

Development of Human Facial Expression Game for Autism Children Using Design Thinking Method

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Abstract

Facial expression is one of the important factors in interacting and communicating activities. People can know the emotions and feelings of the interlocutor through their facial expressions. However, this can be difficult while doing interactions with children with autism. These limitations become obstacles in socializing for children with autism because not everyone can understand their feelings. To overcome this problem, a study was proposed with the title "Development of a Game for Recognizing Human Facial Expressions for Children with Autism Using Design Thinking Methods". The existence of this research is expected to help children with autism to learn facial expressions according to the emotions they feel and can improve their social skills. The method used in this study is the Design Thinking method which consists of 5 stages, namely Empathize, Define, Ideate, Prototype, and Test.

Keywords: *Autism; Design Thinking; Facial Expression; Game*

I. Introduction

A facial expression is a form of nonverbal communication that is produced through facial muscle movements. Expression is created through the details of the shape of the eyebrows, eyes, nose, and mouth [1]. Through facial expressions, one can understand the meaning, emotions, and feelings of the interlocutor more easily. Therefore, facial expressions are one of the important factors in interacting and socializing activities.

However, this does not apply when interacting with children with autism. In 2018 the Ministry of Women's Empowerment and Child Protection of the Republic of Indonesia stated that the number of autism reached 2.4 million people and it is estimated that it will always increase every year [2]. Children with autism tend to be less able to understand the emotions in the surrounding environment

and are less able to show facial expressions when interacting. Not a few children with autism show emotions in extreme and unnatural ways such as shouting, scratching their arms, to hitting objects around them [3].

Using technology can be done to help train the expression of children with autism. Through games as a learning medium, children with autism can learn to use expressions according to their emotions and avoid extreme behavior. In addition, through games, educational activities become more fun and can be done anywhere and anytime with adult guidance. These benefits can be seen through several studies that have been done previously. In this research [4] he developed games as educational media for special training on disaster mitigation for children with autism. The results obtained from this study are that games are acceptable and have a positive impact on autistic children.

Based on the description that has been presented, "Development of a Game for Recognizing Human Facial Expressions for Autistic Children Using Design Thinking Methods" was chosen as the title of the study. Currently, there are still few educational games for children with autism, especially regarding human facial expressions, so a human facial expression recognition game was made in this study. The Design Thinking method was chosen because it focuses on the user and the stages in the development process can be repeated so that the resulting game is under the user's needs. The existence of this research is expected to help provide learning media for children with autism to learn facial expressions according to the emotions they feel through games.

II. Method

The research was conducted at the Bintang Indonesia Therapy Center located in Gondanglegi, Malang Regency, East Java. The research and development method used in this study is the Design Thinking method. The Design Thinking method is a method that has an iterative process to understand users, challenge assumptions, and redefine a problem to determine alternative solutions with the main focus on the user [5]. The stages of the Design Thinking method can be seen in Figure 1.

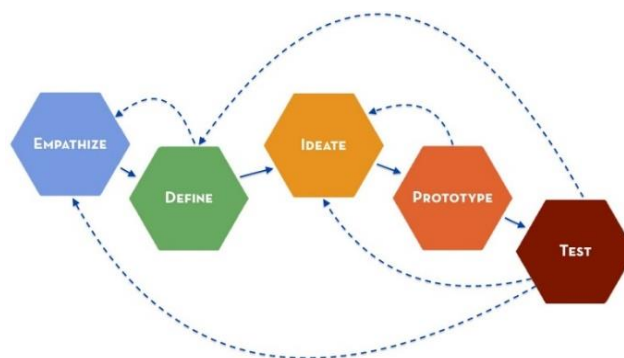


Figure 1. Steps of Design Thinking Method

a. Emphathize

At this stage, data was collected by conducting interviews with teachers at the Bintang Indonesia Therapy Center regarding the problems faced by potential users. The following are questions asked during the interview process:

1. What are the social interaction problems experienced by children with autism at the Bintang Indonesia Therapy Center?
2. What are the problems experienced by children with autism regarding the ability to express and control emotions?
3. In general, problems with the ability to express and control emotions are faced by children with autism in what age range?
4. How to solve the problem described in question number 2?
5. What are the important components that help children with autism understand the solution described in question number 4?
6. How important is the ability to express emotions to socialize for children with autism?
7. Are the autistic children at the Bintang Indonesia Therapy Center accustomed to using gadgets?
8. Can autistic children at the Bintang Indonesia Therapy Center play games on their gadgets?
9. Do children with autism like games that have many levels?
10. In one play, how many levels of autistic children can complete the game?
11. Do children with autism like to repeat the same game?
12. What learning media are suitable for children with autism?

b. Define

At this stage, data in the form of interviews were analyzed to define the focus of the problems of controlling expression and emotions faced by children with autism at the Bintang Indonesia Therapy Center. The results obtained at this stage are in the form of problems related to the control of expressions and emotions experienced by children with autism at the Bintang Indonesia Therapy Center.

c. Ideate

The activity at this stage is to determine the ideas that are used as solutions to overcome the problems of controlling expression and emotions faced by children with autism at the Bintang Indonesia Therapy Center. To get the best idea, several techniques are needed, including the following:

1) *How Might We*

The use of the How might we technique aims to open up every possibility so that it triggers the emergence of creative and abundant ideas. The results at this stage are in the form of a formula

for the question "approximately how we ..." related to solutions to the problems of controlling expression and emotions faced by children with autism at the Bintang Indonesia Therapy Center.

2) *Brainstorming*

Brainstorming is an activity carried out to think of as many ideas as possible. These ideas then go through validation to the Bintang Indonesia Therapy Center to determine the best ideas by considering the urgency and needs of users.

3) *Arsitektur Informasi*

The next activity is to create an information architecture to describe the concept of information in the game. Information architecture is the form of a chart that shows the elements that exist on each game page.

4) *Alur Pengguna*

User flow is a flow that describes the steps or course of an application that serves as a guide that is used to make it easier for users to understand and access the features provided in the game. In this study, the user flow is described through a flowchart.

5) *Wireframe*

Next is the wireframe design to visualize the ideas that have been obtained. Wireframes are used to provide an overview of the layout of the components in the game.

d. *Prototype*

At this stage, the wireframe that has been designed is implemented into a test product or prototype. This stage serves to provide an overview to the user about the solution provided through the game prototype that has been designed.

e. *Test*

At this stage, the product goes through 3 testing processes, namely:

1) *Media Expert Validation*

Testing is done by someone who is an expert in the field of game development. Testers are asked to run the game first to assess the feasibility of the game in terms of system functionality. Examiners were asked to fill out a questionnaire consisting of 10 question indicators with 5 score categories, namely very decent (5), decent (4), enough (3), less feasible (2), and very less feasible (1). The final score obtained is a percentage with a range of 0% to 100% using the following formula:

$$\text{Percentage} = \frac{\text{obtained score}}{\text{maximum score}} \times 100\% \quad (1)$$

2) *Material Expert Validation*

The test is carried out by someone who is an expert in the field of psychology. Examiners will be asked to run the game to see if the material presented in the game is appropriate. The assessment is carried out as in the media expert validation activity, only the context of the questions on the questionnaire is different and refers to the material presented in the game.

3) System Usability Scale (SUS) Testing

The test will be carried out by trying the game directly on children with autism at the Bintang Indonesia Therapy Center accompanied by a companion. After that, respondents were asked to fill out a questionnaire consisting of 10 questions that were tested based on the user's feelings when using the system. Each question has 5 categories of answers, namely Strongly Disagree (STS), Disagree (TS), Neutral (N), Agree (S), and Strongly Agree (ST). The final score obtained ranges from 0 to 100 with a calculation based on formula 1 [6].

$$SUS = ((Q1 - 1) + (5 - Q2) + (Q3 - 1) + (5 - Q4) + (Q5 - 1) + (5 - Q6) + (Q7 - 1) + (5 - Q8) + (Q9 - 1) + (5 - Q10)) \times 2.5 \quad (2)$$

Based on the SUS score that has been obtained, the next step is to draw conclusions with the following conditions:

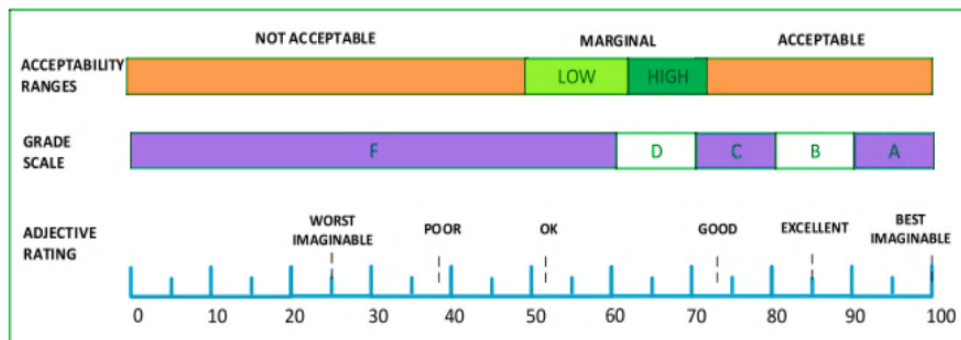


Figure 2. System Usability Scale (SUS) Assessment Scale

III. Results and Discussion

a. Emphathize

At this stage, interviews were conducted with consultants at the Bintang Indonesia Therapy Center. The following are the results of the interviews that have been conducted:

1. What are the social interaction problems experienced by children with autism at the Bintang Indonesia Therapy Center?
 - a. Less able to interact, not interested in interacting and tend to have their preoccupations, sometimes ignores when called or invited to chat and only focuses on themselves

- b. Difficulty regulating expressions and emotions, some convey emotions through actions such as tending to scream when annoyed, scratching their arms, and slamming things.
 - c. Shows repetitive behavior, likes to flap his hands, has his way of playing with a toy and the method used is not common and never changes
2. What are the problems experienced by children with autism regarding the ability to express and control emotions?
Some can't show a sad expression so when they're sad sometimes they even laugh or bang their hands on the table. Some rarely show any expression, their expression is always flat, so to know what they are feeling, one has to ask how they feel whether they are happy or sad. There are also those who, if they don't like something or are in a bad mood, will cry while screaming and scratching.
 3. In general, problems with the ability to express and control emotions are faced by children with autism in what age range?
Since childhood, but most parents only realize it when they are around 5 – 13 years old, roughly equivalent to the age of children from kindergarten to elementary school.
 4. How to solve the problem described in question number 2?
Through learning about the ability to imitate concepts and the ability to understand and express language. For learning the concept of imitation, mentors usually give examples of some of their expressions and then the children imitate them. In addition, the concept of imitating can also be done through an animated video. When the focus of the video shows the faces and expressions of the characters, children are usually taught to understand the expressions conveyed and imitate them. Children are also taught when to use appropriate expressions according to how they are feeling. For the ability to express language, children are taught to communicate what they want and what they feel by talking to their mentor about how they feel or what they want to do.
 5. What expressions are taught to children with autism?
The most frequently taught are expressions that are commonly used in everyday life such as happy, sad, angry, crying, and afraid. Sometimes children are also taught other random expressions such as bored, sleepy, and curious as well as expressions to show negative things such as mocking or condescending.
 6. What are the important components that help children with autism understand the solution described in question number 4?
The main thing is patience because dealing with children with autism requires extra time and effort. In addition, the learning carried out must be repeated several times until the child

understands and can apply it. In addition, the learning applied must be under everyday life to make it easier for children to accept the material presented.

7. How important is the ability to express emotions to socialize for children with autism?

Very important. Moreover, as a human in life, we also need socializing activities, talking to friends, and playing with friends, especially children who are generally their age and who like to play and hang out with friends. If the ability to express themselves is lacking, children will find it difficult to convey their feelings and cannot be understood. Not everyone, especially children, can accept these shortcomings. There is a possibility that children who have difficulty expressing their emotions will be isolated and isolated.

8. Are the autistic children at the Bintang Indonesia Therapy Center accustomed to using gadgets? Some are used to it or not, depending on whether their parents allow it or not. Even if it is allowed, the hours are usually limited so that children do not continue to play with gadgets. But the majority can use it well.

9. Can autistic children at the Bintang Indonesia Therapy Center play games on their gadgets?

Most can play simple, less complicated games like puzzles or matching.

10. Children with autism can play how many levels of the game?

For simple games such as matching shapes where each level has the same level of relative difficulty, children can play about 10 to a maximum of 20 times.

11. Can children with autism play games sequentially?

Not with all children, some can and some don't. For those who do not, this can be done under the guidance of a companion.

12. What learning media are suitable for children with autism?

For learning childrens tend to like things that can be seen and imitated, such as brightly colored images or videos

b. Define

Based on the results of interviews that have been carried out at the empathize stage, here are the problems experienced by children with autism at the Bintang Indonesia Therapy Center:

1. Children with autism are less able to show expressions according to the emotions they feel so emotions are conveyed through inappropriate behavior.
2. Understanding the material presented to children with autism requires repetition of the material several times.
3. To facilitate the understanding of children with autism, the material presented is following everyday life.

c. Ideate

1) How Might We

Through the how might we technique, the possibilities obtained are as follows:

1. How can we teach expressions according to the emotions felt by children with autism through games?
2. How can we convey material that is easily understood by children with autism through games?

2) Brainstorming

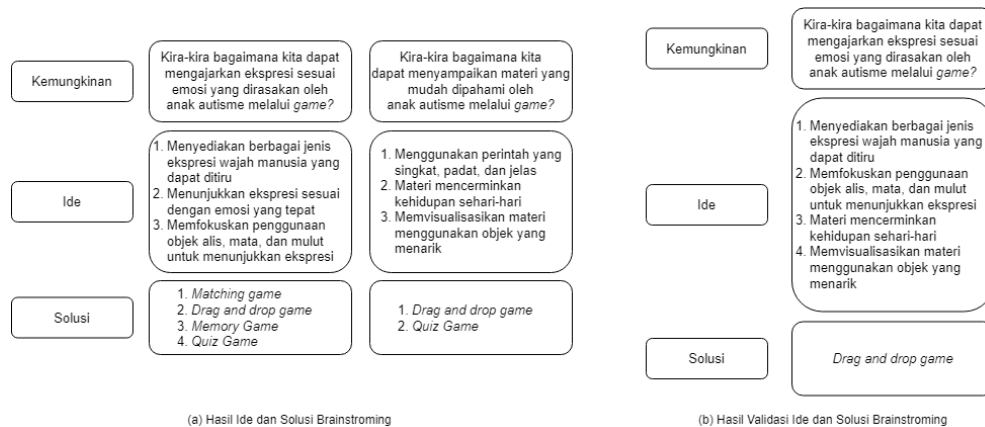


Figure 3. Brainstorming Results and Validation

The idea and solution obtained from the validation activity is the creation of a drag and drop game. Players are asked to compose an expression that is determined by choosing among the objects of the right eyebrows, eyes, nose, and mouth. The game consists of 20 expressions selected based on validation to mentors at the Indonesian Bintang Therapy Center by referring to research [7][8][9]. There is no difference in the level of difficulty in each expression. These expressions consist of happy, scared, condescending, worried, sad, disgusted, disappointed, assertive, crying, neutral, bored, sly, angry, laughing, hurting, mocking, shocked, sleepy, confused, and curious.

3) Information Architecture

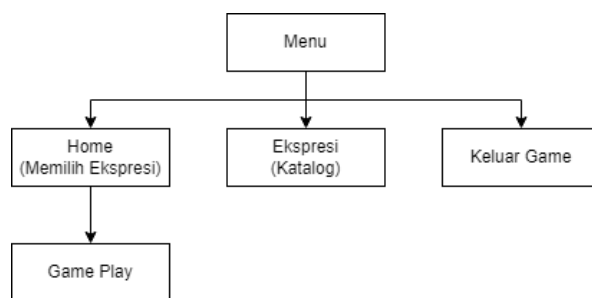


Figure 4. Information Architecture

4) User Flow

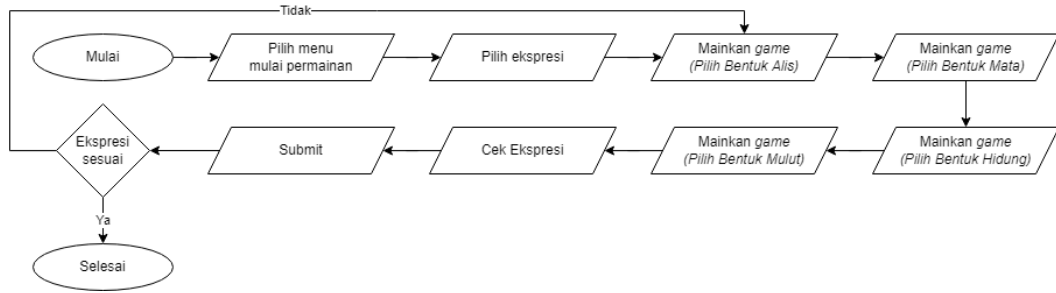


Figure 5. Flowchart User Flow

5) Wireframe

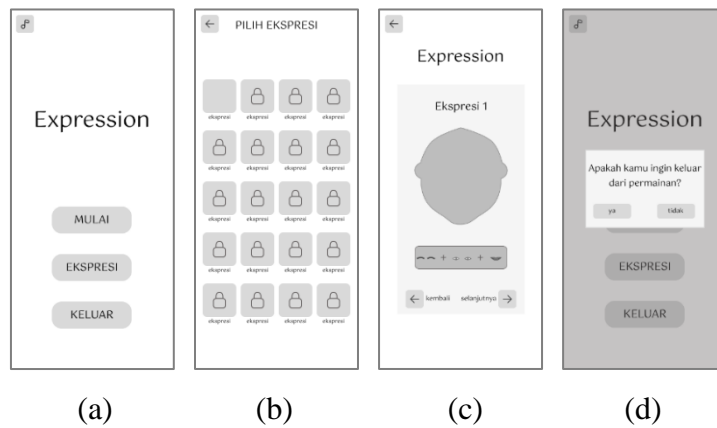


Figure 6. Wireframe of (a) Menu, (b) Start, (c) Expression, (d) Quit Game Page

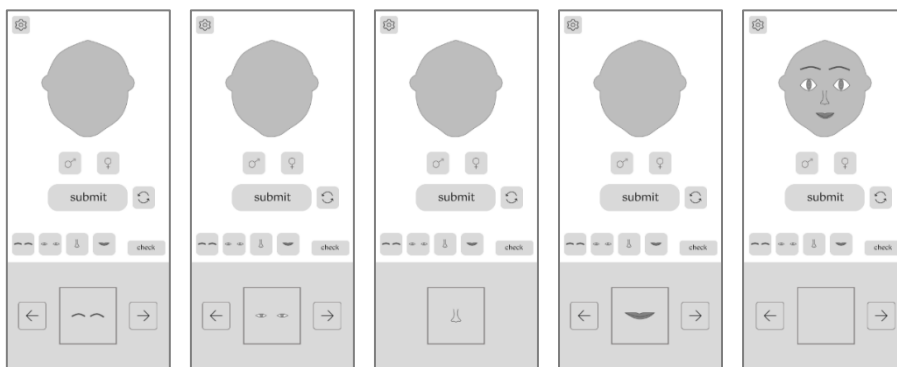


Figure 7. Wireframe of Gameplay Page

a. Prototype

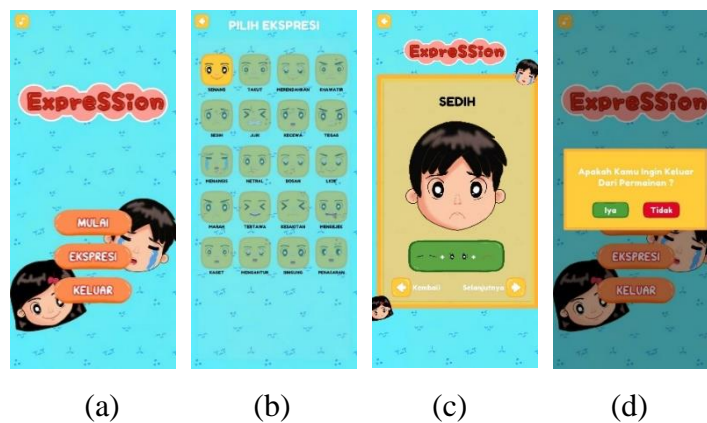


Figure 8. Appearance of (a) Menu, (b) Start, (c) Expression, (d) Quit Game Page

Figure 8. (a) is a menu page display where the user can select the main menu to enter the game, the expression menu which contains a catalog of existing expressions in the game, and the menu to exit the game. (b) Shows the user's playable expression selection page. the user will be redirected to this page when selecting start on the menu page. (c) An expression page that shows a catalog of expressions On this page the user can see the correct combination of eyebrows, eyes, and mouth for each expression. (d) Represents the display when the user opts out of the menu page.



Figure 9. Appearance of Gameplay Page.

Figure 9. is a gameplay page display were to compose an expression that the user asked to choose the right shape of eyebrows, eyes, nose, and mouth. The eyebrows, eyes, and mouth components consist of several shapes that can be selected by pressing the left and right arrow keys. These components are dragged and dropped onto the empty face.

b. Test

1) *Media Expert Validation*

The test was carried out by Mr. Catur Putra Endar Prasetya S.T. as an expert in the field of game development. Based on the tests that have been carried out, the following results were obtained:

Table 1. Media Expert Validation

Question										Total
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	
5	4	5	3	5	5	4	5	5	4	45

$$\text{Percentage} = \frac{\text{obtained score}}{\text{maximum score}} \times 100\% = \frac{45}{50} \times 100\% = 90\%$$

Based on the test results, the score obtained is 90% and the game is feasible to use without revision.

2) *Material Expert Validation*

The test was carried out by Ms. Fifie Indayani S.Psi., M.Psi. as a Psychologist and Head of the Indonesian Star Therapy Center. Based on the tests that have been carried out, the following results were obtained:

Table 2. Validation of Material Experts

Question										
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total
4	5	5	4	5	4	5	5	5	5	47

$$\text{Percentage} = \frac{\text{obtained score}}{\text{maximum score}} \times 100\% = \frac{47}{50} \times 100\% = 94\%$$

Based on the test results, the score obtained is 94% and the game is feasible to use without revision

3) System Usability Scale (SUS) Testing

The test was carried out on 5 children with autism at the Bintang Indonesia Therapy Center accompanied by a mentor with the following results:

Table 3. SUS Testing Data

Responden	Question									
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
1	4	4	4	1	4	4	4	3	4	2
2	4	4	4	0	4	4	4	3	3	3
3	3	3	3	1	4	4	4	3	3	2
4	4	4	4	0	4	3	4	4	3	3
5	3	4	4	1	4	4	4	3	4	3

$$\text{Average score of SUS} = \frac{\text{score of each respondent}}{\text{number of respondents}} = \frac{85 + 82.5 + 75 + 82.5 + 85}{5} = 82$$

Based on the results of the average SUS score obtained, which is 82, the human facial expression recognition game for children with autism is in the Acceptable category with Grade B. These results indicate that the human facial expression recognition game for children with autism is feasible and can be used as a learning medium for help children with autism understand human facial expressions based on the emotions they feel.

IV. Conclusion

Based on the results of the research entitled "Development of Human Expression Game for Autistic Children Using Design Thinking Method", the conclusions obtained are as follows:

1. The design of human facial expression recognition for autistic children's educational games presents 20 different expressions that are commonly encountered in everyday life.
2. Development of human facial expression recognition games for children with autism using the Design Thinking method consists of 5 stages, namely Empathize, Define, Ideate, Prototype, and Testing. Through these five stages, educational game products for recognizing human facial expressions are produced that can be used on the android platform.
3. The feasibility of the human facial expression recognition game for children with autism was determined based on the results of the validation of media experts who obtained a percentage rate of 90% and a material expert validation of 94%. These results indicate that the game is feasible to use.
4. Based on testing using the System Usability Scale (SUS) method, the results obtained are 82 with Grade B and Acceptable categories. Therefore, the human expression recognition game can be used as a learning medium to help children with autism understand human facial expressions based on the emotions they feel.

References

- [1] G. Faigin, "The Artist's Complete Guide to Facial Expression," 2008.
- [2] D. Anurogo, "Menggapai optimisme meskipun autis ," *Antara News*, Jakarta, 2021.
- [3] R. N. Khoirunnisa and M. Nursalim, "Studi Kasus Dinamika Emosi Pada Anak Autis," *J. Psikol. Teor. dan Terap.*, vol. 2, no. 2, p. 108, 2012, doi: 10.26740/jppt.v2n2.p108-120.
- [4] R. Kurniawan, I. Muhimmah, J. T. Informatika, U. I. Indonesia, and E. Wajah, "Abstrak," pp. 1–12, 2008.
- [5] R. Dam and T. Siang, "What is Design Thinking and Why Is It So Popular?," *Interact. Des. Found.*, 2018.
- [6] R. Ulfa, "Mengukur Kepuasan Pengguna Sistem Informasi Bimbingan Konseling (E-Bk) Menggunakan System Usability Scale (Sus) Di Smk Negeri 1 Banda Aceh," 2021.
- [7] T. Cassalea, "Perancangan Ekspresi Wajah Karakter Asih yang Efektif dalam Menyampaikan Emosi Pada Animasi 'Asih dan Anta,'" 2017.
- [8] G. Faigin, "The Artist's Complete Guide to Facial Expression - Gary Faigin - Google Buku," 2008.
- [9] L. Wang, R.-F. Li, K. Wang, and J. Chen, "Feature Representation for Facial Expression Recognition Based on FACS and LBP," *Int. J. Autom. Comput.*, vol. 11, no. 5, pp. 459–468, 2014, doi: 10.1007/s11633-014-0835-0.

