Mobile Apps for Students: Usability Without Barriers?

An Analysis of the Usability and Accessibility of Selected Apps for Students

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Abstract— **The aim of the paper is to evaluate the usability and accessibility of three mobile apps designed for university students, including those with various types of disabilities. The following apps from Polish universities were selected for analysis: Kampus Pollub, PW Navi, and SmartUMED. The study employed multiple methods to assess usability, including eye-tracking technology, the System Usability Scale (SUS), the User Version of the Mobile App Rating Scale (uMARS), and an automated accessibility evaluation tool. The study was conducted with a group of 30 participants. The results indicate that contemporary mobile apps intended for students generally achieve a satisfactory level of usability, although variability in user evaluations was observed. Significant differences were found between objective and subjective quality assessments within the uMARS questionnaire, with users rating objective aspects more favorably than their overall subjective experience. Furthermore, no statistically significant relationship was identified between SUS scores and uMARS ratings, suggesting that usability and perceived app quality represent distinct dimensions of user experience. Eye-tracking analysis revealed trends indicating higher visual effort for less usable interfaces; however, these differences were not statistically significant.**

Keywords-mobile apps for students; usability; accessibility; eye tracking; SUS; uMARS; Accessibility Scanner.

I. INTRODUCTION

Nowadays, mobile apps constitute an integral part of the everyday functioning of most users. Their large number and diversity contribute to improving the performance of daily activities in almost every area of life. The widespread availability of mobile devices makes it possible to use these apps anytime and anywhere. A particularly important group of mobile app users are young people, including students, for whom such apps serve as a significant tool supporting the organization of the educational process. They enable, among other things, the optimization of study schedules, quick access to essential information, assistance in planning travel to the university or locating teaching facilities, and above all, they allow for time savings and the reduction of potential difficulties resulting from the lack of specific information.

Regardless of functionality and the scope of provided content, an important aspect of mobile apps quality is the intuitiveness and simplicity of the user interface, which enables effective use. Equally important is adapting apps to the needs of people with various types of disabilities, which still does not constitute a universally applied standard.

Despite the wide range of mobile apps dedicated to students, many of them are not fully adapted to the needs of diverse user groups due to the design solutions applied. The lack of essential features, such as options for configuring and personalizing the user interface, as well as insufficient accessibility support for users with mobility impairments, means that some apps do not meet the requirements of full functionality.

Usability evaluation includes the verification of ease of use, intuitiveness, and efficiency of app usage in the context of achieving user goals. Accessibility evaluation, in turn, focuses on determining whether the app is adapted to the needs of people with various types of disabilities, including visual, auditory, motor, and cognitive impairments. Such studies are conducted based on the Web Content Accessibility Guidelines (WCAG), which constitute an international standard developed by the World Wide Web Consortium (W3C) and define principles for designing and creating websites and mobile apps [1].

The evaluation of a mobile app is conducted to improve its quality, reduce errors, and enhance user satisfaction. One common approach involves user-based testing in the form of experiments, in which participants perform predefined task scenarios. During task execution, user interactions with the app are analyzed using selected research methods and tools.

The remainder of the paper is organized as follows. Section II reviews selected studies presenting various approaches to evaluating mobile apps for diverse user groups. Section III defines the research aim and formulates the hypotheses. Section IV describes the methodology, including the evaluated apps, research procedure, participant characteristics, research environment and instruments, and study scenarios. Section V presents the results, including SUS and uMARS questionnaire outcomes, eye-tracking measures, scenario performance metrics, and qualitative accessibility assessment. Finally, Section VI discusses the findings, verifies the hypotheses, outlines limitations, and suggests directions for future work.

II. RELATED WORK

The literature presents a variety of approaches to evaluating mobile apps designed for diverse user groups. Usability studies often adopt mixed-method strategies that combine subjective techniques, such as questionnaires and interviews, with objective methods, including eye tracking. Eye-tracking technology, in particular, is widely recognized as an effective tool for analyzing user–interface interactions and identifying potential usability issues related to interface design [2].

Examples of such approaches can be found in recent studies. A usability evaluation of an educational mobile app incorporating gamification elements, intended for children with type 1 diabetes, their caregivers, and diabetes educators, applied a combination of eye tracking, the thinking-aloud technique, the System Usability Scale (SUS) questionnaire, and focus group interviews [3]. A similar methodological framework was used to assess the usability and interface quality of the “DiagNurse” app, designed for practicing nurses and nursing students [4].

In another study, eye-tracking data were combined with the results of the User Experience Questionnaire (UEQ), allowing for a comprehensive evaluation of mobile app usability through the integration of objective and subjective data [5]. In turn, studies focusing on the quality and functionality of nutrition-related mobile apps employed the standardized Mobile App Rating Scale (MARS) as an evaluation tool [6]. In the usability assessment of the “DiaCare” app, which supports self-management of diabetes, the User Version of the Mobile App Rating Scale (uMARS) was used. This instrument is designed for end users and enables the evaluation of aspects such as engagement, functionality, aesthetics, and information quality [7].

III. AIM AND HYPOTHESES

The aim of the article is to evaluate the usability and accessibility of three selected mobile apps intended for students, while also providing broader insights with implications for the scientific community. Accordingly, the following research hypotheses were formulated:

H1: Mobile apps designed for students demonstrate a measurable level of usability, which varies depending on interface design characteristics.

H2: Statistically significant differences exist between the mean scores of the objective quality dimensions (sections A–D) and the subjective quality dimension (section E) of the uMARS questionnaire in mobile app evaluation.

H3: There is a significant positive correlation between usability scores obtained using the SUS and interface quality scores obtained using the uMARS.

H4: Differences in usability of mobile app interfaces are associated with corresponding trends in eye-tracking metrics, such as fixation count, fixation duration, and saccade count.

IV. METHODOLOGY

A. Selection of Apps

Before selecting the apps, criteria were defined, including availability on Android and iOS, free access, key functionalities (e.g., campus maps and navigation), and suitability for users with various disabilities, allowing adaptation to individual needs.

Three mobile apps for Polish university students were selected:

- Kampus Pollub (Lublin University of Technology)
- PW Navi (Warsaw University of Technology)
- SmartUMED (Medical University of Łódź)

Their main interfaces are shown in Figure 1.

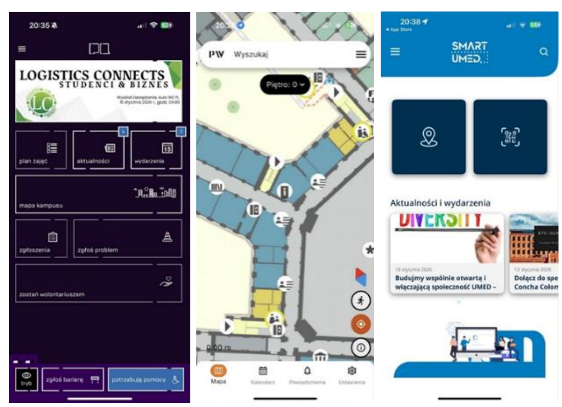

Figure 1. Main panels of the selected apps analyzed in the study.

B. Procedure

To conduct the study, the eye-tracking technique was employed alongside the SUS and uMARS questionnaires, consisting of 10 and 23 items, respectively. The research procedure comprised the following stages:

- **Study preparation**: selection of apps for analysis, development of research scenarios, recruitment of the study group, preparation of the testing environment, and conduct of a preliminary study.
- **Eye-tracking study**: participants completed four predefined test scenarios for a given app.
- **Questionnaires**: participants completed two questionnaires: SUS and uMARS.

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- **Data processing**: analysis of eye-tracking data and calculation of SUS and uMARS scores.
- **Results analysis**: interpretation of the obtained results and formulation of conclusions.

C. Participants

The study involved a group of 30 participants aged between 20 and 25 years and included both first-year students and students at the final stage of their academic education. Their experience and proficiency in using mobile apps varied, ranging from highly experienced users to individuals with relatively limited familiarity with such solutions.

A. Research Environment and Instruments

The study was conducted in a laboratory at the Department of Computer Science, Lublin University of Technology, under controlled conditions to ensure participant comfort and concentration. A Motorola Moto G73 5G smartphone with the evaluated apps installed was mounted in a fixed desk holder, providing stable positioning at an appropriate angle and distance from the participant.

Participants' actions and eye movements were recorded using Pupil Invisible eye-tracking glasses connected to a OnePlus 8 smartphone via the Pupil Companion app. The system enables binocular gaze tracking (up to 200 Hz for eye cameras and ~30 Hz for the scene camera) and supports natural movement. Data were transmitted to Pupil Cloud and analyzed using iMotions 11 on an Acer Nitro 5 laptop.

The eye-tracking study began with informing each participant about the purpose and course of the study, followed by obtaining their informed consent to take part in the experiment. Next, the participant's position was adjusted to ensure proper posture and optimal conditions for eye-tracking data collection, and a one-point calibration was performed to ensure measurement accuracy. During the main phase, participants completed tasks defined in the research scenario while wearing the eye-tracking glasses, which recorded both the visual scene and eye-movement activity. The experimental workstation and example views of the evaluated mobile apps with recorded fixation points and saccades during task execution are illustrated in Figure 2.

The study was conducted under the supervision of an experienced moderator, whose role was to oversee the proper course of the experiment and ensure that all procedures were carried out consistently across participants. Task scenarios were provided on paper at the workstation, allowing participants to refer to them freely whenever needed and minimising additional eye movements that would otherwise occur when switching between the task description and the evaluated application on the same screen. After completing the tasks, participants were asked to fill in two standardised questionnaires: the System Usability Scale (SUS) and the user version of the Mobile Application Rating Scale (uMARS), which together provided subjective feedback complementing the objective eye-tracking measurements.

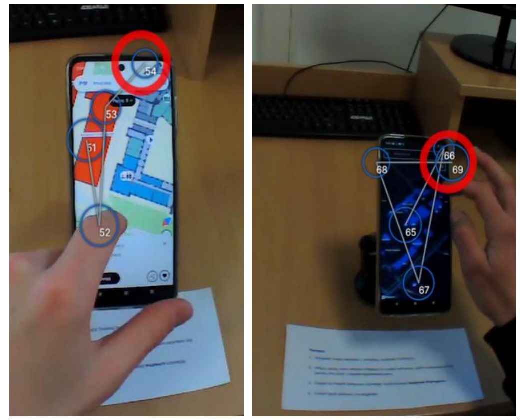

Figure 2. Example views from the eye-tracking study.

The SUS questionnaire consists of 10 items rated on a five-point Likert scale, producing a score from 0 to 100, where values above 68 indicate above-average usability [8]. The uMARS questionnaire, designed for non-expert users, evaluates app quality across 20 items in five sections: engagement, functionality, aesthetics, information quality, and subjective quality, also using a five-point Likert scale [9].

D. Research Scenarios

Tables I–III present the research scenarios, including tasks designed specifically for the SmartUMED, Kampus Pollub, and PW Navi apps, respectively.

TABLE I. SCENARIO FOR SMARTUMED APP

No.	Tasks
1	Display the campus map and locate the Sędziowska Campus in the Bałuty district.
2	Enable the route option adapted for users with disabilities.
3	Using the search function, find the Rectorate building on the UMED campus map.
4	Change the app language to English.

TABLE II. SCENARIO FOR KAMPUS POLLUB APP

No.	Tasks
1	Display the campus map and locate the CENTECH building.
2	Enable the option that indicates on the campus map locations with various barriers for people with disabilities.
3	Using the search function, find the Pentagon building on the campus map.
4	Change the app language to English.

TABLE III. SCENARIO FOR PW NAVI APP

No.	Tasks
1	Display the campus map and locate a men's restroom adapted for people with disabilities.
2	Set the navigation option to bypass stairs for users with mobility difficulties.
3	Using the search function, find the museum on the Warsaw University of Technology campus map.
4	Change the app language to English.

V. RESULTS

To compare the apps, the study utilized the following metrics:

- SUS score – for a reliable assessment of the app's usability, including user satisfaction and memorability.
- uMARS score – which allows evaluation of the overall quality of mobile apps.
- Scenario performance metrics: scenario completion time, scenario execution correctness.
- Eye-tracking measures: fixation count, fixation duration, saccade count.
- Qualitative accessibility assessment – evaluates how well a mobile app meets the needs of users with disabilities using accessibility features and the automated Accessibility Scanner tool.

A. *SUS Evaluation*

Based on the data collected using the SUS questionnaire from 30 participants, a SUS score was calculated for each participant and each app. The results were then averaged across the three tested apps and presented in Figure 3, together with standard deviations. All apps achieved scores above 68 points, which represents the commonly accepted threshold for satisfactory usability [10].

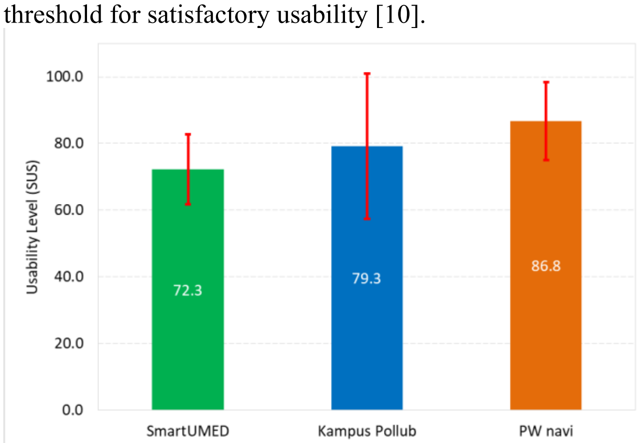

Figure 3. Results of SUS evaluation.

A one-sample t-test was conducted to compare the mean SUS scores of each app against the benchmark value of 68 in order to assess H1. The results showed that the Kampus Pollub ($M = 79.25$, $SD = 11.73$, $p = 0.014$) and PW Navi ($M = 86.75$, $SD = 10.54$, $p < 0.001$) apps achieved usability scores significantly above the benchmark, indicating high usability. In contrast, although the SmartUMED obtained a mean score above 68 ($M = 72.25$, $SD = 21.81$), this difference was not statistically significant ($p = 0.553$), likely due to greater variability in user evaluations.

B. *uMARS Evaluation*

The uMARS results were used to compare the three apps. Figure 4 presents mean scores and standard deviations for each section: four objective dimensions: engagement (A), functionality (B), aesthetics (C), and information quality (D), and one subjective dimension assessing overall app quality (E).

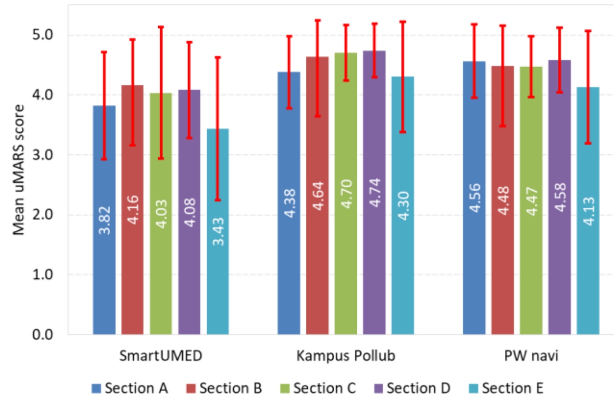

Figure 4. uMARS assessment by sections A–E.

The results show that Kampus Pollub achieved the highest scores in functionality, aesthetics, information quality, and subjective evaluation, while PW Navi scored highest in engagement. SmartUMED received the lowest ratings across the evaluated apps.

In addition, Figure 5 presents a chart showing the average scores calculated for sections A–D (left bars) and section E (right bar).

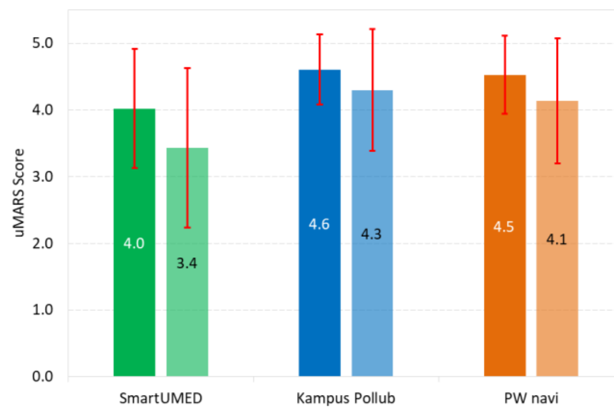

Figure 5. Average uMARS scores for sections A–D and section E.

A Wilcoxon signed-rank test was conducted to compare the objective quality scores (sections A–D) and subjective quality scores (section E) obtained from the uMARS in order to assess H2. The results revealed a statistically significant difference between the two measures ($W = 26.0$, $p < 0.001$), indicating that users evaluated the apps differently in terms of objective quality and subjective experience.

The relationship between SUS usability scores and uMARS interface quality ratings was examined to assess H3. Due to the non-normal distribution of the data, Spearman rank correlation was applied. The analysis revealed no statistically significant relationship between SUS and either the objective quality dimensions (A–D) ($\rho = -0.23$, $p = 0.23$) or subjective quality (section E) ($\rho = -0.28$, $p = 0.13$), indicating that usability scores were not associated with perceived app quality.

C. Scenario Performance Evaluation

Figure 6 shows results of evaluation scenario performance using mean completion time and execution correctness. Correctness exceeded 80% for all apps. Kampus Pollub achieved the shortest completion time (17.6 s) and the highest execution correctness (100%), while SmartUMED required the longest time (21.0 s) and exhibited lower correctness (80.9%). These differences suggest variations in interaction efficiency between the apps.

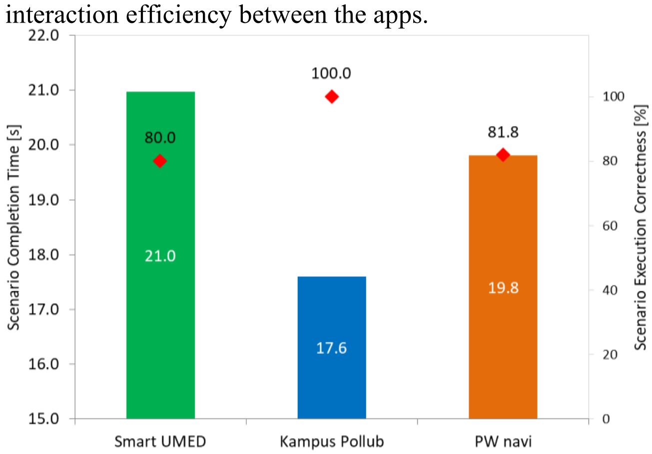

Figure 6. Average results of scenario performance evaluation.

D. Eye-tracking Measures Evaluation

Figures 7–9 present the results for three eye-tracking metrics: fixations count (Figure 7), saccade count (Figure 8), and fixation duration (Figure 9). These metrics enable the identification of usability issues and differences in interaction efficiency between interfaces [2].

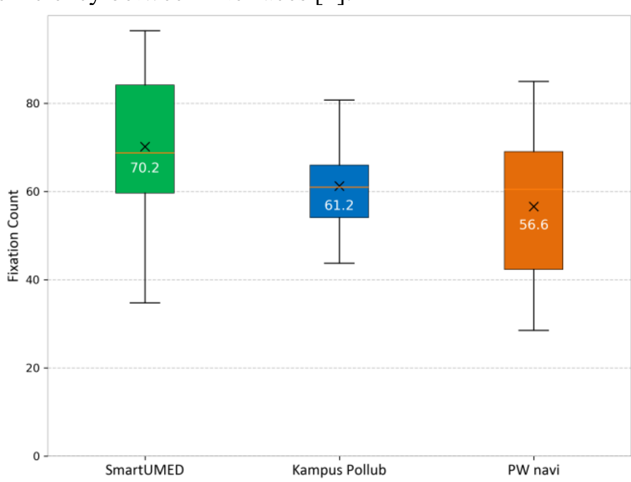

Figure 7. Average fixation count.

Across all three metrics, the highest values were observed for the SmartUMED app. In contrast, PW Navi and Kampus Pollub achieved lower and relatively comparable values. The elevated metrics for Smart UMED suggest that users devoted more visual attention to its interface, which may indicate increased cognitive load or lower interface intuitiveness [11]. Conversely, the lower values recorded for Kampus Pollub and PW Navi point to more efficient visual processing and easier task navigation [12]. However, Kruskal–Wallis tests revealed no statistically significant differences between the apps for fixation count ($H = 1.95$, $p = 0.378$), saccade count ($H = 0.40$, $p = 0.817$), or fixation duration ($H = 2.55$, $p = 0.280$). These observations relate to H4, indicating that while trends in eye-tracking metrics correspond to differences in usability, they do not reach statistical significance.

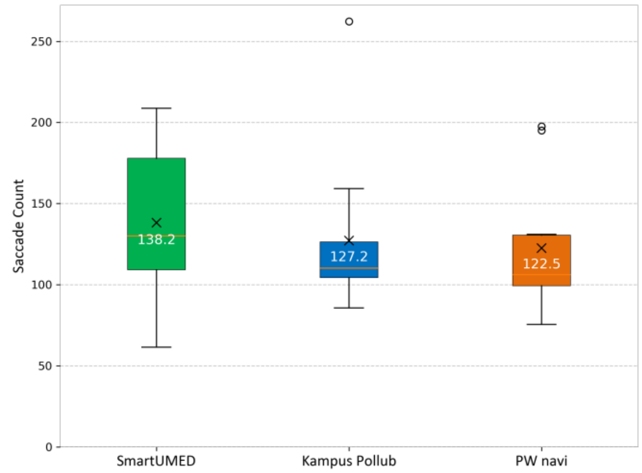

Figure 8. Average sacade count.

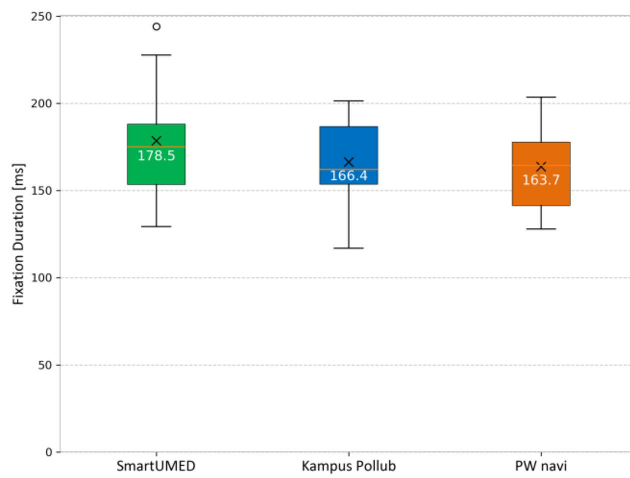

Figure 9. Average fixation duration.

E. Accessibility Evaluation of Mobile Apps

To assess the accessibility of the evaluated apps, both built-in accessibility features and automated analysis results were examined. Table IV presents the additional accessibility settings of each app. These settings enable users with limited abilities to use the apps more easily. The PW Navi offers a significant number of accessibility options compared to the others, which have only a few settings. Accessibility analysis using the Accessibility Scanner revealed that most issues occurred with maps (Table V), where the contrast between the background and interactive elements was often insufficient. Additionally, some interactive elements were too small, potentially hindering use for users with visual or motor impairments.

TABLE IV. ACCESSIBILITY FEATURES PRESENT IN THE APPS

App	Accessibility Features
SmartUMED	**Adaptive route option** – automatically selects a route that avoids obstacles hindering movement for users with mobility impairments. **SOS function** – enables quick contact with campus services supporting users with disabilities.
Kampus Pollub	**Theme change** (light, dark, high contrast) **Ability to report and locate barriers** for wheelchair users
PW Navi	**Visual support options** ● Voice-guided navigation points ● Alternative views adapted for visually impaired users ● Always display location information ● Show warnings when approaching obstacles ● Use vibration notifications ● Path planning based on segments for visually impaired users **Hearing support options** ● Present content using sign language ● Disable voice prompts ● Use vibrations instead of sounds ● Use vibration notifications **Mobility support options** ● Avoid stairs in navigation ● Use wheelchair-accessible navigation

TABLE V. ACCESSIBILITY ANALYSIS RESULTS WITH THE MAP VIEW

App	Panel	Potential issues
SmartUMED	Home	Image contrast
	Map	Low contrast Buttons too small
	Settings	-
Kampus Pollub	Home	-
	Map	Repeated element descriptions Low contrast Problematic element for screen readers
	Settings	-
PW Navi	Home	-
	Map	Low contrast
	Settings	Buttons too small

VI. CONCLUSION AND FUTURE WORK

The aim of this analysis was to evaluate the usability and accessibility of three mobile apps designed for students, using eye-tracking metrics, the SUS and uMARS questionnaires, and an automated accessibility assessment tool.

The usability assessment based on the SUS questionnaire indicated that all evaluated apps achieved good or higher ratings, with scores ranging from 72.3 to 86.8 – well above the standard 68-point threshold. The uMARS evaluation showed that Kampus Pollub achieved the highest scores in most sections, except for engagement (Section A), where PW Navi scored highest. In contrast, SmartUMED received the lowest scores across all categories and exhibited the largest standard deviations, indicating a wider variability in user experiences. This suggests that PW Navi and Kampus Pollub provided more consistent user experiences, whereas SmartUMED elicited diverse responses, possibly reflecting a less refined interface.

Performance metrics, which are among the most commonly used usability measures [2], also supported these findings. Kampus Pollub demonstrated the shortest mean scenario completion times and the highest scenario execution correctness, indicating efficient and accurate task performance [13]. Although SmartUMED users required longer task completion times, scenario correctness remained comparable to PW Navi. Eye-tracking data revealed that SmartUMED elicited a higher number of fixations and saccades, as well as longer mean fixation durations, likely reflecting increased cognitive load or less intuitive interface design [11], [14].

All tested apps exhibited a small number of accessibility-related issues. Based on the results, it is recommended to increase button sizes, improve their visibility, and enhance the contrast of certain interface elements to ensure better legibility for users. It is also worth noting that the apps differ in the range of accessibility support features. PW Navi stands out, offering the most comprehensive set of accessibility functions for users with various types of disabilities.

The analysis of the collected data enabled the verification of the formulated research hypotheses and provided insights into the relationships between usability, perceived quality, and user interaction patterns. The results of this analysis led to the following conclusions:

- H1 was partially supported: The analysis of SUS scores indicates that mobile apps designed for students generally achieve usability levels above the accepted benchmark. However, not all apps reached statistical significance, likely due to variability in user evaluations. Overall, these findings suggest that contemporary student-oriented mobile apps tend to provide a satisfactory level of usability.
- H2 was supported: The analysis revealed statistically significant differences between the mean scores of the objective quality dimensions (sections A–D) and the subjective quality dimension (section E) of the uMARS questionnaire. These findings indicate that users tend to evaluate mobile apps more favorably in terms of objective quality aspects than in terms of their overall subjective experience. This suggests that functional and structural qualities of apps do not necessarily translate into equally positive user perceptions, highlighting the importance of considering both objective and subjective measures in mobile app evaluation.
- H3 was not supported: The analysis did not reveal a statistically significant relationship between usability scores obtained using the SUS and interface quality assessments measured with the uMARS questionnaire. These findings indicate that subjective usability and perceived app quality represent distinct dimensions of user experience and should therefore be considered complementary in evaluation.
- H4 was only partially supported: The analysis indicated observable differences in eye-tracking metrics between the evaluated apps, with lower usability interfaces generally associated with higher fixation counts, longer

fixation durations, and increased saccade activity. However, these differences were not statistically significant.

The study demonstrates that PW Navi and Kampus Pollub provide high levels of usability and accessibility, with PW Navi particularly excelling in accessibility support, whereas SmartUMED requires further improvements to achieve comparable user satisfaction and interface intuitiveness. These findings highlight the value of combining eye-tracking techniques, standardized usability questionnaires, and automated accessibility assessments to obtain a comprehensive evaluation of mobile apps [15].

Although all analyzed apps meet the essential usability and accessibility criteria, further interface optimization is recommended. Among them, PW Navi stands out as a strong example of accessibility-oriented design.

Finally, the limitations of the present study should be acknowledged, including the homogeneity of the study group, which consisted of 30 participants aged 20–25 years. Future research should consider including a more diverse sample of participants, including older individuals and people with varying degrees of disability, in order to increase the generalizability of the findings.

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