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ORIGINAL ARTICLE

USABILITY OF A MOBILE APPLICATION ON ANEMIA PREVENTION AMONG ADOLESCENTS

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ABSTRACT

The availability and usability of a smartphone application in Indonesia for preventing anemia, particularly for adolescents, are understudied due to the large number of health applications available for hematologic diseases. This research aims to provide a comprehensive overview of a mobile application development process to prevent anemia among adolescents and test its usability to the end user. The study analyzed the usability of a hybrid application called "AneMia-Prev" at a junior high school in Serang, Banten, Indonesia. The application was developed through conducting a content review, creating a prototype, and undergoing expert development. The usability was assessed by 15 adolescents using a Think Aloud and Smartphone Usability questionnaire. Meanwhile, data analysis was conducted using Jaspers' iterative 3-cycle model. The AneMia_Prev (TA) application was developed using server-client architecture, MySQL database, Apache Tomcat, and Spring Framework. A usability test was conducted on 15 female end users, with a mean age of 16.8 years and 60.0% of them in grade 8. The application received an overall usability average of 112.5 points, indicating good usability. The study demonstrates the high usability of the prototype, indicating its effectiveness, efficiency, and satisfaction, suggesting that future research could use TA methods with larger sample sizes.

Keywords: *Adolescent; anemia prevention; development; mobile application; usability*

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INTRODUCTION

The World Health Organization's Global Observatory for eHealth defines mobile health (mHealth) as public health and medical strategies enabled by mobile technology such as mobile phones. mHealth goes beyond the mobile phone services of the past and uses more advanced functionality and applications (Organization, 2011). More than 53,000 medical applications were available on the Android Play Store (one of the main download platforms) at the start of 2021 (Narrillos-Moraza et al., 2022). Diabetes (Kalhori et al., 2021; Kebede & Pischke, 2019), pain (Dantas et al., 2021; Kwan et al., 2019), rheumatic (Collado-Borrell et al., 2020; Terhorst et al., 2018), and psychiatric illnesses (Salehinejad et al., 2021; Singh et al., 2020), and cancer (Ali et al., 2019; Amor-García et al., 2020; Jongerius et al., 2019), have all been targeted by medical applications. Applications for patients with hematologic diseases are also available on the major download platforms, but little information is available about them. Moreover, adolescents have a low adoption of online education platforms due to a lack of awareness and low quality perceptions.

A previous meta-analysis indicated that 8 (9%) of 88 mHealth applications were available on both digital distribution platforms, while 54 (61%) were exclusively available on the Android Play Store, and 26 (30%) were only available on the Apple App Store. Furthermore, only 6 (7%) of these 88 applications required payment (mean cost: € 3.16 [US $3.60], SD € 1.57 [US $1.79]). (Narrillos-Moraza et al., 2022). In terms of purpose, most of the apps (60/88, 68%) were informative, followed by preventive (23/88, 26%) and diagnostic (5/88, 6%). Of the 88 applications, 43 (49%) were

updated in the previous year, and 23 (26%) were designed and built with the help of a healthcare organization. The distribution of applications for hematologic conditions was as follows: anemia (23/88, 26%), leukemia (12/88, 14%), hemophilia (11/88, 13%), thrombosis (8/88, 9%), thalassemia (7/88, 8%), hematological cancers (leukemia, lymphoma, or myeloma; 5/88, 6%), hemorrhage (5/88, 6%), and lymphs (Narrillos-Moraza et al., 2022). Given the vast number of health applications accessible for patients with hematological diseases and the growing interest in tools that promote patient self-care, a thorough examination is required. However, there is no clear agreement on the best way to evaluate the quality of health applications (Agarwal et al., 2021).

In Indonesia, there is a mobile application for the prevention of anemia for adolescents called CERIA. The application focuses on body weight and height measurements, as well as Fe tablets (source and records). No other application provides comprehensive health education, monitors Fe table consumption, and dietary patterns (Darmawati, 2019), and provides online consultation. Little is known about the current availability of a smartphone application in Indonesia to prevent anemia, and there are no studies on the overall development and usability of existing mobile applications that focus on anemia prevention for adolescents. Therefore, this research aims to provide a thorough account of the procedure to establish the feasibility of a mobile application designed to prevent adolescent anemia.

METHOD

Study design

This study investigated the usability of the hybrid application "AneMia-Prev," a mobile application that prevents anemia among adolescents. The users evaluated the application's prototype usability and tested its efficacy sequentially.

A total of six distinct algorithms make up the AneMia_Prev application (shown in Figure 1: 1) identification creation, 2) teenage education quiz (choose the right or wrong answer), 3) adolescent education film, 4) a meal log, 5) iron intake, and 6) communication online. The "AneMia-Prev" prototype is an innovative application that uses the user's mobile device without requiring an active Internet connection. To be suitable for Android systems, AneMia-Prev uses User-Centered Design, HTML, CSS, and JavaScript across its 10 menus and 63 screens.

Setting

The study was conducted in a junior high school in Serang, Banten, Indonesia, during February 2023.

Sample

Fifteen teenagers used the application during the experimental phase. A modest number of evaluators (between three and five) was suggested to ensure interface precision and evaluation using the specified heuristics (Gresse von Wangenheim et al., 2014). The participants were selected using convinience sampling. Those with severe physical or mental disabilities were not considered.

Testing was planned ahead of time to evaluate usability in three groups. However, statistical significance could not be attained. The respondents met the predetermined qualifications: they were between 15 and 19 years old, they were registered at the health center, they owned a mobile device for personal use and they were familiar with and competent in the usage of applications. The test results were based on the prototype performance during a maneuverability evaluation.

Instrument

The SURE (Smartphone Usability Questionnaire) usability measurement instrument was administered after an average of 20 minutes of handling or when the user felt that they had used the application over a sufficient time (Gresse von Wangenheim et al., 2014). SURE is comprises 31 items, all are smartphone-centric and created using Item Response Theory (IRT). The respondents rated their level of agreement with each statement using the following criteria: 1 = Very Poor, 2 = Fair, 3 = Good, 4 = Excellent, and NA = Not Applicable. The tool's overall score was calculated by adding all the participants' responses. When all item scores are added together, a maximum possible score of 124 is obtained. Level 30 indicates a chance of fully or partially disagreeing, level 40 indicates a chance of agreeing, level 50 indicates a failure to go from partially to strongly agreeing, level 70 indicates a strong agreement, and level 80 indicates complete agreement (Gresse von Wangenheim et al., 2014).

Data collection

The researchers approached the students during class breaks. They were briefed on the study and those interested in participating were led to a private room to discuss the study's goal. They were also shown the application prototype features through a tutorial delivered via PowerPoint, and then shown the application prototype. Participants signed the free and informed consent term after consenting to the study. They started with practical tasks following the Think-Aloud (TA) protocol. Each participant was informed that the researcher was primarily concerned with application performance and was urged to speak for more than 5 seconds (Ericsson & Simon, 1980). The main purpose of the application requires six tasks. Every TA activity was recorded.

The application was made available on the user's choice of mobile device (smartphone or tablet).

Data analysis

Videotaped TA sessions were transcribed and analyzed. The transcripts of the TA sessions included the participant's actual words and the elapsed and necessary processing times for each task. We used Jaspers' (2009) iterative 3-cycle model to probe the overarching ideas. We started by analyzing two TA meetings thoroughly and writing a report on the attendees' usability problems. Next, we sorted the codes into categories to find the overarching ideas. The reliability of the verbalizations was assessed by assigning codes to them. When we encountered a new problem, we evaluated it to see if it fit into any of the existing categories or if it was something entirely different. Tables were used to display the data. The data were then compared in the context of the relevant literature. Descriptive statistics, including frequency, percentage, mean, standard deviation, and test mean, were used to examine variables. The result of the usability test were compared using the adopted scores of the SURE instrument. Due to its foundation in the IRT, data reliability is ensured by the fact that each rater's reaction to an item indicates the probability of the item's parameters and ability (Gresse von Wangenheim et al., 2014).

Ethical considerations

The Ethics and Research Committee of Faletehan University approved the study (023/A.1/ETIK/2023). After receiving information about the study, each participant signed a

consent form. Participants are named by alphanumeric codes during the investigation to maintain anonymity.

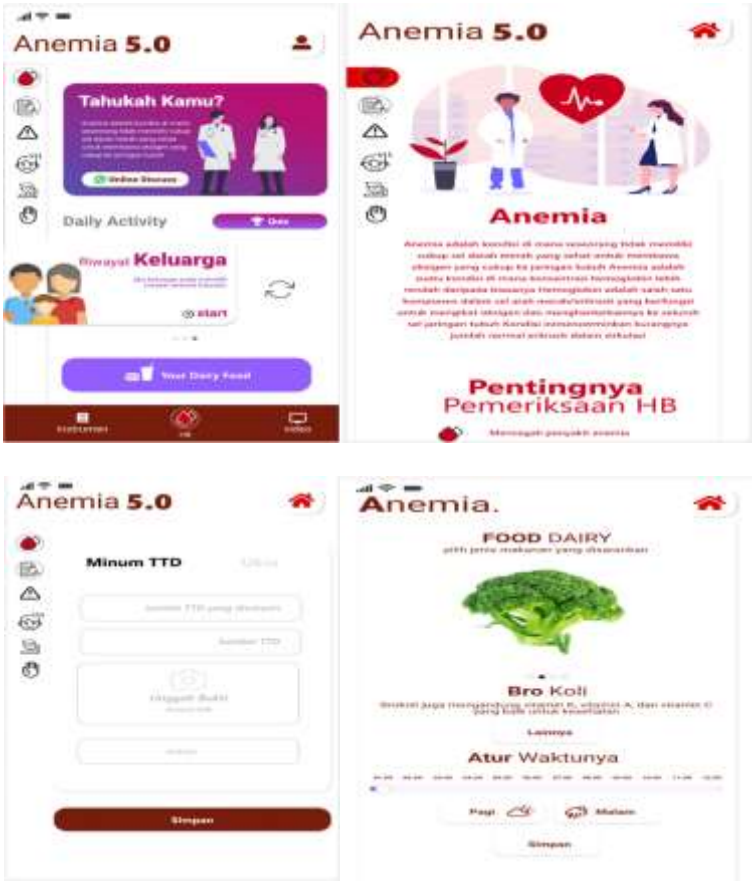

Figure 1. The mobile application “AneMia-Prev”

RESULTS

Characteristics of the participants

Fifteen end users participated in the usability test. All participants were female with an average age of 16.8 (SD = 1.32) and 60% were in the 8th grade.

Task Performance

We evaluated participant performance and task completion using completion rates, timeframes, and usability concerns. Table 1 shows completion rates and times. Due to connectivity troubles and the application's size, Task 1 (downloading and installing) took longer than the other tasks. All participants completed task 1 (downloading and installing the application), 10 of 15 completed task 2 (filling in the questionnaire), 13 of 15 completed task 3 (create an account) and 14 completed task 5 (finding the video education), 15 completed task 4 (finding the right homepage), 13 completed task 6 (finding the online chat) and 13 completed task 7 (finding the account/profile page). The download and installation of the application took the longest, followed by the filling out of the questionnaire and creating an account. Task 4—find online chat—took the least time.

Table 1. Completion of the participant task and time (n = 15)

Tasks	Completion rate	Times (minutes/seconds)
Downloading and installing the application	15/15	5/35
Filling in the questionnaire	10/15	7/15
Creating account	13/15	5/15
Finding the right homepage	15/15	0/24
Finding the video education	14/15	0/30
Finding the online chat	13/15	1/20
Finding the account/profile page	13/15	0/50

Usability

Table 2 shows the results of the SURE heuristic evaluation of the usability of the application prototype by end users.The scores of most of the participants for SURE items ranged from 3 to 4. Most of the participants (n = 12) agreed that the terminology used in texts, labels, titles, etc., is easy to understand. About 11 participants rated 4 for the following item: *“I would recommend this app to others. I found the app to be consistent. For example, all functions can be performed in a similar manner, and I found the texts easy to read”*.

Table 2. Responses of participants to each SURE item

Item	Score			
	1	2	3	4
1. I found it easy to enter data in these applications. For example, using QR code, picklist, etc.	-	2	3	10
2. When I made a mistake, it was easy to correct it.	-	3	5	7
3. I found the app help/tipto be helpful.	-	2	7	6
4. It was easy to find the information I needed.	-	1	5	9
5. I felt in charge when using this app.	-	-	7	8
6. I found the time it took to complete the tasks to be adequate.	-	3	6	6
7. It was easy to learn how to use this app.	-	4	3	8
8. The sequence of actions in the application corresponds to the way I usually perform them. For example, the order of buttons, data fields, etc.	-	2	3	10
9. It is easy to do what I want using this app.	-	3	4	8
10. It was easy to navigate the application menus and screens.	-	2	4	9
11. The app meets my needs.	-	3	3	9
12. I would recommend this app to others.	-	-	4	11
13. Even in a hurry I would be able to perform the tasks in this application.	-	2	4	9
14. I found the app to be consistent. For example, all functions can be performed in a similar manner.	-	1	3	11
15. It is easy to remember how to do things in this app.	-	4	4	7
16. I would use this app often.	-	3	3	9
17. The organization of menus and action commands (such as buttons and links) is logical, allowing you to easily find them on the screen.	-	4	5	6
18. I can successfully complete the tasks using this app.	-	3	7	5
19. I enjoyed using this app.	-	5	4	6
20. The app provides all the information needed to complete tasks clearly and in a straightforward way.	-	4	3	8
21. I found the app very complicated to use.	-	3	2	10
22. Symbols and icons are clear and intuitive.	4	1	3	7
23. I found the texts to be easy to read.	-	-	4	11
24. I found the application to be too complex. I had to recall, research or think hard to complete the tasks.	1	3	2	10
25. The terminology used in texts, labels, titles, and more is easy to understand.	-	-	3	12
26. I would need the support of one person to use this app.	2	3	2	8
27. I felt comfortable using this app.	-	3	5	7
28. The app behaved as expected.	-	1	8	6
29. I found it frustrating to use this app.	-	4	1	10
30. I found that the various functions of the application are well integrated.	-	2	7	6
31. I felt very confident in using this app.	-	3	8	4

The SURE tool's proposed assessment level for each user is listed in Table 3. Table 3 shows that the range of usability scores ranges from 87 to 117, with an average of 112.5. Therefore, we framed usability as a single level (80 = fully agree), which is indicative of the prototype's high level of usability.

Table 3. Scores obtained from end-user assessment using the SURE usability tool

Respondent	Total SURE	Level
1	110	Totally agree
2	104	Totally agree
3	98	Totally agree
4	118	Totally agree
5	112	Totally agree
6	114	Totally agree
7	116	Totally agree
8	117	Totally agree
9	119	Totally agree
10	87	Totally agree
11	113	Totally agree
12	95	Totally agree
13	106	Totally agree
14	118	Totally agree
15	120	Totally agree

Think-aloud evaluation
In this section, we look at the major usability concerns with identifying terms and other issues with the app's informational value.

Issues of terminology interpretation
Before they could start using the app, participants had to take a survey to determine their degree of social media addiction. Misunderstandings of key concepts in the TA analysis made it challenging for participants to obtain actionable insights. The participants had difficulty collecting specific personal information in the end due to widespread misunderstandings of the words used in the TA analysis, as follows:

> *'Table iron supplements are difficult to interpret, as are some phrases in the food record; but when pictures are used in conjunction with words, the process becomes relatively simple.'*

Filling out food diary and iron consumption
Some users were confused by the limited space given to the food diary and iron intake on the main page. The two participants who went straight to the tips section had the following remarks.

> *"I found it challenging to keep track of the daily food that needs to be documented, particularly when it comes to identifying various types of food with names that are not always universally recognizable."*

DISCUSSION

The end users strongly agreed that Anemia_Prev has good usability, as evidenced by the SURE and TA evaluation results. Respondents found the product useful since it allows them to easily enter and edit data. Such capabilities are similar to those found on currently available devices. In addition, the interface is user-friendly and interactive, the content is simple and straightforward, and the language used is understandable and accessible. At the highest level, users agree that the application's assistance and advice are excellent. Therefore, this finding suggests that the application is easy to learn and use in daily life.

Furthermore, the respondents stated that the design and presentation of the application greatly affected the enthusiasm and commitment of certain adolescents to using it. Despite the fact that most users felt they had accomplished the application's primary purpose, their expectations were not reached. This finding is consistent with previous TA-based research on mHealth and digital health (Bolle et al., 2016; Van der Vaart et al., 2013). Although survey participants reported finding data on an online tool to be simple, Bolle et al. (2016) found that many users could not do so. Thus, games and animations could be used in future anemia prevention apps.

The field of human-computer interaction has recently paid much attention to the usability of mobile apps, and with good reason (Hoehle et al., 2016). As a result, various usability assessment methods have made their way into published works. However, these models may not apply to any particular mobile app due to their complexity and lack of proper definitions for determining usability measures such as usability dimensions, criteria, and metrics (Zahra et al., 2017). The exponential rise of applications, the widespread availability of poor-quality apps, and the proliferation of app categories, and various platforms are all additional considerations. Since each app category has unique functional and nonfunctional requirements, usability assessment techniques cannot universally evaluate their properties. Therefore, unique usability models may be needed to evaluate these different apps (Zahra et al., 2017). The usability of this mobile health app has been evaluated according to the standards established by the Healthcare Information and Management Systems Society. Although the criteria were wide and included usability engineering factors to measure efficiency, effectiveness, user pleasure, and platform optimization, the Likert scale used to categorize them does indicate their quality (Marques et al., 2020). Before this research, there was no established method for determining the effectiveness of mobile health apps in terms of usability. There are usability models for mobile applications, but they have not been thoroughly investigated, and most are not useful. Due to unique qualities and changing application context, current usability principles are insufficient to design effective app interfaces (Zahra et al., 2017).

Total usability rating was determined after assigning points to each category using a Likert scale from 1 to 5. The application mainly received a score between 3.0 and 4.0, making it a moderate to mediocre option at best, especially for its limited feature sets. Three main factors defined usability: prompt and clear feedback, an intuitive interface, and easy identification of clickable areas. These factors are considered before making an app available to the public. Usability testing provides a technical foundation for users to become accustomed to the capabilities of mobile technology before conducting comprehensive context applicability assessments. This paves the way for more detailed user feedback on feature needs and potential applications (Vélez et al., 2014). Furthermore, an app's content is one component that can ensure its usefulness. On this basis, the government has proposed strategies for anemia prevention apps at the individual, healthcare provider, and software engineer levels (Rose et al., 2019). The specific setting requires that the present app conforms to clinical practice and provides the most fundamental requirements. Future studies could use TA methods to test usability by incorporating a larger sample size.

One of the weaknesses of this study is the small size of the sample population. In addition, we have no way to know whether each respondent read and considered each question carefully when completing the questionnaire.

CONCLUSION AND RECOMMENDATION

The results of the usability test showed that the Anemia_Prev app was very usable. The users agreed on the above criteria, indicating that the product was designed with their needs in mind and offered high usability. Therefore, mobile health technology can improve the effectiveness of clinical treatments for the prevention of anemia by providing users with increased access to information and less paperwork.

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