Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Evaluation of Mobile Academic Information System with Notifications Using Heuristic Evaluation and WCAG-EM

I Gede Pradipta Adi Nugraha [1)*], Gede Indrawan [2)], Ahmad Asroni [3)], I Gede Aris Gunadi [4)]
[1*)2)4)] Universitas Pendidikan Ganesha, Indonesia, [3)] Institut Bisnis dan Teknologi, Indonesia
[1)] pradipta.adi@undiksha.ac.id, [2)] gindrawan@undiksha.ac.id, [3)] ahmadasroni@instiki.ac.id, [4)] igedearisgunadi@undiksha.ac.id

Submitted :Mar 27, 2025 | **Accepted** : April 16, 2025 | **Published** : April 23, 2025

Abstract: SIsKA-NG Mobile is a mobile information system that provides specific information related to students' study activities in the Computer Science Study Program at Universitas Pendidikan Ganesha. This newly developed application has never been evaluated. Therefore, it is necessary to evaluate the accessibility and interface for improvement. This study focuses on the analysis related to the application accessibility of partial color blindness users, using the WCAG-EM method and the heuristic evaluation method. Based on the accessibility evaluation results on the first development, it was found that SIsKA-NG mobile did not fully meet the standards of the mobile application, while based on the results of the heuristic evaluation, it was found 24 problems, where 8 problems with the highest severity rating (Catastrophic), 7 problems with high priority (Major), and others related to low priority (Minor) problems and insignificant problems. The subsequent development to enhance the quality of the interface and accessibility of SIsKA-NG Mobile used those findings as a reference so that this application can meet the needs of all users more effectively and inclusively.
Keywords: Heuristic Evaluation, Mobile Information System, Partial Color Blindness, WCAG-EM

INTRODUCTION

Universitas Pendidikan Ganesha (Undiksha), as a state education university in North Bali, Indonesia, focuses on developing various information systems to support institutional operations. The academic information system is a product developed by Undiksha to facilitate academic operational activities in terms of academic planning, academic results, and various other academic activities involving students, lecturers, and education staff. Currently, academic information systems are developed on a web-based platform. To improve the quality of system services, efforts are needed to increase the mobility of system use, including the development of mobile application-based systems.

This research focuses on advancing interfaces and functionality development, including evaluating the Academic Information System application (hereinafter referred to as SIsKA-NG Mobile), which involves evaluators and users directly (Gunawan, 2021). Considering the increasingly massive development of technology, it is a reference for researchers to evaluate and develop the SIsKA-NG Mobile application, from delivering information quickly to monitoring and evaluating student research. To support the research activities of students, especially in the stages of proposal submission, pre-thesis, and thesis examinations, the Master's Program in Computer Science at Undiksha has developed SIsKA-NG an integrated information system designed to manage and streamline these academic research processes (Sandhiyasa, 2022). The enhancement in this research related to transforming that information system into SIsKA-NG (Next Generation), which integrated its web-based and mobile-based apps. In addition, it can add even more value to study program accreditation for using self-made information systems in daily management.

SIsKA-NG Mobile can help the study program manage students' academic progress related to their research (Indrawan, 2020). Based on initial observations and feedback gathered through user questionnaires, several issues were identified in the interface and functionality of the mobile-based application, which required improvements to align with updated academic policies and advancements in technology.

Based on the issues in the SIsKA-NG Mobile application interface, which impacts user inconvenience and application functionality, and considering an old version of the application, this study used heuristic evaluation to

*name of corresponding author

e-ISSN : 2541-2019
p-ISSN : 2541-044X

evaluate its user interfaces and functionalities so that it can be generally accepted. Heuristic evaluation using Nielsen principles succeeded in finding several usability problems. In addition, opinions and comments from evaluators are very helpful in improving the usability of future prototypes (Azizi, 2021). Heuristic evaluation can find usability issues easily and quickly (Ali, 2022), including evaluation using predefined scenarios on user interfaces by several evaluators. The evaluators identified possible difficulties users may face when using the application and, by using a set of usability standards, assessed existing user interfaces.

To strengthen the evaluation, it was also necessary to evaluate accessibility, namely the Contrast Ratio on SIsKA-NG Mobile. WCAG-EM is a method carried out for accessibility evaluation that refers to WCAG version 2.1. WCAG 2.1 is a set of international guidelines aimed at ensuring website accessibility for all users, including people with disabilities (Kirkpatrick, 2024) (Shah, 2024). Based on the standardization of WCAG, there are four main principles of WCAG, including perceivable, operable, understandable, and robust (Brown, 2021). The success criteria for measuring the compliance level of a website consist of three levels, namely level A (minimum accessibility level), level AA (intermediate accessibility level), and level AAA (maximum accessibility level).

After the evaluation, the results will be the references for developing the SIsKA-NG Mobile application using the Waterfall method. The Waterfall model is one of the SDLC models often used in developing information systems or software. This model uses a systematic and sequential approach (Hossain, 2023). SDLC is also a pattern for developing a software system consisting of planning, analysis, design, implementation, testing, and maintenance.

A questionnaire on user satisfaction responses after using the application was also conducted using the User Experience Questionnaire (UEQ) questionnaire. UEQ is a method that can be used to measure user experience qualitatively and quantitatively (Santoso, 2022) (Hernández-Campos, 2023). Measurement with the UEQ method can provide more advantages because it can provide comprehensive measurement results for the user experience. The UEQ method has six main scales: novelty, perspicuity, dependability, efficiency, attractiveness, and stimulation.

Based on this background, the author conducted a study evaluating the application using heuristic evaluation and WCAG-EM. This research aims to make SIsKA-NG Mobile an information system with business processes to accommodate study activity notifications in the Computer Science Study Program, Graduate Program, Undiksha. This paper consists of the following sections, including Introduction, Methods, Result and Discussion, and Conclusion.

METHOD

As the evaluation object in this study, SIsKA-NG had three roles with their access rights, namely study program manager, students, and lecturers. The application development methodology (Figure 1) consists of identifying issues, studying/reviewing the literature, collecting data, analyzing data, and developing the application. Identifying issues includes the application's interfaces and functionalities. Reviewing the literature related to methods used in this study, namely heuristic evaluation and WCAG-EM. Collecting data related to the heuristic assessment by 5 evaluators refers to 10 heuristic evaluations by Nielsen, where the model consists of 5 aspects of measurement, including efficiency, error, learnability, memorability, and satisfaction. This evaluation produced qualitative and quantitative data. The evaluator recommendation form constructed qualitative data as the application development reference, while the severity rating form prioritizing which usability problem will be solved first (based on the highest rating starting from 0 to 5) constructed quantitative data.

The data analysis phase related to the accessibility evaluation process uses tools provided directly in the WCAG standardization. Standardization in WCAG comes in three levels: A, AA, and AAA. The previous guidelines referred to AA compliance levels. For better accessibility, plain text should have a contrast ratio of 7:1. Large-scale texts must have a minimum contrast ratio of 4.5:1 to achieve AAA compliance under WCAG.

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X

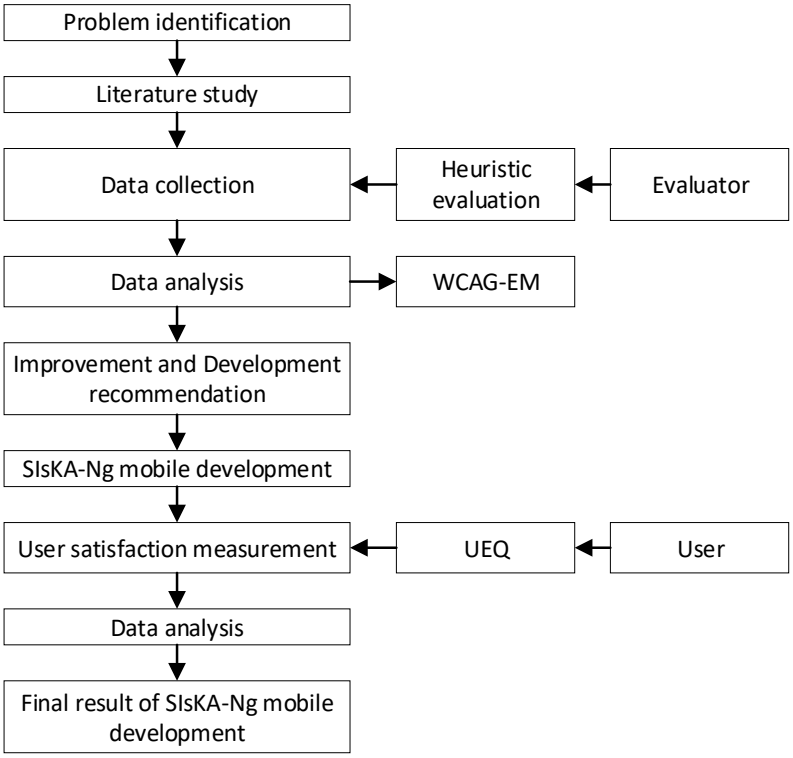


Fig. 1 SIsKA-NG Mobile Development Methodology Overview

Heuristic Evaluation

This usability evaluation utilizes a corresponding heuristics set (Benaida, 2023) (Kumar, 2020) to enhance a design effectively. Identifying issues related to website usability is the objective of this evaluation. The advantage of this evaluation is related to obtaining relatively fast and inexpensive feedback. Other usability evaluations can also work along with this evaluation method. Heuristic evaluation, with its heuristics set, contains aspects of usability as a reference for information system evaluation. Ten principles of this evaluation (Nielsen, 2024) consist of aesthetic and minimalist design, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, help and document, help user recognize and recover from errors, match between system and real world, user control and freedom, and visibility of system status.

Color Contrast Ratio Measurement

The measurement of color ratio contrast is based on the anticipation of the presence of a user with partial color blindness (dyschromatopsia) who needs to see the user interface of the SIsKA-NG application clearly. Based on the standardization of color accessibility according to WCAG 2.1, users of dyschromatopsia can see the difference between the foreground and the background with a contrast ratio threshold value of 4.5 (Fish, 2021) (Bile, 2023). Color ratio contrast measurements are used to ensure that the colors in the background and foreground have a clear preference. This measurement is carried out based on the WCAG 2.1 standardization, which is an accessibility standard document that has been recommended by The World Wide Web Consortium (W3C). Color Contrast Ratio Measurement uses a tool to calculate the contrast ratio between two valid CSS colors (Verou, 2023).

There is a visual approach to choosing colors with a contrast ratio value above the threshold of 4.5. It uses an open-source color palette to ensure a relative contrast color code between the foreground and background colors on the app interface. The color palette uses the Flatuicolorpicker platform reference with color code preferences based on Hexadecimal, RGB, RGBA, HSV, HSL, HSLA, and CMYK values. A relatively frequently used color code easily identifiable by mobile application platforms is to use a color code format in the form of Hexadecimal or RGB. Figure 2 shows a list of colors that have adopted a variety of colors that are relatively safe to use with contrast ratios above the threshold of 4.5 and are used as a reference to increase the SIsKA-NG contrast ratio value.

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X

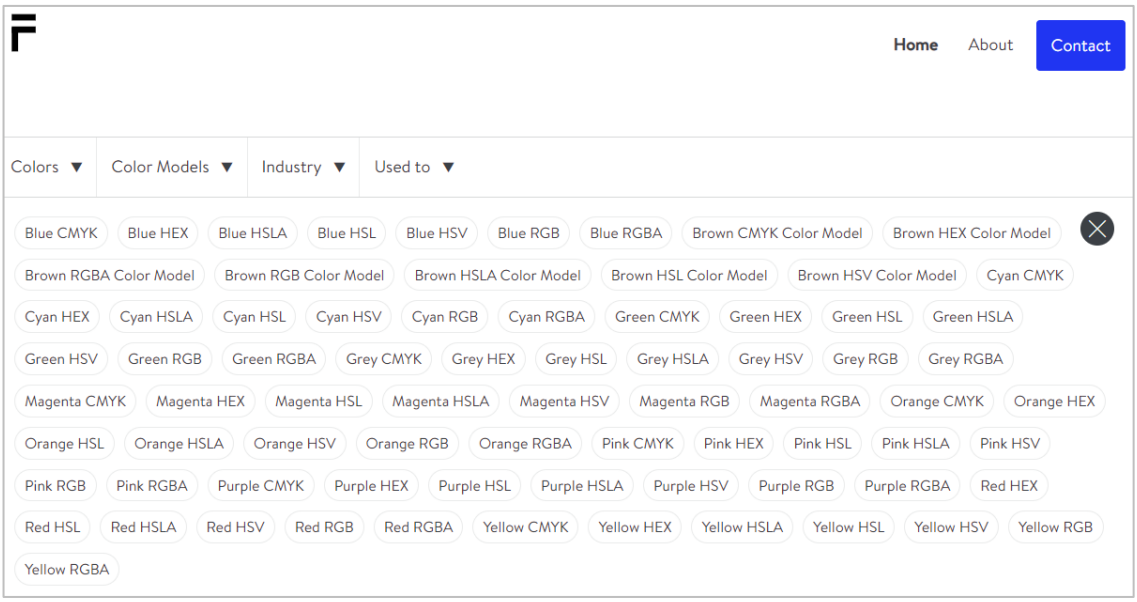


Fig 2 Open-source color palette from the Flatuicolorpicker platform

Observation activities by looking for contrast ratio values aimed at assessing color preferences used in applications with a comfortable contrast level for people with partial color blindness (dyschromatopsia). Obtain contrast ratio values using an open-source utility with WCAG 2.1 guidelines. The steps taken in this measurement involve two color components, namely the background color and the main focus color (foreground color). Stages to get the value that the workflow uses in Figure 3.

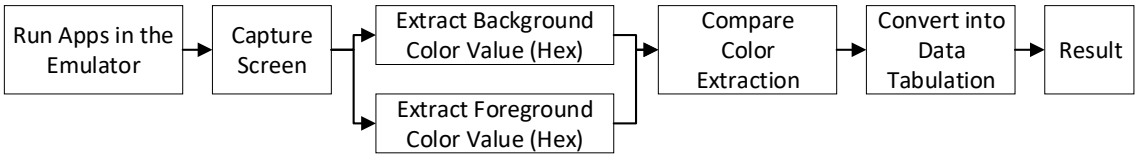


Fig 3 Contrast Ratio Measurement Workflow

RESULT

Heuristic Evaluation

At this stage, the evaluation results were consolidated from 5 heuristic evaluators. The evaluation results obtained from the evaluators contained 24 considerations that covered all heuristic principles. The consolidation results produce the average severity rating of SIsKA-NG Mobile implementation.

The respondents' answers were represented by a severity rating value from 0 – 4, where the severity rating of 0 stated that there was no problem at all, 1 stated a simple problem, 2 stated a minor problem, 3 stated a major problem, and 4 stated a catastrophic problem or the highest priority for improvement. Each item in the question is calculated as a percentage of what percentage is found and what percentage is not found. The table of the results of the calculation of the questionnaire in Usability Testing to measure the level of usability in the SIsKA-NG Mobile application prototype is found in Table 2.

Table. 1 Aspects of Heuristic Evaluation and Statement

No	Aspect of Heuristic Evaluation	Statement
1	**Visibility of system status (H1)** A condition that is able to provide information that occurs to the user both what is being done, what is being done and what is happening.	1. Each page has a title that explains the content of the page. (q1) 2. Menu names and pages already exist according to their content (q2) 3. Menu names and pages already exist according to their content (q3) 4. Every page can already function properly (q4)

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X

2	**Match beetwen system and the real world (H2)** The system must be able to provide information that is easy to understand like everyday language. To give an impression of familiarity and trust for users.	1. Menu names are written logically and understood by users (q5) 2. Error messages using an understood language (q6) 3. Each page is already in a language that the user understands (q7)
3	**User Control and Freedom (H3)** Able to provide convenience and freedom to users in using the interface.	1. There is a search feature on the app (q8) 2. If the app has a tiered menu/page, users can easily go back to the previous menu/page (q9)
4	**Consistency and Standards (H4)** Consistent and good design will make it easier for users to get to know the features so as not to make users hesitate when using certain features. Avoid using different information or images that have the same meaning.	1. Each page has a consistent title (q10) 2. The writing standards and language on each page are consistent (q11) 3. The appearance of the application on each page has the same shape and content and is consistent. (q12)
5	**Error Prevention (H5)** Errors or bugs in the system are unprofessional when seen by the user, but to handle this, it can be replaced with error messages in the form of design. By using the number one principle (visibility of system status) the user understands what is happening to the system.	1. The text on the instructions is clear and does not cause double meaning (ambiguity). (q13) 2. There is an error notification when a system failure occurs. (q14)
6	**Recognition rather than recall (H6)** So that users are not confused, create an application that allows users to recognize the design patterns created so that they can continue to use the application without having to remember the steps that must be taken afterwards.	1. Implement active menus to distinguish between active and inactive menus. (q15) 2. There is a difference between the button and the text highlight color. (q16)
7	**Flexibility and efficiency of use (H7)** For new users or visitors, of course, they will learn the system or application first. Especially if the application has many features, users definitely need more to learn it. Therefore, the application must be flexible and efficient.	1. The menu and information are well displayed. (q17) 2. Menu groupings and information can be easily remembered. (q18) 3. There is a navigation that can help on every page. (q19)
8	**Aesthetic and minimalist design (H8)** A good layout design must be comfortable to look at by using good color contrast, appropriate and harmonious positioning. With a minimalist design combined with appropriate whitespace (distance between elements), it will make the application look elegant.	1. Responsive display adjusts smartphone resolution. (q20) 2. Menu layout is easily accessible to users. (q21) 3. The display already uses good coloring for users to see (q22)
9	**Help users recognize, diagnose, and recover from errors (H9)** A good and comfortable design is certainly not complete without handling errors when they occur. When an error occurs, the application should not only provide an error message but also provide a solution.	1. Information is already displayed on each page, allowing users to make decisions. (q23) 2. Clear error message when an error occurs. (q24) 3. Makes it easier for users to identify, diagnose and exit errors. (q25)
10	**Help and documentation (H10)** The hope of users using the system or application is certainly to solve their problems and work. To assist them in solving their problems or work, we need to be provided with help features and documentation of possible errors in use.	1. There is a help menu that can help users better. (q26) 2. There is a contact / correspondence facility for application admins. (q27) 3. There is an *application* guide book. (q28)

Based on the results of Table 2, it is known that of the 28 statements, as many as 17% of statements with a severity rating of 0 (No problem at all), 14% of statements with a severity rating of 1 (Simple problems only), 8%

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X

of statements with a severity rating of 2 (Minor), 16% of statements with a severity rating of 3 (Major) and 45% of statements with a severity rating of 4 (Catastrophic). Meanwhile, there are 8 statements that evaluators have assessed with a severity rating of 3, and there are 15 statements that evaluators have assessed with a severity rating of 4, which will be a reference in the evaluation of heuristic evaluation. Furthermore, the evaluators provided the problems faced during the evaluation of the SIsKA-NG application, which is summarized and shown in Table 3.

Based on Table 4, eight (8) problems with the highest severity rating (Catastrophic) were found by the evaluator, so these problems must be fixed. These findings have an impact on the lack of user comfort or application functionality. Seven (7) problems needed to be fixed with high priority (Major), while three (3) problems did not need to be fixed unless there was additional time.

Table. 2 Statement Item Percentage

Variable	Statement	Percentage				
		0	**1**	**2**	**3**	**4**
Visibility of System Status (H1)	q1	60	40	0	0	0
	q2	0	60	40	0	0
	q3	0	60	0	40	0
	q4	0	0	0	40	60
Match between system and the real world (H2)	q5	100	0	0	0	0
	q6	80	20	0	0	0
	q7	0	60	40	0	0
User Control and Freedom (H3)	q8	0	0	0	0	100
	q9	0	0	0	0	100
Consistency and Standards (H4)	q10	0	0	0	40	60
	q11	0	40	0	60	0
	q12	0	40	0	60	0
Error Prevention (H5)	q13	60	0	40	0	0
	q14	40	60	0	0	0
Recognition rather than recall (H6)	q15	100	0	0	0	0
	q16	0	0	0	0	100
Flexibility and efficiency of use (H7)	q17	0	0	0	0	100
	q18	0	0	0	0	100
	q19	0	0	0	0	100
Aesthetic and minimalist design (H8)	q20	0	0	0	0	100
	q21	40	0	60	0	0
	q22	0	0	0	100	0
Help users recognize, diagnose, and recover from errors (H9)	q23	0	0	0	0	100
	q24	0	0	40	0	60
	q25	0	0	0	0	100
Help and documentation (H10)	q26	0	0	0	0	100
	q27	0	0	0	60	40
	q28	0	0	0	60	40
Mean		17%	14%	8%	16%	45%

Table. 3 Summary of Problems

Item	Evaluator Code	Issues	Severity Rating (0-4)
1	Ev1, Ev2, Ev3, Ev4, Ev5	1. There is a splash screen when the application is first launched. 2. During the login process, there is a long loading time if the username or password is entered incorrectly.	4
2	Ev1, Ev3, Ev4	1. The language used is already quite easy to understand	1
	Ev2, Ev5	2. The language usage is inconsistent, whether using Indonesian or English.	2

*name of corresponding author

e-ISSN : 2541-2019
p-ISSN : 2541-044X

3	Ev1, Ev2	1. There is no control over user preferences. If the user logs in and closes the application, upon reopening the application, they are required to log in again.	4
	Ev1, Ev2, Ev3, Ev4, Ev5	2. There is no feature to manage user profile data. Users cannot change personal data such as profile photos and passwords	3.4
4	Ev1, Ev2, Ev3, Ev4, Ev5	1. It does not yet reflect the interface of a mobile application, especially on Android. The application's appearance does not reflect the user experience of using an Android application.	3.8
5	Ev1, Ev2, Ev3, Ev4, Ev5	1. The application already includes specific error pages for handling errors during processes, but the long loading times need improvement.	1.2
6	Ev1, Ev2, Ev3, Ev4	1. On the research timeline page, there are cards and icons that make it slightly difficult for users to view the displayed information.	4
	Ev1, Ev2, Ev3, Ev4	1. On the research dashboard page, the amount of information displayed is not visible enough, making it highly ineffective and requiring further improvement.	4
	Ev5	1. From a mobile application perspective, it is not easy to understand because the components still resemble those used in web applications.	4
7	Ev1, Ev2	1. In the News menu, the display could be made even easier to understand, and there is no notification indicating whether the news is being loaded or not.	3.5
	Ev2, Ev3, Ev4, Ev5	1. When opening the application, it requires logging in again, which makes the system usage time inefficient.	4
	Ev3	1. There is a lack of information that is recently updated, making the application not real-time.	4
	Ev5	1. The display for the exam schedule menu needs improvement because there are icons that are not efficient to use.	4
8	Ev1	1. The menu color differentiation between active and inactive states makes it easier for users. 2. The design of the bottom bar/menu at the bottom is already quite easy to understand; it just needs to be refined further in terms of menu transitions.	1 2
	Ev3	1. The bottom menu already facilitates users in navigating between menus.	1
	Ev2, Ev3, Ev4	1. The menu coloring needs to be changed because it can be distracting when opening the application in dark conditions.	3.6
	Ev2, Ev4	1. The bottom bar/menu design is already quite easy to understand. However, the coloring should be changed because it is too bright.	3
	Ev5	1. The color theme is not comfortable to look at for extended periods.	3
9	Ev1, Ev2, Ev3, Ev4, Ev5	1. Error messages and error pages appear when the internet is turned off.	1
10	Ev1, Ev2	1. The application already displays a history of research conducted; however, the display is still not suitable for a mobile application.	3
	Ev3, Ev4, Ev5	2. There is no application manual or feature that explains the function of each menu.	1.6

Table. 4 Recapitulation of Problem Summary

No	Nielsen's Heuristic Principal	Number of Problems
1	Visibility of system status	2
2	Match between system and the real world	2
3	User control and freedom	2
4	Consistency and standards	1
5	Error prevention	1
6	Recognition rather than recall	3
7	Flexibility and efficiency of use	4

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X

8	Aesthetic and minimalist design	6
9	Help users recognize, diagnose, and recover from errors	1
10	Help and documentation	2
Total		24

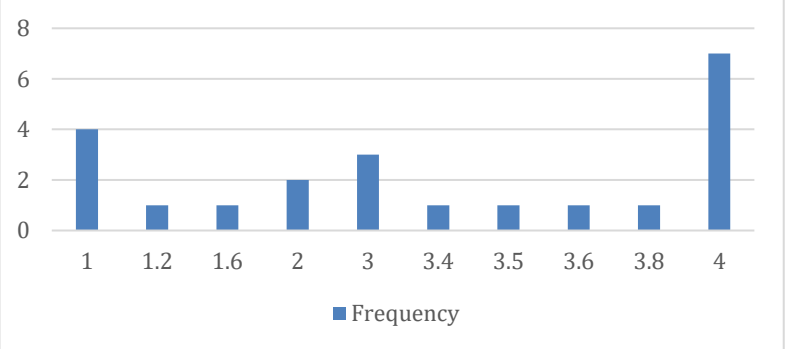


Fig 4 Frequency Graph of Severity Rating in SIsKA-NG Mobile

Of the 24 issues summarized, the researchers consolidated with evaluators to verify the issues and recommendations. These results served as a reference for implementing improvements in the application related to interface and functionality. Table 5 shows the consolidation result with the evaluator in detail.

Table. 5 Final Evaluation Results Using Heuristic Evaluation Method

No	Item	Issues	Recommendation
1	Visibility of system status	1. There is a splash screen when the application is launched for the first time. 2. During the login process, there is a long loading time if the username or password is entered incorrectly.	1. Improve the login page as it significantly disrupts the system's interface. 2. Improve the login process to display warnings when entering incorrect usernames or passwords.
2	Match between system and the real world	1. Inconsistent language use whether using Indonesian or English	1. The use of language in the application is corrected and adjusted if using Indonesian or English.
3	User control and freedom	1. There is no control over the user's wishes. If the user logs in and the application is closed, and reopens the application then it is required to log in again.	1. To fix if the user is logged in and the application is closed, the user is not automatically logged out.
		2. There is no feature to manage user profile data. Users cannot change personal data such as profile photos and passwords.	2. To add a feature to manage user profile data, so that users can update personal data.
4	Consistency and standards	1. It does not reflect the interface of a mobile-based application, especially Android, the appearance of the application does not reflect the user experience using the android application.	1. The overall interface on the application has been changed and adapted to the modern android mobile-based interface today.
5	Error prevention	1. The application already contains a special page if there is an error in performing a process in the application, but the long loading process needs to be corrected.	1. Fix the old loading process so that it can improve the user experience.
6	Recognition rather than recall	1. On the research timeline page, there are cards and icons that make it a little	1. Improve the research timeline page so that it can make it easier for users to see information.

*name of corresponding author

		difficult for users to see the information displayed.	
		2. On the research dashboard page, the amount of information displayed is not visible, so it is very ineffective and needs to be improved.	2. Fix on the research dashboard page the display is made better so that users can clearly see the information of the number of studies.
		3. From the point of view of mobile applications, it is not easy to understand because components still use components in web applications.	3. Fix the entire app display to mirror the mobile app so that users can clearly see the information.
7	Flexibility and efficiency of use	1. In the News menu, the display may be made easier to understand and there is no notification that the news is being loaded or not.	1. The display on the news menu is fixed and provides loading information if the news is being loaded or when clicked.
		2. When opening the application, you have to log in again so that the time to use the system becomes inefficient.	2. When logging in, you don't have to repeat again When the application is closed, the login will still be saved even if the application is closed.
		3. The lack of information that has just been updated makes the application not *real time*.	3. Add a notification feature if there is the latest news or the latest schedule update.
		4. The display for the exam list menu needs to be improved because there are icons that are less efficient to use.	4. Improve the appearance of the exam list page to improve satisfaction for app users.
8	Aesthetic and minimalist design	1. The color of the menu when active and disabled is different so that it is easier for users.	**1.** Improve the appearance of the exam list page to increase satisfaction for application users.
		2. The bottom bar design is quite easy to understand, it just needs to be refined again in moving the menu.	2. Fix in menu moves so that the process in menu moves can be seen.
		3. The bottom menu can make it easier for users to move menus, but the display is still rigid.	3. The display needs to be changed to improve the user experience so that it doesn't look monotonous.
		4. Menu coloring needs to be replaced because when opening the app in dark conditions can interfere with vision.	4. Menu coloring should be replaced so that it does not interfere with eye vision.
		5. The bottom bar design is quite easy to understand. The coloring should be replaced because it is too bright/bright.	5. The color on the bottom bar should be changed and adjusted to the background color of the app so that it is not too bright/bright.
		6. The coloring theme is not comfortable to look at for a long time.	6. The coloring of the entire application display should be replaced and maximized properly.
9	Help users recognize, diagnose, and recover from errors	1. Error messages have appeared and the page has an error when the internet is turned off.	1. The display of the error message is good, but it needs to be updated in the form of a modern android application.
10	Help and documentation	1. The application has displayed the history of the research carried out, but the display is still not feasible for a mobile application.	1. The history is improved to make it easier for users to understand the history of student research.
		2. There is no application manual book or feature that explains the functions of each menu	2. The importance of a manual book on the application or each feature makes it easier for users to use the application. Need to add manual book.

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Implementation of SIsKA-NG Mobile

From the evaluation results carried out by the evaluator, recommendations for improvement were obtained, which will then be carried out in the application development stage. At this stage, implementation was carried out by comparing the previous application with the latest application that has been developed. Figure 5 shows a comparison of the previous version of the SIsKA-NG Mobile application (Figure 5a), which is still using the old version, and SIsKA Mobile (Figure 5b), which has used the latest application interface where the interface is included in one of the 8 problems with the highest severity rating (Table 1) in the process of logging in to SIsKA-NG Mobile which often occurs splash screen. Thus, these problems were addressed with the highest priority. The latest design also uses a menu using the bottom navigation bar model (Figure 5c) to further maximize the display on the user's device screen.

In conveying information quickly to users, SIsKA-NG is also equipped with a real-time notification feature displayed on the front page of the user's device (Figure 6a), where the notification consists of news notifications, exam schedule notifications, research timeline notifications, and study period notifications. Notifications will also appear when the application is opened (Figure 6b). Notifications can also be seen in the research timeline menu, and users can also see the details of incoming notifications when they have logged in to the application (Figure 6c).

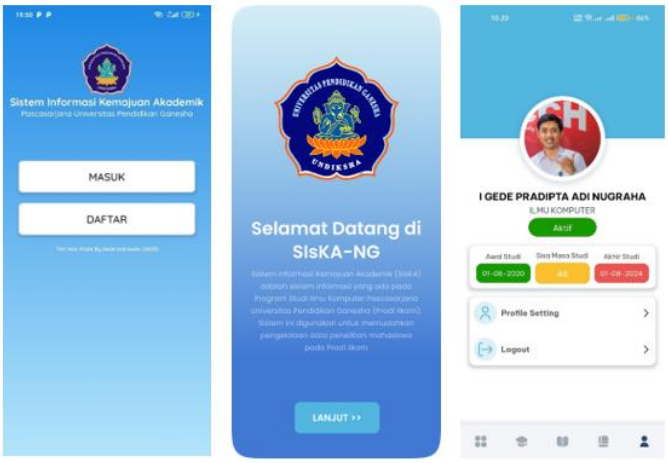


Fig 5 SIsKA-NG Mobile Home Page and User Profile

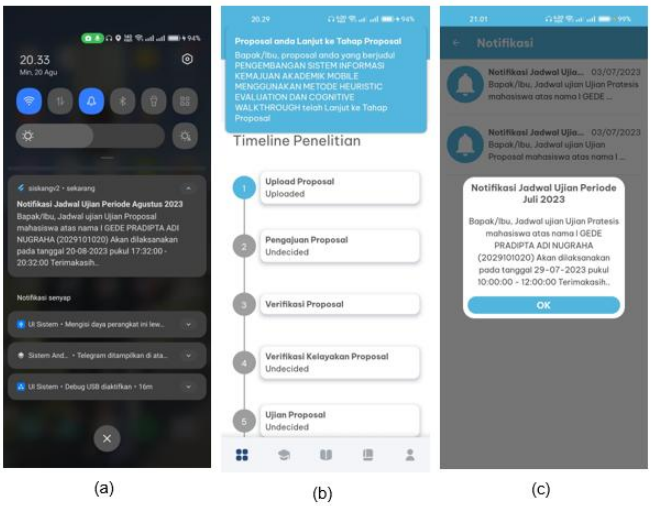
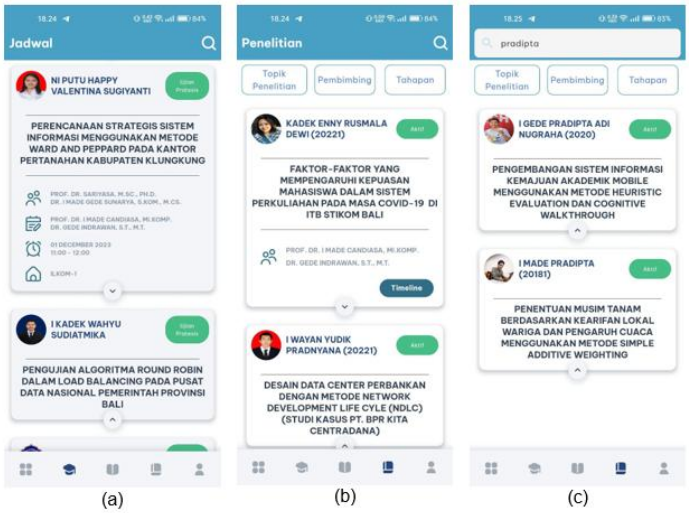


Fig 6 SIsKA Mobile Real-Time Notification Feature Display

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X



(a) (b) (c)

Fig 7 View of Research Page and Research Schedule Page

SIsKA-NG Mobile can also be used by students to see the research that is being done or has been done by students in the study program. SIsKA-NG Mobile has a research schedule page (Figure 7a) that aims to display the details of student research, namely student name, exam status, the title of topic taken, supervisor name, examiner name, exam time, and student exam place. The research and timeline of student research can also be seen on the research page (Figure 7b), which contains the name of the student, the batch of students, the research status, the name of the student supervisor, and the button to view the timeline of the student research if the student wants to do a search, it can be done with the search help button shown in (Figure 7c).

Contrast Ratio Measurement

From the evaluation and development results, this study also evaluated the application's accessibility using the WCAG-EM method by maximizing the Contrast Ratio for users with partial color blindness. The Contrast Ratio Measurement process is carried out following the WCAG 2.1 standardization by taking the background color of the application and comparing it with the color of the text (Foreground) on the application, then generating the feasibility of the Contrast Ratio by displaying numbers and indicators that the application is suitable for use (green) or it needs to be improved (red) as shown in Figure 8

Fig 8 Contrast Ratio Measurement Process

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14675
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Table 6 summarizes the Contrast Ratio Measurement on each page in SIsKA-NG Mobile, which users most often visit, so as many as 16 sample results were obtained. Based on the WCGA 2.1 standard, the contrast ratio (CR) value is at the threshold of 4.5. The CR value < 4.5 shows that the contrast ratio tends to be invisible to people with partial color blindness (dyschromatopsia). The CR value of >= 4.5 indicates a relatively normal contrast ratio seen by all ages. The higher the CR score, the clearer the content can be seen. Based on Table 6, 100% of the colors that have been applied to SIsKA-NG can be clearly seen by people with partial color blindness (Dyschromatopsia).

Table. 6 Summary of Contrast Ratio Measurement

No	Screen	Background	Foreground	CR	Remarks
1	Menu Bar (Bottom)	#F4F5F9	#28487A	8,38	Visible
2	Research Timeline (Text Title)	#FFFFFF	#585858	7,11	Visible
3	Research Timeline (Text Date)	#FFFFFF	#505659	7,45	Visible
4	Landing Page (Button)	#2D70AD	#FFFFFC	5,19	Visible
5	Profile (Logout Button)	#FFFFFF	#343F45	10,8	Visible
6	Profile (Setting Button)	#FFFFFF	#343F45	10,8	Visible
7	Schedule (Name)	#F4F5F9	#2E4771	8,54	Visible
8	Schedule (Topic)	#F4F5F9	#354048	9,74	Visible
9	Schedule (Detail)	#F4F5F9	#606569	5,41	Visible
10	Schedule (Status)	#F4F5F9	#21704B	5,53	Visible
11	Research Page (Graph Button)	#FFFFFF	#465C8C	6,62	Visible
12	Research Page (Search Button)	#2D70AD	#FFFFFF	5,2	Visible
13	Notification Page (Unread Notification)	#CBE9F4	#5D5B5B	5,3	Visible
14	Notification Page (Read Notification)	#FFFFFF	#5D5B5B	6,74	Visible
15	Notification Page (Detail Notification)	#FFFFFF	#545454	7,57	Visible
16	Realtime Notification	#1D6C8C	#FFFFFF	5,87	Visible

DISCUSSIONS

The evaluation results of the Academic Information System (SIsKA-NG Mobile) highlight significant usability and accessibility challenges in the system's interface and functionality. The heuristic evaluation identified 24 usability issues, with 8 classified as catastrophic and requiring immediate attention, 7 categorized as major concerns, and the rest as minor issues. These findings indicate that while SIsKA-NG Mobile provides essential academic services, its usability still needs improvement to enhance user experience and effectiveness.

Addressing these usability issues is critical for ensuring that students and academic staff can interact with the system efficiently. The recommendations provided from the first development stage served as a foundation for refining the system in its second iteration. By incorporating these suggested improvements, the development team aimed to create a more user-friendly interface with enhanced functionality.

Furthermore, accessibility evaluation using WCAG-EM (Web Content Accessibility Guidelines Evaluation Methodology) demonstrated that SIsKA-NG Mobile meets the necessary contrast ratio standards. The assessment focused on WCAG 2.1 and 2.0 guidelines, particularly ensuring a Contrast Ratio Measurement (CRM) of at least 4.5. The results confirmed that the system achieved 100% compliance across 16 test samples, making it highly accessible for individuals with partial color blindness (dyschromatopsia). This is a significant achievement as it ensures that the system accommodates users with visual impairments, promoting inclusivity in academic digital services.

These findings emphasize the importance of iterative development and accessibility compliance in designing academic information systems. While the system has improved in terms of usability and accessibility, future enhancements should continue to focus on refining both interface design and functionality to optimize user satisfaction and system effectiveness.

CONCLUSION

Based on the evaluation results of the Academic Information System (SIsKA-NG Mobile) using heuristic evaluation and WCAG-EM, problems were found in two aspects, namely the interface and the functionality of the system. In the interface aspect, an evaluation of SIsKA-NG Mobile (the first development) was carried out by finding 24 problems, 8 problems with the highest severity rating (Catastrophic) that must be fixed, 7 problems with high priority (Major) problems that need to be fixed, and others related to problems that need to be fixed but are of low priority (Minor). From these problems, the evaluator also provides recommendations as a reference for the second development of SIsKA-NG Mobile. From the implementation results, the final evaluation process was

*name of corresponding author

e-ISSN : 2541-2019
p-ISSN : 2541-044X

also carried out, namely accessibility with guidance from WCAG-EM, namely WCAG 2.1 and 2.0 in the Contrast Ratio section of the application. In this result, the Contrast Ratio Measurement (CRM) was carried out by meeting the standardization of WCAG to avoid CR < 4.5 which tends to be invisible to people with partial color blindness. CRM was carried out on SIsKA-NG pages by producing 16 sample results with a feasibility of 100%, which means that the application is very feasible for people with partial color blindness (dyschromatopsia).

ACKNOWLEDGMENT

The authors thank Direktorat Riset, Teknologi, dan Pengabdian kepada Masyarakat, Direktorat Jenderal Pendidikan Tinggi, Riset, dan Teknologi, Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia for supporting this work through a 2024 research grant.

REFERENCES

Gunawan, I. M. A. O., Indrawan, G., & Sariyasa, S. (2021). The development of academic progress information system using incremental models based on usability evaluation and white box testing. *SINTECH (Science and Information Technology) Journal*, *4*(1), 67–78. https://doi.org/10.31598/sintechjournal.v4i1.661

Sandhiyasa, I. M. S., Gunadi, I. G. A., & Indrawan, G. (2022). The evaluation of the academic progress information system SIsKA-NG Mobile based on heuristic and user experience. *International Journal of Modern Education and Computer Science*, *14*(2), 55–64. https://doi.org/10.5815/ijmecs.2022.02.05

Indrawan, G., Gunawan, I. M. A. O., & Sariyasa, S. (2020). The usability evaluation of academic progress information system (SIsKA-NG). *Advances in Science, Technology and Engineering Systems Journal*, *5*(2), 460-468. https://doi.org/10.25046/aj050259

Azizi, A., et al. (2021). Usability evaluation of hospital information system according to heuristic evaluation. *Frontiers in Health Informatics*, *10*(1), 69. https://doi.org/10.30699/fhi.v10i1.271

Ali, G., Dida, M. A., & Sam, A. E. (2022). Heuristic evaluation and usability testing of G-MoMo applications. *Journal of Information Systems Engineering and Management*, *7*(3), 15751. https://doi.org/10.55267/iadt.07.12296

Kirkpatrick, A., O'Connor, J., Campbell, A., & Cooper, M. (2024). *Web content accessibility guidelines (WCAG) 2.1*. Retrieved December 12, 2024, from https://www.w3.org/TR/WCAG21/

Shah, H. (2024). Enhancing web accessibility - navigating the upgrade of design systems from WCAG 2.0 to WCAG 2.1. *International Journal of Web & Semantic Technology*, *15*(1), 1–16. https://doi.org/10.5121/ijwest.2024.15101

Brown, J. D. (2021). Analysis of free browser-based accessibility tools: WCAG 2.1 evaluation of Mississippi Gulf Coast public library websites. *SLIS Connecting*, *10*(2), 101–115. https://doi.org/10.18785/slis.1002.10

Hossain, M. I. (2023). Software development life cycle (SDLC) methodologies for information systems project management. *International Journal for Multidisciplinary Research*, *5*(5). https://doi.org/10.36948/ijfmr.2023.v05i05.6223

Santoso, H. B., Schrepp, M., Hasani, L. M., Fitriansyah, R., & Setyanto, A. (2022). The use of user experience questionnaire plus (UEQ+) for cross-cultural UX research: Evaluating Zoom and Learn Quran Tajwid as online learning tools. *Heliyon*, *8*(11), e11748. https://doi.org/10.1016/j.heliyon.2022.e11748

Hernández-Campos, M., Thomaschewski, J., & Law, Y. C. (2023). Results of a study to improve the Spanish version of the user experience questionnaire (UEQ). *International Journal of Interactive Multimedia and Artificial Intelligence*, *8*(4), 202. https://doi.org/10.9781/ijimai.2022.11.003

Benaida, M. (2023). Developing and extending usability heuristics evaluation for user interface design via AHP. *Soft Computing*, *27*(14), 9693–9707. https://doi.org/10.1007/s00500-022-07803-4

Kumar, B. A., Goundar, M. S., & Chand, S. S. (2020). A framework for heuristic evaluation of mobile learning applications. *Education and Information Technologies*, *25*(4), 3189–3204. https://doi.org/10.1007/s10639-020-10112-8

Nielsen, J. (2024). *10 usability heuristics for user interface design*. Retrieved December 12, 2024, from https://www.nngroup.com/articles/ten-usability-heuristics

Fish, A. L., Alketbi, M., & Baillif, S. (2021). Evaluation of a new test for the diagnosis of congenital dyschromatopsia in children: The color vision evaluation test. *American Journal of Ophthalmology*. https://doi.org/10.1016/j.ajo.2020.11.003

*name of corresponding author

e-ISSN : 2541-2019
p-ISSN : 2541-044X

Bile, A., Bile, G., Pepino, R., & Tari, H. (2023). Innovative and non-invasive method for the diagnosis of dyschromatopsia and the re-education of the eyes. *Research on Biomedical Engineering*. https://doi.org/10.1007/s42600-023-00263-1

Verou, L. (2023). *GitHub - contrast-ratio: A tool to calculate the contrast ratio between any two valid CSS colors*. Retrieved December 12, 2024, from https://github.com/LeaVerou/contrast-ratio

*name of corresponding author