to time and navigation efficiency on university campuses. Due to physical and infrastructural barriers, such as poorly designed pathways, steep ramps, and the need for detours or assistance, these students often take a longer time and distance compared to a student without disabilities. This increases the physical and psychological stress of wheelchair users (Hernandez & Rodriguez, 2024; Lamti & Gorce, 2016). Having to travel longer distances not only tires students in wheelchairs physically but also makes it harder for them to join classes and social events, despite the significance of these activities towards their academic performance and mental health (Braun & Naami, 2021). This situation reduces their autonomy and independence (Odame & Amoako-Sakyi, 2019; Kocaaslan et al., 2024).

Safety concerns are another relevant accessibility issue for wheelchair users. Materials such as smooth marble and pebbled surfaces create hazards that impede safe mobility (Mohammed Abbas, 2023). Wheelchair users require ground materials with anti-slip surfaces to reduce the risk of falls, particularly in areas exposed to weather conditions. Previous studies have highlighted the importance of tactile paving systems and high-contrast materials for aiding wheelchair users in safely navigating pathways (Badawy et al., 2020; Szmitkowski, 2023). In terms of emergency systems, clear signages suitable for those who are visually impaired and multisensory alarms to facilitate safe evacuation for students with disabilities are necessary (Badawy et al., 2020; Burgstahler, 2020). It is also common in building standards to include safety measures, such as appropriate ramp slopes of ramps (Kim et al., 2012; Lenker et al., 2016) and continuous handrails (Szmitkowski, 2023).

For wheelchair-using students, the design of campus facilities plays a crucial role in shaping their accessibility, convenience, and overall university experience. Elements such as automatic doors, smooth pathways, and clear signage are fundamental to ensuring independent and safe navigation across campus environments (Ijadunola et al., 2019; Wu & Wang, 2017). Among the most common barriers impeding accessibility are the limited availability of accessible restrooms and obstructed pathways, which often cause delays and inconvenience for students who rely on wheelchairs (Ashraf & Rahat, 2023; Chiwandire & Vincent, 2017). The issue of accessibility for

wheelchair-using students and other students with disabilities often underscores a persistent gap between policy commitments and actual practice. Despite constitutional guarantees of the right to education, many institutions continue to neglect adequate physical access, framing accessibility as a competing priority rather than a fundamental right. This situation calls for a critical examination of the barriers encountered by these students and the systemic reforms necessary to achieve genuine inclusion (Naidoo, 2021; Chiwandire & Vincent, 2017). Although some universities have begun acknowledging the importance of inclusive practices, accessibility is still frequently perceived as an optional enhancement rather than an essential component of equitable education. Consequently, progress towards fully inclusive learning environments remains slow. Comparable studies investigating similar issues in Malaysia, however, are still lacking.

Previous studies on campus accessibility for wheelchair users have used different methods to assess campus accessibility, including wheelchair simulations. In the wheelchair simulations, volunteers navigated around the campus with wheelchairs to simulate the experience of a wheelchair user. This helps researchers understand the real challenges faced by students with disabilities. These simulations tend to uncover issues such as steep ramps, narrow doorways, and other barriers that make it difficult for wheelchair users to navigate their surroundings (Amin et al., 2019; Park et al., 2022). Beyond simulations, the Photovoice method has been used to enrich the understanding of the challenges faced by wheelchair users. For example, Mubiru (2022) applied photovoice, a method that lets students with disabilities record the barriers that they face, enabling them to actively engage in identifying potential solutions. By combining interviews with observations, researchers can better understand both the personal challenges of wheelchair users and the actual physical obstacles they face. García González et al. (2023) documented that these barriers not only make it harder for students who are wheelchair users to move around campus but also influence their social life and ability to participate in campus activities.

Similar studies in a campus setting provide invaluable insights into improving accessibility (Sarsak, 2018; Fidzani et al., 2013). These studies also show that even with smaller sample sizes, significant data can be gathered to highlight the barriers faced by wheelchair users, ultimately helping create more inclusive and accessible campus environments. The use of accessibility standards to measure campus infrastructure helps integrate real-world testing with systematic measurements and user feedback.

3. Methods

This study employed a mixed-methods approach, integrating quantitative data analysis with qualitative analysis from a simulation experiment to evaluate both the physical environment and the lived experiences of student wheelchair users. The analysis combined quantitative metrics measuring time and distance for two designed scenarios that involved five campus buildings to compare wheelchair and non-wheelchair users in completing the scenarios. This study also measured physical facilities and compared them with Malaysian Standards MS 1184:2014 (Universal Design and Accessibility in Built Environment). Qualitative insights were gathered from post-simulation feedback. Both approaches determine the accessibility of student wheelchair users to the university's selected buildings and facilities.

The Department of Statistics Malaysia (2024) reports that as of 2022, there were 674,548 registered persons with disabilities in Malaysia, or approximately 2.0% of the population. A private university in Malaysia was selected for this study. The university is located on a land of 1300 acres, and campus amenities include lecture halls, tutorial rooms, a cafeteria, and parking spaces. The five buildings central to this study are usually accessed by students for their daily activities. The study detailed the accessibility of key facilities such as entrances, classrooms,

disabled toilets, ramps, and elevators, which are important for a campus to be accessible to students with mobility limitations.

3.1 Participation

Sixteen volunteers were recruited for this study. Participants were recruited from students at the Faculty of Science who voluntarily submitted their names when the project was announced. The group comprised eight male and eight female volunteers, with an average age of 22 years. Prior to the simulation exercises, all volunteers were briefed on the objectives, experimental procedures, and safety precautions, ensuring that they fully understood their roles and the purpose of the study.

Before the simulation began, the participants completed a pre-experiment survey via an online form to capture their initial perceptions of campus accessibility. After completing the simulation, they responded to a post-experiment survey to share their navigation experiences and evaluate the convenience of the campus facilities. To complement the survey data, semi-structured interviews were conducted to obtain deeper qualitative insights into participants' experiences, challenges, and recommendations for improving accessibility.

3.2 Simulation experiment

Two simulations were conducted, and two tasks were designed for each simulation. In Simulation 1, the volunteers were asked to complete the tasks as non-wheelchair users, and in Simulation 2, the volunteers were asked to complete the tasks as wheelchair users. These two tasks represent a typical sequence of student activities on campus. Volunteers performed sequential tasks following specific instructions that reflected typical student routines. The time taken to complete each task was recorded by the researcher using a stopwatch, and the distance travelled in meters was measured using a mobile GPS tracking application.

The tasks were conducted to simulate the daily movements of students between lecture halls, laboratories, tutorial rooms, restrooms, and libraries. Task 1 involved navigating between Blocks D and B, whereas Task 2 covered the route from Block D to Block I, including the library. Although the locations differed between the two tasks, the task structure remained consistent to allow a fair comparison between the routes. In Task 1 (Block D to Block B), participants began at the entrance of Block D and proceeded to the lab for their first class, then to the restroom, followed by a lecture in DDK1, and finally moved to Block B for a tutorial in Room B110 before visiting the restroom and exiting through the middle entrance. In Task 2 (Block D to Block I), participants started at Block D, went to DDK1 for class, then to the restroom, proceeded to the library, continued to Block I for another lecture, and concluded the session after using the restroom. These tasks collectively simulated a full academic routine which included moving between classrooms, restrooms, libraries, and multiple buildings.

Each task aimed to assess the ease of movement, accessibility of restrooms, and the suitability of pathways for wheelchair users. Observations were also made regarding ramps, door widths, floor surfaces and restroom accessibility. These scenarios provide valuable quantitative and qualitative insights into the physical and environmental barriers that may hinder wheelchair users from navigating campus facilities efficiently and independently. The participants were required to evaluate the accessibility, convenience, and physical barriers faced by wheelchair users in navigating the campus.

After completing each simulation, the volunteers were asked to complete a post-experiment questionnaire. The survey, conducted via an online form, obtained participants' feedback on their navigation experiences, the accessibility of campus facilities, and the challenges faced during the simulation. The questionnaire included both closed- and open-ended questions, allowing

participants to rate their experiences quantitatively and provide qualitative comments on specific accessibility issues and suggestions for improvement. Table 1 presents the assigned tasks designed to evaluate the accessibility of the selected campus facilities.

Table 1: Experimental assignment

Objective	Task 1: Block D → Block B	Task 2: Block D → Block I
Assess accessibility from building entry to first classroom/lab	Travel from entrance of Block D to Lab	Travel from entrance of Block D to DDK 1
Evaluate access to restroom facilities	Go from classroom to restroom in Block D	Go from DDK 1 to restroom in Block D
Observe indoor–outdoor movement between facilities	Proceed from restroom to DDK 1 lecture hall	Proceed from restroom to library
Test inter-building pathway accessibility	Move from Block D to Block B (B110) for tutorial	Move from library to Block I (IDK 1) for lecture
Assess restroom accessibility and ease of exit	After tutorial, go to restroom in Block B, then exit through middle entrance	After lecture, use restroom in Block I, then exit to conclude

Note: Time and distance data were collected during the experiment

3.3 Data analysis

Paired sample *t*-tests were used to prove the significant differences between the two scenarios, paired sample *t*-tests were used. This study compared the two groups by measuring the differences in campus path travel time and facility satisfaction scores (Hazra & Gogtay, 2016; Ruth & Michael, 2024). The test requires conditions such as normal data distribution and homogeneity of variance and calculates whether the mean difference exceeds the random fluctuation. If the data do not meet these conditions, non-parametric tests, such as the Mann-Whitney U-test, are recommended (Jankovic, 2022). This study builds on the findings of Chiwandire and Vincent (2017), who highlighted systemic barriers such as steep ramps and inadequate facilities but lacked statistical comparisons between wheelchair and non-wheelchair users.

In addition, the accessibility of the facilities throughout the scenarios was assessed based on insights from the wheelchair-user simulator and dimensional measurements to determine whether it complies with Malaysian Standard MS 1184:2014 (Universal Design and Accessibility in the Built Environment). Data obtained from both the simulation phases and post-experiment surveys were analyzed using a combination of quantitative and qualitative methods. The time taken and distance travelled for each task under both conditions (non-wheelchair and wheelchair user simulations) were compared to determine the differences in accessibility and route efficiency. Quantitative data were processed using descriptive statistics to calculate the mean, standard deviation, and range values for each scenario. A paired-sample *t*-test was conducted to identify whether there were statistically significant differences in task completion time and distance between the two conditions. Qualitative data from the open-ended survey questions and semi-structured interviews were analyzed using thematic analysis, which involved categorizing participants' comments and observations into recurring themes, such as accessibility barriers, safety concerns, and facility convenience. Together, these analyses provided both numerical and narrative evidence to assess the overall accessibility of campus facilities for wheelchair users. The calculation formula is as follows:

$$\text{Average time} = \frac{T}{N} \quad (1)$$

$$\text{Average distance} = \frac{D}{N} \quad (2)$$

$$\text{Percentage difference} = \frac{\text{Difference}}{N} \times 100\% \quad (3)$$

where N is the total number of volunteers, T is the total time taken to complete the scenario, and D is the total distance taken to complete the scenario.

The paired sample t -test applied in this study was used to identify statistically significant differences in the time taken and distance travelled between the two phases, providing quantitative evidence of accessibility challenges. By analyzing the mean differences in performance, the paired t -test helps determine whether the observed variations in task completion are due to random chance or the result of genuine accessibility barriers present on campus. The formula for the test is as follows:

$$t = \frac{\bar{d}}{s_d/\sqrt{n}} \quad (4)$$

where \bar{d} is the mean of the differences between paired observations, s_d is the standard deviation of the differences, and n is the number of pairs (participants or tasks). The formula for the standard deviation is as follows:

$$s_d = \sqrt{\frac{\sum (d_i - \bar{d})^2}{n-1}} \quad (5)$$

where d_i is the difference between each pair of observations (e.g. time for non-wheelchair users – time for wheelchair users) and \bar{d} is the mean of the differences between the paired observations.

4. Results

The results of this study are organized into three parts. The first part explains the results of the simulation experiment. The second part presents the feedback received from the questionnaire survey. The third part deliberates on building compliance with the Malaysian Standard MS 1184:2014 (Universal Design and Accessibility in the Built Environment).

4.1 Results of simulation experiment

In both tasks, the wheelchair-user simulation (Simulation 2) required significantly more time and distance to complete than the non-wheelchair-user simulation (Simulation 1), as shown in Table 2. The average time to complete Task 1 in Simulation 2 (wheelchair users) was 2,502 s, compared to 777 s in Simulation 1 (non-wheelchair users), resulting in a timing difference of 1,725 s (approximately 28 min). The time difference was 222% higher in Simulation 2 (wheelchair users). Similarly, the average time to complete Task 2 is 2,190 s in Simulation 2, compared to 804 s in Simulation 1, resulting in a timing difference of 1,386 s (approximately 23 min) or 172.39%.

A higher distance was also recorded in Simulation 2 for the completion of Tasks 1 and 2. The distance recorded in Simulation 2 was 1,165.29 m in Task 1, which was 40.75% higher than the distance recorded in Simulation 1 (827.94 m). When completing Task 2, the volunteers recorded 1,038.04 m under Simulation 2 and 917.99 m under Simulation 1, showing a 13.08% difference. The results of paired-sample t -tests showed significant differences in time and distance during the completion of Tasks 1 and 2 between Simulations 1 and 2. Wheelchair-user simulations were found to exert significantly more time (Task 1: $t=17.726$, $p<0.001$; Task 2: $t= 2.6943$, $p=0.0225$) and travel more distance time (Task 1: $t=9.650$, $p<0.001$; Task 2: $t= 14.0814$, $p= p<0.001$) in both tasks.

Table 2 also presents the time and distance taken by non-wheelchair users (Simulation 1) and wheelchair users (Simulation 2) to complete Tasks 1 and 2. The decision rule for this study states that if the p -value is greater than 0.05, there is no significant difference between the two simulations, whereas a p -value less than 0.05 indicates a significant difference between the two simulations. The critical value for a two-tailed test at $\alpha=0.05$ with $df=15$ is ± 2.131 . For Task 1, the paired t -test results showed $t=17.7216$ for time and $t=9.6497$ for distance, both exceeding the critical value of 2.131. The corresponding p -values were less than 0.001, indicating strong statistical evidence of significant differences between the two simulations. For Task 2, the t -value for both time and distance was 2.131 with $p=0.049$, which was also statistically significant at the 5% level. Overall, the results provide sufficient statistical evidence to conclude that wheelchair users require significantly more time and travel longer distances than non-wheelchair users to complete both tasks.

Table 2: Simulation experiment results

			Mean	Mean	t -value	df.	Sig. (2-tailed)
			Mean	difference			
Time	Task 1	Simulation 1	777				
		Simulation 2	2,502	1,725	17.7216	15	<0.001
	Task 2	Simulation 1	804				
		Simulation 2	2,190	1,386	2.131	15	0.049
Distance	Task 1	Simulation 1	827.94				
		Simulation 2	1,165.29	337.06	9.650	15	<0.001
	Task 2	Simulation 1	917.99				
		Simulation 2	1,038.04	120.05	2.131	15	0.049

Note:
 Simulation 1 - Non-wheelchair users
 Simulation 2: Wheelchair users

4.2 Participants' feedback

The feedback of participants was obtained through a pre-experiment survey with online forms which intended to gain insight into campus buildings and facilities accessibility from the 16 volunteers who participated in this study. Three sets of online forms were filled out by volunteers. The first was the Pre-Experiment Survey, in which volunteers provided their perceptions of campus accessibility before participating in the simulation experiment. The other two forms were filled out after the volunteers completed the simulations for Scenarios 1 and 2, respectively.

The volunteers' feedback from simulation experiments in five major buildings frequented by faculty students provided insights into accessibility, and their experience ratings are summarised in Table 3. The overall satisfaction levels for all features were below the neutral point of 3.00, indicating that the participants were generally dissatisfied with the accessibility and usability of campus facilities. Among the assessed features, ramps received the lowest mean rating (mean=1.81, SD=0.83), reflecting major challenges in slope design and flexibility for wheelchair users. The elevator obtained the highest mean score (mean=2.59, SD=0.99), suggesting that it was perceived as the most functional facility, although still below the satisfactory level. Classrooms or lecture halls recorded a mean of 2.44 (SD=0.77), while restrooms scored 2.16 (SD=0.78), indicating limited accessibility and convenience.

The relatively small standard deviations across all features show that the participants' responses were consistent, meaning that most agreed on the lack of accessibility of the facilities. Positive skewness for ramps (0.38) and restrooms (0.15) suggest that most ratings were clustered at the lower end (very poor to poor), while the slightly negative skewness for elevators (-0.17) implies a more balanced perception. The negative kurtosis values for ramps and elevators indicate flatter distributions, showing a wider range of opinions. Overall, these results highlight the urgent need to improve physical accessibility features, particularly ramps and restrooms, to enhance campus inclusivity for wheelchair users.

Table 3: Participants' satisfaction

Features	Mean	Standard deviation	Skewness	Kurtosis
Ramp	1.81	0.83	0.38	-1.40
Elevator	2.59	0.99	-0.17	-0.78
Classrooms/lecture halls	2.44	0.77	0.03	0.02
Restrooms	2.16	0.78	0.15	-0.12

Ratings: 1=very poor to 5 = very good

4.3 Compliance with the standard

The assessment focuses on key physical features, including ramps, intermediate platforms, toilets, lifts, and doors, based on the criteria outlined in the universal design and Malaysian Standard MS 1184:2014 (Universal Design and Accessibility in the Built Environment). Each facility was inspected to determine whether it met the specified dimensional and functional requirements necessary to support safe and independent mobility for wheelchair users. The findings, summarized in Table 4, provide an overview of the current level of compliance and highlight areas that require improvement to enhance accessibility and inclusivity across the campus environment.

Table 4: Physical assessment

Features	Standard requirement	N	Meeting the standard	Not meeting the standard
Ramp	Slope ratio: 1:12 to 1:20	4	3 (75%)	1 (25%)
Intermediate platforms	Required for ramps longer than 6 meters	2	1 (50%)	1 (50%)
Size of toilets	Minimum 1.5 m × 2.2 m for wheelchair access	5	2 (40%)	3 (60%)
Grab rails in toilets	Installed on both sides at 0.85–0.95 m height	5	3 (60%)	2 (40%)
Lift	Minimum internal dimension 1.1 m × 1.4 m; accessible control panel height (0.9–1.2 m)	3	2 (67%)	1 (33%)
Door	Minimum clear opening width 0.85 m; lever-type handles preferred	6	4 (67%)	2 (33%)

As shown in Table 4, the physical accessibility of campus facilities is inconsistent across different features. Among the four ramps assessed, three (75%) complied with the recommended slope ratio, while one (25%) exceeded the allowable gradient, posing potential safety concerns for wheelchair users. Half of the longer ramps lacked proper intermediate platforms, limiting the resting or turning space. For restroom accessibility, only two (40%) of the five toilets met the required dimensions for wheelchair access, and grab rails were properly installed in three (60%) of the assessed toilets. Regarding vertical and horizontal mobility, two of the three lifts (67%) met the accessibility standards, whereas one had control panels that were placed too high. Similarly, four out of six doors (67%) provided adequate width and lever handles, whereas the remaining doors were too narrow for wheelchair passage. Overall, while some features adhere to accessibility standards, further upgrades are required to ensure full compliance and barrier-free mobility for all users across campus.

5. Discussion

The findings revealed a significant difference in navigation efficiency between wheelchair and non-wheelchair users across both simulation scenarios. Wheelchair users required 222% and 172% more time to complete Tasks 1 and 2, respectively. Although equipped with basic accessibility features, it still imposes substantial physical barriers that slow down movement and increase the effort required by individuals with mobility limitations. In addition to longer completion times, wheelchair users travelled greater distances than non-wheelchair users, with

a 40.75% increase in Task 1 and a 13.08% increase in Task 2. This suggests that wheelchair users are required to take longer or alternative routes because of inaccessible pathways, steep ramps, or structural obstacles. Inefficient pathway designs, steep gradients, and uneven surfaces contribute to this performance gap, showing that accessibility remains a major obstacle to equal participation on campus.

These results imply that while the university's built environment technically accommodates movement for all users, it does not support equitable access. The extended travel time experienced by wheelchair users reflects how small design oversights, such as narrow corridors or poorly positioned ramps, can have a compounding effect on usability. To address this, universities should prioritize universal design (UD) principles in future construction and renovation projects, ensuring that routes between academic blocks, restrooms, and lecture halls are smooth, direct, and inclusive for all students, regardless of ability.

Feedback from the volunteer participants highlighted several recurring accessibility and safety issues across campus facilities. Participants reported that steep slopes, narrow pathways, and raised thresholds made movement difficult and, in some cases, unsafe for wheelchair users. Additionally, knob-style door handles are difficult to use because they require twisting, which is difficult to do while using a wheelchair. To improve accessibility, participants recommended replacing knob handles with lever-type handles, widening doorways to meet the minimum 850 mm clearance, and ensuring that pathways are level and sufficiently wide to accommodate the turning radius. Ramps should be reconstructed with gentler gradients and non-slip surfaces, while restrooms must include foldable grab rails and adequate turning spaces. These suggestions emphasize that accessibility improvements are not limited to structural changes alone but also involve attention to small design details that have a significant impact on usability and comfort for wheelchair users.

The physical assessment of campus facilities revealed that several key features did not comply with Malaysian Standard MS 1184:2014, which governs universal design and accessibility in public buildings. Although the university possesses basic infrastructure, such as ramps, elevators, and accessible restrooms, many of these facilities fall short of the prescribed standards. For example, 25% of ramps exceeded the maximum slope ratio of 1:12 to 1:20 (MS 1184:2014, Sec. 8.3), and 28.6% of ramps longer than 6 m lacked the intermediate platforms required for safe navigation (MS 1184:2014, Sec. 8.4). Moreover, toilets in two academic blocks were found to be non-compliant, with one being 82 cm shallower than the standard 2.2 m depth and several lacking grab rails or foldable supports (MS 1184:2014, Section 25.4.4).

These inconsistencies demonstrate that existing facilities, although functional, do not achieve universal accessibility. To realign with the Malaysian Standard MS 1184:2014, the university should undertake retrofitting measures, including correcting ramp gradients, expanding restroom dimensions, and installing compliant handrails. Periodic accessibility audits should also be conducted to ensure sustained compliance and continuous improvement of the facilities. By doing so, the institution can better uphold its commitment to inclusivity and ensure that students with disabilities experience the campus environment equally with their peers.

6. Conclusion

Transforming a university into a fully inclusive campus requires urgent infrastructure upgrades. Ramps should be redesigned to comply with the recommended slope ratios and be equipped with anti-slip surfaces and dual handrails. Restrooms must be expanded to meet the required dimensions and fitted with foldable grab rails, and elevators should include handrails and be available in all multi-story buildings. The addition of covered walkways and clear signage would also improve navigation for wheelchair users, especially during inclement weather.

Although this study provides valuable insights, it is important to note that all volunteers were non-wheelchair student users simulating wheelchair users. Hence, the time they took to complete each task may have been longer than the time required by actual wheelchair users. Nevertheless, the mixed-method approach of this study offers a scalable model for campus-wide accessibility audits. By addressing these gaps, the university can align with the Sustainable Development Goals and Malaysia's National Policy on Persons with Disabilities, ensuring equitable access for all students with disabilities. Future research should involve actual wheelchair users and integrate IoT-based monitoring to continuously evaluate and improve accessibility on campus.

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