Development of an Android-Based Game Using Forward Chaining for Detecting Bullying Among Junior High School Students

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Abstract

Bullying is an aggressive behavior commonly occurring among junior high school students, with detrimental impacts on both physical and mental health. This research developed an Android-based quiz game to detect bullying using the Forward Chaining method. The application is designed to identify five types of bullying: physical, verbal, direct non-verbal, indirect non-verbal, and cyber. The development process employed the Multimedia Development Life Cycle (MDLC), which includes concept, design, material collection, assembly, testing, and distribution. Testing results indicated that the application is effective in detecting bullying cases, facilitating guidance counselors (BK teachers) in obtaining accurate data, and enhancing student engagement through an interactive approach. This study aims to aid in bullying prevention within schools while serving as a foundation for further development in integrating technology for social intervention and providing opportunities for subsequent research on optimizing game features and developing data-driven interventions.

Keywords: bullying, Android-based game, bullying detection, Forward Chaining, students.

1. Introduction

Bullying refers to aggressive behavior directed at an individual, occurring repeatedly, deliberately, and with the intent to harm, demean, and dominate others emotionally, physically, or mentally [1]. While bullying has existed for a long time, it remains a persistent issue in Indonesia to this day. Adolescents are particularly vulnerable, often acting as both perpetrators and victims in bullying cases [2]. Victims of bullying are at a higher risk of experiencing various health problems, both physical and mental [3]. Bullying, generally perpetrated by individuals perceived as stronger or more powerful than their peers, frequently occurs in school settings across primary, junior high, and senior high schools.

The prevalence of bullying among adolescents is attributed to their heightened egocentrism during this developmental stage. The process often begins with incidents that trigger negative emotions, leading individuals to choose between confronting, escaping, or challenging the situation. The "challenging" response is particularly concerning as it frequently manifests as aggressive behavior, bullying, and violence [4]. Common forms of bullying include coercing victims to perform physical exercises, shouting at victims, extorting money, mocking, intimidating, threatening, and, in severe cases, physical assault [5].

The efforts of counseling services in preventing bullying are not optimal, partly due to the use of paper-based questionnaires, which result in waste, paper accumulation, and inefficiency, as well as security issues in data collection.

Based on previous research, the study titled "PKM Deteksi Dini Kecemasan Korban Bully Berbasis Teknologi Informasi dan Peningkatan Minat Belajar melalui Game Based Learning pada anak di SD IT Fadhilah Pekanbaru" involved three stages: preparation (system design and development), implementation (outreach and training on the use of anxiety detection applications, art therapy, and game-based learning), and evaluation and reporting. The results of the study indicate that this system is effective in detecting bullying victims among students in schools [6].

Another study, titled "Deteksi Bullying Pada Anak Usia Sekolah di SD Muhammadiyah Paesan Kecamatan Kedungwuni Kabupaten Pekalongan" utilized the PIPS (Peer Interaction Primary School)

measurement tool, consisting of 22 questions with three answer options: Frequently (F), Sometimes (S), and Never (N). This instrument measured bullying detection variables. The study found that 82% of respondents were categorized as victims, 17% as perpetrators, and 1% as both victims and perpetrators [7].

Several related studies, titled "Aplikasi Game Simulasi 3D Pencegahan Bullying Anak Remaja Berbasis Role Playing Menggunakan Metode FSM dan BT" adopted the MDLC (Multimedia Development Life Cycle) method. Testing the game using the Technology Acceptance Model (TAM) yielded a positive response rate of 76%. This study aimed to provide an effective and engaging alternative medium for fostering understanding of bullying [8].

Other related studies, titled "Efektivitas Game Edukasi Stop Bulliying Dalam Meningkatkan Kesadaran Anti-Bulliying Pada Anak SD Menggunakan Construct 2 Dan Metode MDLC" produced a game titled "Stop Bullying." The game aimed to help elementary school children understand the forms and intentions behind bullying [9].

Other related studies with the title "Bullying dan Deteksinya Melalui Metode Games di SMP N 5 Banguntapan" employed a three-phase methodology: observation, socialization, and reflection. The resulting game contained 20 questions, revealing that 66% of respondents had been victims of bullying, while 59% had been perpetrators [2].

This research uses the forward chaining method to detect bullying in students based on existing symptoms. Previously, questionnaires were still paper based, often identifying almost all students as bullying victims.

To reduce paper usage and assist bullying victims, an Android-based questionnaire game was developed. This game also serves as an information medium and supports counseling services in collecting bullying data, while making students more engaged and less bored when filling out the questionnaire.

2. Methods

The Multimedia Development Life Cycle (MDLC) is an appropriate method for designing and developing media applications that integrate various types of media, such as images, sound, video, and animation [10]. By utilizing multimedia as a learning tool, users can enjoy an engaging learning experience through the combination of different elements, which helps reduce boredom and is well-suited for self-directed learning [11]. The development of games in this study adopts the Multimedia Development Life Cycle (MDLC) model. One applicable method is Luther's method, commonly referred to as the Multimedia Development Life Cycle (MDLC), which consists of several stages: concept, design, material collecting, assembly, testing, and distribution [12].
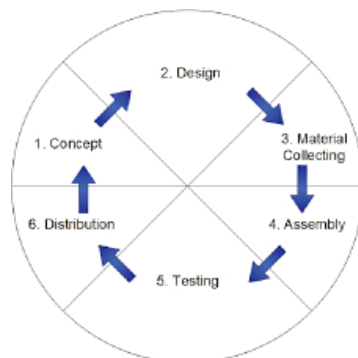

Figure 1. MDLC Method

2.1. Concept

In the concept stage, the program's objectives, general specifications, and target users for development are determined [13]. The objective of this application is to design an engaging Android - based questionnaire game. The game will incorporate images in each question to ensure that middle school students do not feel bored. A detailed description of the designed game concept is presented in Table 1.

Table 1. Game Description

Aspect	Description
Title	Bullying Questionnaire Game
Genre	Quiz
Duration	Unlimited
Objective	To assist users, particularly school counselors, in collecting information on whether students fall into bullying categories.
Target Users	Middle school students
Graphics	2D
Application Format	.apk Format
Aspect	Description
Title	Bullying Questionnaire Game

2.2. Design

The design phase involves creating specifications that include project structure, visual design, style, and material requirements for the program. These specifications are developed with a high level of detail to ensure that decisions in subsequent phases, such as material collection and assembly, can be effectively based on the results of the design phase [14]. In this phase, the application design utilizes Forward Chaining, a Menu Structure, and an Interface Design.

A. Forward Chaining

Forward chaining is a reasoning method that begins with facts to test the validity of a hypothesis or match the facts. This approach starts by evaluating the initial part of a statement (the IF part) [15]. The process begins with premises or initial information (if) and proceeds to conclusions or derived information (then) [16]. In the proposed application design, 25 symptoms of bullying have been identified, as outlined in the following Table 2.

Table 2. Bullying Symptoms Codes

Symptom Code	Symptom Name
G1	Experiences physical violence such as being hit, pushed, or kicked
G2	Feels worried in certain places due to physical threats
G3	Fears approaching someone due to concerns about experiencing physical violence
G4	Has been injured because of physical actions
G5	Avoids certain places because of threats of physical violence
G6	Receives ridicule or insults
G7	Is called by an unflattering nickname
G8	Feels disturbed by slander or false accusations
G9	Feels embarrassed or uncomfortable due to negative comments
G10	Feels pressured due to verbal harassment
G11	Is stared at with a cynical or demeaning gaze
G12	Is insulted through facial expressions or body gestures
G13	Experiences mockery involving gestures like sticking out the tongue
G14	Feels anxious when someone uses demeaning body gestures
G15	Becomes a victim of behavior such as being deliberately ignored
G16	Is ignored by a group of friends
G17	Hears that someone is spreading negative rumors
G18	Feels manipulated, leading to disrupted social relationships
G19	Is secretly avoided
G20	Is excluded from certain groups
G21	Receives threatening or insulting messages via social media
G22	Feels targeted by negative rumors
G23	Feels anxious due to private photos or videos being uploaded to social media without consent

G24	Becomes a victim of false information dissemination
G25	Fears opening social media because of online intimidation

Table 3. Bullying Type Codes

Bullying Code	Bullying Type
B1	Physical Bullying
B2	Verbal Bullying
B3	Direct Non-Verbal Bullying
B4	Indirect Non-Verbal Bullying
B5	Cyberbullying

Table 4. Relation Table

Rule	Bullying Type
G1, G2, G3, G4, G5	Physical Bullying
G6, G7, G8, G9, G10	Verbal Bullying
G11, G12, G13, G14, G15	Direct Non-Verbal Bullying
G16, G17, G18, G19, G20	Indirect Non-Verbal Bullying
G21, G22, G23, G24, G25	Cyberbullying

Figure 2. Relational Structure

Explanation:
1. If bullying involves G1, G2, G3, G4, G5 ➔ B1 = Physical Bullying
2. If bullying involves G6, G7, G8, G9, G10 ➔ B2 = Verbal Bullying
3. If bullying involves G11, G12, G13, G14, G15 ➔ B3 = Direct Non-Verbal Bullying
4. If bullying involves G16, G17, G18, G19, G20 ➔ B4 = Indirect Non-Verbal Bullying
5. If bullying involves G21, G22, G23, G24, G25 ➔ B5 = Cyberbullying

B. Menu Structure

This game application features five main menus: the Intro Menu, Main Menu, Quiz Menu, and Results Menu. The application provides 25 questions with "Yes" and "No" answer choices, which will determine the result based on the provided answers. After the user accesses the Results Menu, the application will return to the Main Menu via the available "Back" button. Below is the menu structure for the " Bullying Questionnaire Game."
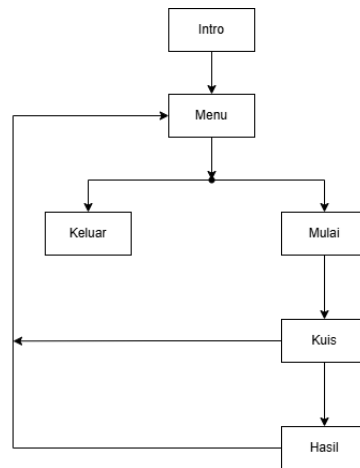
Figure 3. Menu Structure

C. Interface Design
1. Intro Menu Interface Design
The Intro Menu interface features a text title, content text, and a "Start" button. The "Start" button directs the user to the next menu, which is the Main Menu.

Figure 4. Intro Menu Interface Design

2. Main Menu Interface Design
The Main Menu interface includes the game title and two buttons: "Play" and "Exit." The "Play" button directs the user to the Quiz Menu, while the "Exit" button closes the game application.
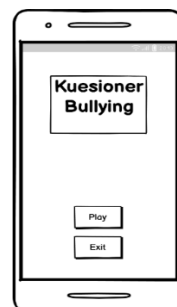

Figure 5. Main Menu Interface Design

3. Quiz Menu Interface Design
The Quiz Menu interface is designed to display the questions, supporting images, and two interactive buttons: "Yes" and "No." The user can select one of these buttons to answer the displayed question.
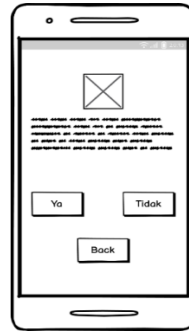
Figure 6. Quiz Menu Interface Design

4. Results Menu Interface Design
   The Results Menu interface is designed to display text containing the result based on the user's answers. Additionally, there is a "Back" button that allows the user to easily return to the Main Menu.

Figure 7. Results Menu Interface Design

2.3. Material Collecting

Material collecting is the process of gathering and organizing materials that align with the design requirements [17]. In this stage, all necessary materials are identified, selected, and categorized to facilitate the assembly or implementation in the next stage. In this application design, 2D objects will be created and collected as the main elements. The required 2D objects are obtained from various sources, such as the internet, custom creation, or free sources. The collected materials include background images, button images, and images for each question, most of which are created using a web-based graphic design application, Canva. Additionally, the font used in this application is also freely available from the internet.

2.4. Assembly

The assembly stage is the process where all multimedia elements are designed, arranged, and integrated into a cohesive whole [18]. In this stage, each multimedia object, such as images, text, audio, and other interactive elements, is produced and processed according to the project's needs. This process ensures that each component supports one another to create the result that aligns with the design goals. The assembly process includes:

a. The first stage involves creating assets, such as background designs, illustrations for each question, and buttons using a web-based design application, Canva. Additionally, font selection is done using free fonts obtained from the website https://www.dafontfree.io, ensuring an attractive display that meets the application's requirements.
b. The second stage is the coding process and the configuration of the scene in Unity. The scenes are arranged based on the interface design planned in the Design stage. Each object within the application must serve a specific function, which is implemented through coding using the C# programming language. This stage ensures that all elements in the application work properly and according to the design.
c. The third stage is the process of integrating all the assets created in the first stage into the application. At this stage, each asset, such as background designs, buttons, and supporting images, is integrated with its respective objects, which have already been programmed with specific functions. This integration ensures that all elements work in accordance with the application's design.

2.5. Testing

In this stage, testing is conducted to identify and correct any errors within the system, with the aim of minimizing faults [19]. This is done to ensure that the system functions properly and as expected when applied or implemented. The testing of this game application is carried out in two phases: White Box Testing and Black Box Testing. Below are the results of both testing phases.

A.   White Box Testing

White-box testing is a method of testing applications or software by examining the existing modules to analyze and evaluate the written code [20]. The goal is to identify any errors or issues within the code by inspecting the internal components or the source code of the software being tested.
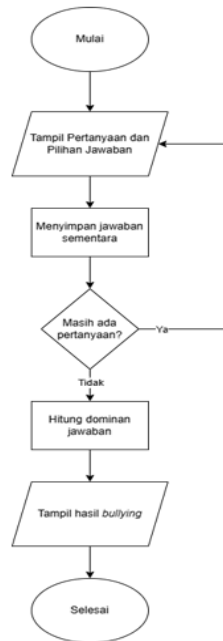
Figure 8. White Box Testing

In Figure 8, users can perform the bullying detection process by answering the questions provided. The user's answers will match the rules established during the design phase. The type of bullying will be determined based on the answers provided by the user. For example, if the user answers "yes" to three out of five questions related to physical bullying, and answers "yes" to two questions out of five related to other types of bullying, the output will categorize the user as a victim of physical bullying. This is because the output is based on the most dominant symptom data according to the types of bullying. Based on the application testing results, no issues or errors were found in the "Bullying Questionnaire Game"

B.   Black Box Testing

Black Box Testing is a software testing method that focuses on the functionality or performance of the application without considering its internal structure or the underlying code [21]. In this type of testing, the evaluation is based solely on what the application does, such as whether the features work properly and as expected, without needing to know how the application operates behind the scenes.

Table 5. Black Box Testing on the Intro Menu

Test ID	Test	Result	Conclusion
A01	Intro text displayed	Displays text object on the Intro Menu	Success
A02	Navigation button to Main Menu pressed	Displays and switches to Main Menu scene	Success

Table 6. Black Box Testing on the Main Menu

Test ID	Test	Result	Conclusion
B01	"Play" button pressed	Displays and switches to the Quiz Menu scene	Success

Test ID	Test	Result	Conclusion
B02	"Exit" button pressed	Application exits	Success

Table 7. Black Box Testing on the Quiz Menu

Test ID	Test	Result	Conclusion
C01	Question text displayed	Displays the text of each question from first to last	Success
C02	"Yes" button pressed	Switches to the next question	Success
C03	"No" button pressed	Switches to the next question	Success

Table 8. Black Box Testing on the Results Menu

Test ID	Test	Result	Conclusion
D01	Result text displayed	Displays the result text based on user answers	Success
D02	"Back" button pressed	Displays and switches back to the Main Menu	Success

2.6. Distribution

In the distribution stage, the application that has undergone testing will be exported in .apk file format, with the purpose of allowing the application to be installed and used by Android device users [22]. The application will be stored on Google Drive to facilitate easy access and downloading. Subsequently, the download link for the application will be shared with users through various platforms, such as email, social media groups, or instant messaging, ensuring that users can easily download and install the application on their devices. This step is taken to ensure that the application can be widely distributed and used by the target audience.

3. Result and Discussion

The development results of the "Bullying Questionnaire Game" application were carried out using Unity as the main platform for game creation. To support the visual display, the graphic design of the game was created using Canva as the design tool. Below are the results of this game application:
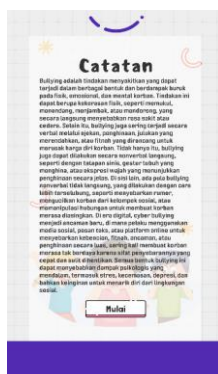
1. Intro Menu

Figure 9. Intro Menu

In figure 9, the Intro Menu page is displayed, containing a brief explanatory text or note about the different types of bullying. This page serves as an introduction for the users before proceeding to the next stage. On this page, there is also a button labeled "Mulai" (Start), which users can press to continue to the main menu of the game. Once the "Mulai" button is pressed, users are directed to the main menu to choose features or continue their activity in the game. This page is designed to provide clear and engaging introductory information that captures the user's attention.
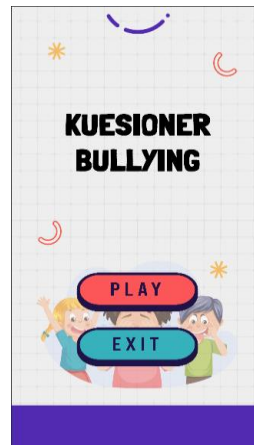
2. Main Menu

Figure 10. Main Menu

In figure 10, the main menu page is displayed, featuring the game title, "Bullying Questionnaire," which serves as the primary identifier for the application. This page also provides two buttons with the following functions:

A. "Play" Button: This button allows users to start the game. When pressed, users are directed to the quiz menu to answer the provided questions.
B. "Exit" Button: This button allows users to exit the application. Pressing this button immediately closes the application.

The main menu page is designed with a simple yet intuitive interface, making it easy for users to understand and navigate the available features of the application.

3. Quiz Menu

Figure 11. Quiz Menu

In figure 11, the quiz menu page is displayed, featuring several key elements to support the quiz-taking process. These elements include:

A. Question Illustration: A visual element that provides context or enhances the appearance of the quiz page.
B. Question Text: Contains the question that the user must answer based on their experiences or opinions.
C. "Yes" and "No" Buttons: Serve as the answer options that the user can select for each question.
D. "Back" Button: Allows the user to return to the previous page, which is the main menu, enabling them to either restart or cancel the quiz session if needed.

This page is designed to offer a simple and engaging experience, making it easy and comfortable for users to respond to questions.
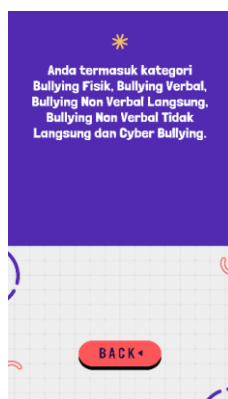
4. Results Menu

Figure 12. Results Menu

In figure 12, the results menu page is displayed, which shows the results based on the answers provided by the user during the quiz session. This page displays the type of bullying detected according to the user's responses. Additionally, there is a "Back" button, which allows the user to return to the main menu page if they wish to retake the quiz.

4. Conclusion

Based on the results of the research conducted, the following conclusions can be drawn This study successfully implemented the Forward Chaining method and the Multimedia Development Life Cycle (MDLC) in the development of a bullying questionnaire media application. The resulting application can easily detect types of bullying, using an approach that is engaging for users. The methods used ensure that this application is not only functional but also provides an enjoyable user experience.

This application provides specific benefits, particularly in the school environment, especially for Guidance and Counseling teachers (BK). The game simplifies the process of filling out a bullying questionnaire efficiently, allowing BK teachers to more quickly and accurately identify the types of bullying experienced by students. Therefore, this application is expected to serve as an effective tool in addressing bullying issues in schools.

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