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Developing Suicide Risk Idea Identification for Teenager (SERIINA) Mobile Apps Prototype using Extended Rapid Application Development

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***Abstract*— Suicide death is the number 15 cause of death in the world. Suicide cases go undetected because the perpetrator shows no signs beforehand. Therefore, it is necessary to identify the risk of suicide in adolescents early, accessed quickly, maintains user privacy, and understand user needs. Using the Risk Factors of Suicidal Ideation (RFSI) questionnaire, it hoped to detect early suicide incidents in adolescents. This research proposed a Suicide Risk Idea Identification for Teenager (SERIINA), a mobile application developed using the Extended Rapid Application Development (ERAD) method. The ERAD method combines the concept of design sprint and RAD in the system development cycle. Based on the research results, SERIINA mobile apps development is completed in 19 days. The functional testing using Black-Box testing shows that the application works well and compatible with the five main scenarios. The results of interface design testing using heuristic evaluation indicate that the application has been well designed, with a usability value of 2.34 or about 72-85% according to design rules.**

Keywords—Rapid Application Development, Design Sprint, Suicide Risk Idea, Risk Factor of Suicidal Ideation

I. Introduction

Suicide is defined as a fatal act of self-harm with some evidence of intention to die. Based on the WHO Global Health Estimation, the death rate due to suicide in 2016 is 10.6 per 100,000, which means around one end every 40 seconds. Suicide constitutes 1.4% of all deaths and is the number 15 cause of death worldwide [1] so that an estimated 1.5 million people will die of suicide by 2020. The Indonesian Ministry of Health conducted the global school-based student health survey (GSHS) in the form of a health survey on junior and senior high school students aged 12-18 years. In the 2015 GSHS survey, the sample came from 75 schools in 68 districts/cities in 26 provinces. The GSHS results show data on the intention to commit suicide in middle and high school by 4.3% in men and 5.9% in women [2]. Adolescent suicide can be prevented by close collaboration between individuals, families, communities, professions, and governments. Teenagers should be asked directly about suicidal thoughts, so they feel cared for and can express problems [2]. The government has conducted various programs as preventive measures such as youth care health, peer counselors, health report card, school health efforts, school-based mental health programs, and child-friendly schools [3]. We support government activities to identify new suicide risks in youth, which can be accessed quickly, maintain user privacy, and understand user needs through school-based mental health programs.

The need for junior high and senior high schools to find out their student's mental health conditions is a reason for making an application quite essential and urgent. Therefore, a fast and value-focused application development method tailored to user requirements is considered relevant to address these needs. Rapid system development methods include RAD and Agile. The Rapid Application Development (RAD) model is based on continuous user interaction in fulfilling prototype development needs so that management is more comfortable. Agile projects are better in flexibility, agility, teamwork, and quality based on user stories. Constant user involvement is avoided, requiring long maintenance times to fix iterations and story point releases. A study by [4] found that projects developed with the RAD methodology performed 13.33% better in providing comprehensive and complete documentation than those following agile techniques. These problems consider Rapid Application Development (RAD) because it is known as developing fast applications reliance on repeated user feedback [5]. The RAD method reduces software development and maintenance costs and focuses on the development, testing, and feedback processes [6]. Software development generally requires a minimum of 180 days, but using the RAD method can be completed in 30-90 days [7]. The RAD method has drawbacks in requiring skilled human resources for large scale projects. RAD requires developers and customers to be committed to the rapid-fire activities needed to complete a system in a short time [8]. If there is no commitment, the RAD project will fail. Team commitment is built on fast manufacturing processes and staying connected during project creation. Additionally, the quick prototype's ability may not always translate well to large projects and commercial applications [9]. To reduce the time spent building prototypes, we speed up the design process.

This research was supported by an LPPM research grant from the Institut Teknologi Telkom Purwokerto for Tenia Wahyuningrum (No. IT Tel1764 / LPPM-000 / Ka. LPPM / VII / 2020).

Acceleration of the design process will reduce production time to be implemented immediately and instantly identified deficiencies of the application. Any deficiencies will be corrected continuously to improve the application prototype.

This study proposes a mobile application for Suicide Risk Idea Identification for Teenager (SERIINA) using the Extended Rapid Application Development (ERAD) method. The ERAD method combines the design sprint method in the RAD system's interface design steps to speed up the process. Design sprints are a framework for teams of any size to solve and test design problems in 2-5 days [10]. The speed of the sprint design process is the advantage of this method to save time and costs. The interface design stage consists of 3 steps, understand, diverge, decide [10]–[12]. This stage's output is a low-fidelity design, which will then be refined into a high-fidelity design and prototype. The understanding phase focuses on human values and shows the user precisely what the design wants. This phase will require reflective thought and conceptual analysis drawing in other disciplines, including philosophy, psychology, art, literary theory, cultural studies, anthropology, sociology, or design [13]. In the diverging step, the team must define or find a solution to the problem (discussed in the previous "understand" stage). At this stage, the group finds the key to the strategy of the problem. In the "decide" stage, all team members will discuss to determine the best ideas. These ideas will later be implemented in the business project. Combining the design sprint method as one stage early in the system's development is expected to improve the experience and speed up project work.

II. Research Method

A. *Suicide Risk Idea Identification Instrument*

The instrument for detecting the risk of suicidal ideation in adolescents using Risk Factors of Suicidal Ideation (RFSI) contains 16 questions combining four dimensions: a sense of belonging, loneliness, hopelessness, and burden with a Cronbach alpha score of 88.2% indicating a high level of validity [3]. How to calculate the score is added up the scores on each item from number 1 to 16; if the score for the sum of all things is ≥ 34, it can be stated that we have a risk of the suicidal idea [3].

This study generally expects adolescents to use risk factor detection tools for suicidal ideation independently, and counseling teachers can carry out new management of prevention of risk of suicidal ideation in adolescents. Control of the prevention of suicide ideas, among others, helps improve self-management (coping) strategies to overcome emotional distress through practicing positive thinking, festive activities, and environmental support [14].

B. *Extended Rapid Application Development*

The ERAD consists of three main phases, interface design, prototype, the last one is testing and implementation can be seen in Fig. 1. The interface design stage lasts for three days, with approximately seven team members. In the first day, the team starts the sprint by sharing knowledge, understanding the problem, and setting goals.

This stage uses the 360-lightning talk method, which lasts for 60 minutes. Each participant is required to explain and tell what they know about the product to be made. The team discussed project vision, user views, and technology used. The participants listened to while writing down the ideas they got from each stakeholder's explanations on sticky notes, then posted them on the wall. If they cannot meet offline, participants can use online application platforms such as Miro or Murals for the brainstorm.

In the "diverge" stage, the team is encouraged to get as many ideas as possible from all the How Might We (HMW) method's problems. This method is about getting as many ideas as potential solutions to a problem or challenge. Another technique used at this stage is the Crazy Eight Method (8 ideas in 8 minutes). Through this method, participants are encouraged to work individually and generate eight different ideas/concepts. Each person only needs one A4 paper and one black marker to illustrate each concept. In the "decide" stage, each participant explains the results of the ideas set out in Crazy Eight. Then, the team voted the big idea to choose the most useful sketch for making a prototype.

The prototype stage is focusing on building a Minimum Viable Product (MVP). MVP is a product with enough features to satisfy users, and they can draw their opinion. Build this MVP by making a prototype from the big ideas obtained from the previous voting. Early iterations occur in approximately four days. Developers, designers, users, and usability experts collaborate in prototype and validate steps. Adjustment in design is discussed and compromised in the prototype stage. At the end of the stage, the developer team then builds the application according to the prototype.

Functional testing activities are essential to check and ensure that the application runs according to its respective services. In comparison, usability testing examines the effectiveness, efficiency, and user satisfaction. The implementation process is carried out by implementing junior and senior high schools' applications, making manual books, and conducting user system training, both counseling teachers, students, and parents.

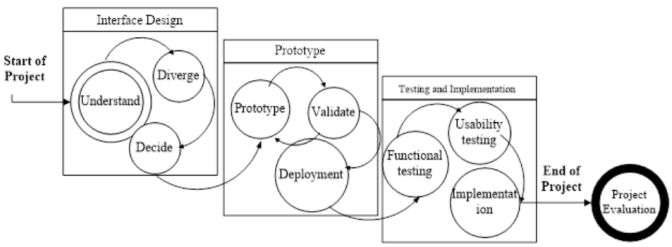

Fig. 1. Extended Rapid Application Development Process

III. Result and Discussion

A. Interface Design

Seven team members consisting of junior high school counseling teachers, senior high school counseling teachers, psychologists, developers, and designers gathered at the interface design stage. During the first few hours of the online meeting, we discussed project vision and user views on the initial screening of suicidal ideation in adolescents. After that, using the HMW method, we illustrate the SERIINA application workflow, as shown in Fig. 2. Users involved in the application are students, counseling teachers, and parents. There are three main work procedures, psychiatric screening requests, filling out questionnaires, results, and recommendations.

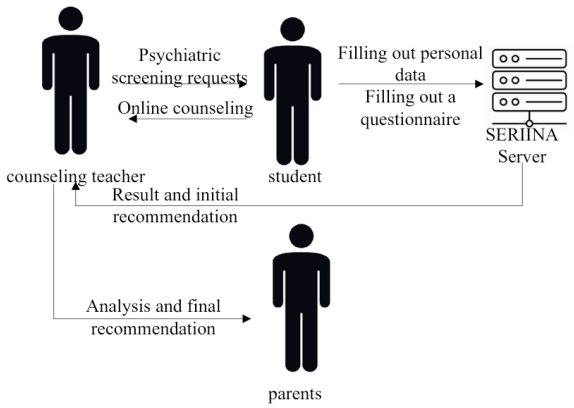

Fig. 2. SERIINA workflow process

The crazy eight methods generate as many ideas as possible quickly in a rough sketch form. The designers turned the selected best sketch into a more refined low-fidelity and high-fidelity design. Fig. 3 shows the low-fidelity design of SERIINA. This design consists of eight user interfaces selected by the team. The low-fidelity design aims to turn a sketch of an idea into a testable artifact to gather and analyze feedback at an early stage. Low-fidelity design is a low-tech and straightforward concept. Fig. 3 shows four of the 8 most selected ideas Fig. 3 (a) is a login page design, Fig. 3 (b) present a user profile page, Fig. 3 (c) is a questionnaire page, Fig. 3 (d) is a recommendation page.

In addition to system interface requirements, team members discuss other provisions related to system requirements, namely technology requirements, system functional requirements, and information. Operational environment requirements consist of hardware requirements for building applications 4 GB RAM minimum, 8 GB RAM recommended 2 GB minimum available disk space, 4 GB Recommended (500 MB for IDE + 1.5 GB for Android SDK and emulator system image), 1280 x 800 minimum screen resolution. Meanwhile, the software needs include the operating system Microsoft Windows 7/8/10 (64-bit), Android studio, Balsamiq mockup, Figma, or Adobe XD.

System functional requirements include questionnaires, user profiles, online consultation, and recommendations. The questionnaire is necessary to fulfill the instrument's function for early identification of suicidal ideation in adolescents. While the need for user profiles is the need to give recommendations, the teacher can see the family background, hobbies, and self-descriptions of students. Consultation needs and guidance are the need to provide feedback to students on the questionnaire analysis results. The information needs of SERIINA applications include reports on the results of consultations and teacher follow-up to students to solve the problem of suicidal tendencies.

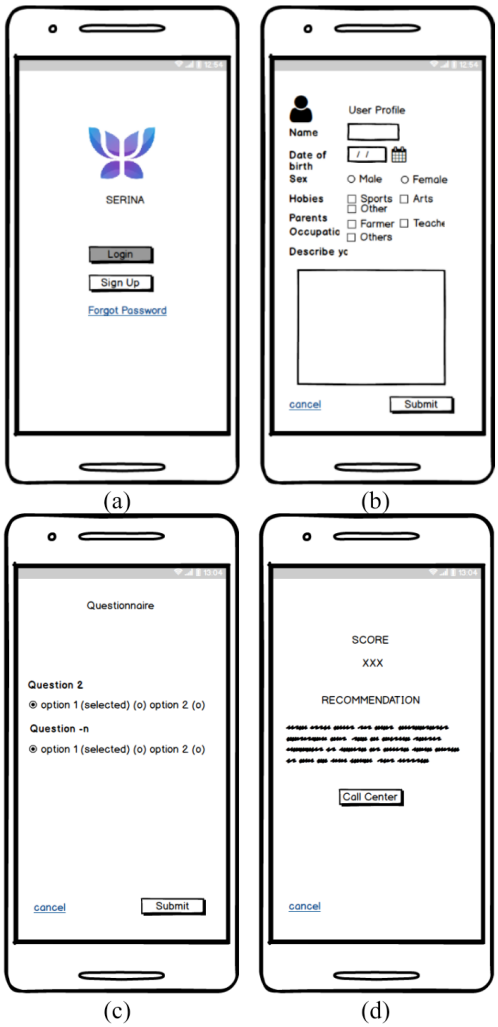

Fig. 3. Low-fidelity design of SERIINA

B. Prototype

At the prototype stage, developers, designers, users, and usability specialists collaborate on prototyping and validating steps. They interact with each other to design the design with high precision. In this step, a prototype provides real and intangible experiences through the implementation of presentations [12]. Fig. 4 shows several pages designed for the high-fidelity of SERIINA. The high-fidelity design has the advantage of being easy to implement because the user has already seen the initial image of the prototype. Another advantage, users are active in the system development process, and communication between developers and users is well maintained.

Fig. 4 (a) describes applying the button hierarchy method to the login page design—hierarchical design principles such as providing a background for the most important buttons (login). The secondary (sign up) and tertiary (forgot password)

buttons are made without experience. The visibility of system status is the first rule in the design. The system should always keep users informed about what is going on through appropriate feedback within a reasonable time. The SERIINA tells the user what page to access by describing the top of the page. Fig.4 (b), (c), (d) shows the pages of a user profile, questionnaire, and page of the inbox. A good and comfortable design should be equipped with an error handler. When an error occurs, the app should provide an error message and offer a solution. On the login page, if the user forgets the username and password, there is a forgot password button. Error prevention is also on the user profile form page (see Fig. 4 (b)). The system will set dd/mm/yyyy to make it easier for users on the date entry. Fields that are not mandatory will get an "optional" description next to the caption field. The next design principle is user control and freedom. The edit, delete, and save buttons are a way for designers to give users the flexibility to change, delete, and preserve personal data on the user profile page (see Fig. 4 (b)). SERIINA mobile app also maintains user privacy, users are given the freedom to write their names or only initials.

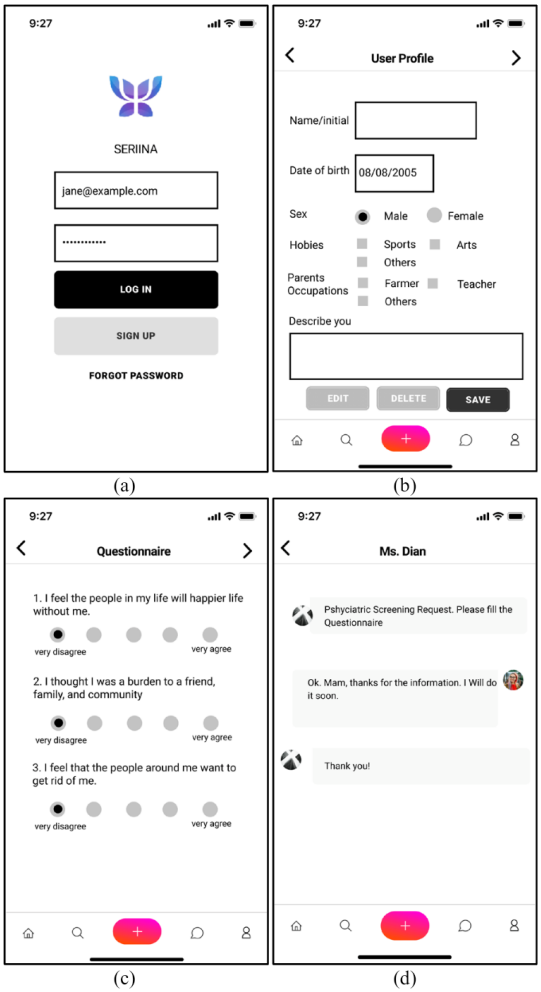

Fig. 4. High-fidelity design of SERIINA

On the recommendation page design, the questionnaire scores are calculated and displayed. Suppose the score <34, the display that appears is the total score with a green background (Fig. 5 (a)). If the score is ≥ 34, the user will see a yellow background display (see Fig. 5 (b)).

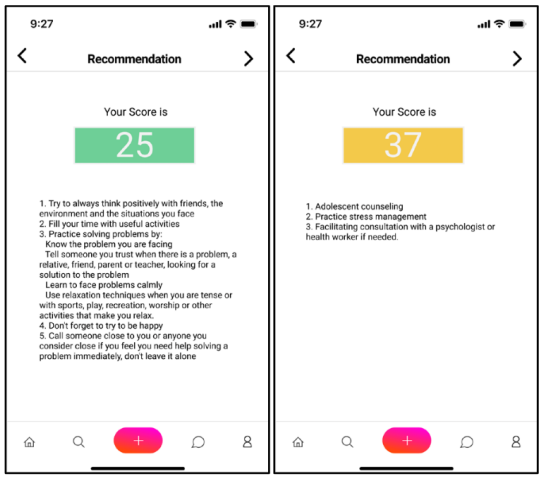

Fig. 5. Recommendation page design

Fig. 6 shows the database schema for the SERIINA application. In the user table, there are three privileges, students, teachers, and parents. Parents only have access to the username, password, and teacher recommendations. According to their characteristics, the student and teacher will each have their profile data stored in the table. The questionnaire table contains students' answers to the questions on the RFSI instrument. Each question answer will be calculated and produce a score. This score is the basis for the recommendation—the inbox table stores messages between users. The system will save and mark messages that have been read and messages that are a priority.

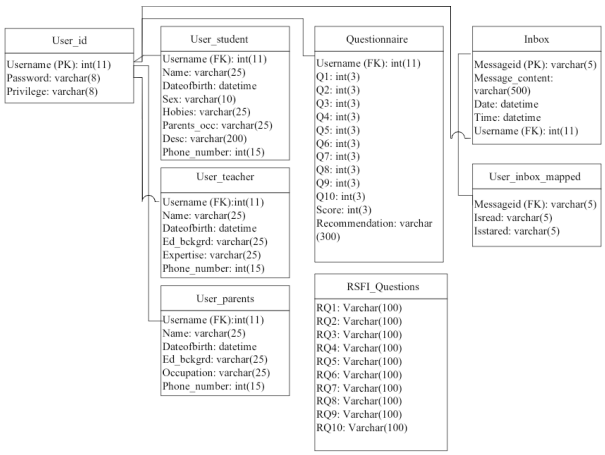

Fig. 6. Database schema of SERIINA

C. *Testing and implementation*

One of the functional application tests is Black Box testing. Black Box testing focused on the application's appearance, the functions in the application, and the suitability of the function flow. This test does not see and test the source code of the program. The test results can be seen in Table I.

Table I shows that the Black-Box test results in the five main scenarios are compatible and successful. These five scenarios and tasks were then tested using heuristic evaluations to obtain more detailed information about the application's usability. Table II shows the usability rules criteria for the SERIINA mobile apps prototype [15].

TABLE I. BLACK BOX TESTING RESULT

Scenario	Task	Expected result	Test Result/ Conclusion
User profile	Filling the user profile form, click the 'save' button.	User enters the user profile page.	Compatible/ Normal
Login	Enter the e-mail and password, click the 'log in button'.	User enters the main page.	Compatible /Normal
Psychiatric screening requests	Click the 'screening' button	Users get messages for psychiatric screening.	Compatible /Normal
Questionnaire	Filling questionnaire	User enters the recommendation page.	Compatible /Normal
Online Counseling	Chatting with counseling teacher	User sends a message to another user	Compatible /Normal

TABLE II. USABILITY RULES

Values	Usability rules of each criteria
86-100%	Compliance with 3 usability rules
72-85%	Compliance between 2 to 3 usability rules
58-71%	Compliance with 2 usability rules
44-57%	Compliance between 1 to 2 usability rules
30-43%	Compliance with 1 usability rules
14-27%	Compliance between 0 to 1 usability rules
0-13%	Compliance with 0 usability rules

Experts assisted in heuristic testing to perform a systematic inspection of the interface design for usability. This evaluation is useful for finding usability problems in design [16]. Based on ten heuristic evaluation criteria, each criterion contains three rules that are examined. If there is an interface design that does not comply with the rules, it will be given a value of 0; otherwise, it will be given a value of 1. Further explanation regarding each evaluation criteria can be seen in Table III.

Table III shows that the third and ninth criteria get the lowest usability value. Regarding the third criteria, usability experts argue that the SERIINA mobile app prototype does not provide an "emergency exit" to leave unwanted circumstances. In the ninth criterion, the rules to help users identify, diagnose, and recover errors can be described. Although error prevention has been implemented on the login page and user profile page, there are no error messages in filling out questionnaires and online counseling scenarios if a user makes a mistake while doing an assignment.

The highest usability value is in the fourth and eighth criteria. The SERIINA mobile app prototype has been well designed using consistent font size and style, placing consistent forms and headings, and using a standard design for calls to action. Besides, the interface design is simple and easy to understand, the icons are depicted, and the forms are easy to fill out. Looking at the overall results of usability values, it can be said that the average heuristic score of the ten rules is 2.34 or about 72-85% (good).

The system development cycle has cut its time to approximately two weeks based on the two processes: interface design and prototype. In the first four days, the team doing the design sprint method, the second four days, the designer focuses on making prototyping. If there is a revision, then four more days are added to improve the prototype design. The total quality is 12 days. The testing process takes around seven days, so the whole SERIINA mobile app prototype development using the ERAD method is approximately 19 days. In general, the main functions have been well built and tested but still require adjustments and improvements in design and development to comply with expert suggestion.

TABLE III. HEURISTIC EVALUATION RESULT

No	Evaluation criteria	Task 1	Task 2	Task 3	Task 4	Task 5	Severity rating
1	Visibility of system status	3	3	3	3	1	72-85%
2	Match between system and the real world	3	3	2	3	3	72-85%
3	User control and freedom	1	1	2	2	2	44-57%
4	Consistency and standards	3	3	3	3	3	86-100%
5	Error prevention	3	3	3	1	3	72-85%
6	Recognition rather than recall	1	1	3	3	3	72-85%
7	Flexibility and efficiency of use	2	2	2	2	2	58-71%
8	Aesthetic and minimalist design	3	3	3	3	3	86-100%
9	Help users recognize, diagnose and recover from error	3	3	2	0	0	44-57%
10	Help and documentation	2	2	2	2	2	58-71%

IV. CONCLUSION

SERIINA application has been completed at the interface design, prototype, and testing stages. At the interface design p stage, a user interface consisting of low fidelity and high-fidelity has been designed. At the prototype stage, a high-fidelity design is then made a prototype that can be clicked on the buttons to get closer to the finished application. The ERAD method combines the concept of design sprint and RAD in the system development cycle. SERIINA application development is completed in less than 20 days. Based on the results of functional testing using Black-Box testing, it can be seen that in the five main scenarios, the application works well and is compatible. The results of interface design testing using heuristic evaluation show that the application has been well designed. Future work is possible in calculating user performance and satisfaction while using the application.

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