Website User Interface Modelling to Enhance Sociability for Autism Spectrum Disorder (ASD) Children Using User Centered Design Method

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Abstract—Autism Spectrum Disorder (ASD) in Children are those who are suffering from problems during their growing phases. Usually, ASD children have a common problem based on Autism Treatment Evaluation Checklists (ATEC) that consist of Cognitive Problems, Communication & Language Problems, Emotional/Behavioural Problems, and Social Problems. Concerning the sides of the social problem trying to figure out the solution in improving their sociability. One of social skill is empathy to others. Furthermore, it turns out that there is one mobile application developed focusing on this issue named "Kloog2". The pitfall for this application is having issues such as the content of the word is lengthy and too many step require to do some action. Furthermore, with website it is compatible to work both mobile devices, personal computer and those who are running older operating system that is embedded with web browser. To solve it, creating model to improve sociability skill, by creating a model for them to learn the empathy skill via storytelling method with User Centered Design. The prototype was built and was tested using SUS. The score that was obtained was 74 that translated to acceptable.

Keywords—autism spectrum disorder, ASD, user centered design, sociability,socialskill

I. INTRODUCTION

A.Background

Autism Spectrum Disorder (ASD) children is disorder that occurred in children that are confronting in their developmental disorder [1]. Commonly, children that are suffering from ASD had 4 types of disabilities that consist Cognitive Problems/disabilities, Communication & Language Problems, Emotional/Behavioural Problems, and Social Problems. Based. Not only that, based on [2] also had problems in their interaction neither verbal nor non-verbal. These types of disability categories are referring to the Autism Treatment Evaluation Checklist (ATEC). ASD can be detected as early as two (2) years old that according to [3].

Social skill or sociability is crucial in communicating with people in order to express something to others. Problems in social skill that are commonly founded in many ASD children referring to [4] is no eye contact with people, not taking care on their surroundings, the tendency on like to be alone and not having many friends. One of the causes that ASD children had weakness in their social skills is they are not capable enough in doing their interpersonal relationship skills. ASD children had an abnormal number of gene compared to normal human being. Coming from the abnormal number of gene in their genetic sequences since theirs birth, thus it's also disturbing their sociability skill therefore affecting their verbal and non-verbal skills as well.

User researched had been conducted to Kuching Autistic Association located in Kuching, Sarawak, Malaysia. In the time being, we had founded an application that supporting for improving social skill for ASD children that named "Kloog2". We asked the expert or teacher to evaluate this application and based on their point of view, this app are not suitable in improving social skill for ASD children. According to the data collected to know what is the flaw of this app is the content of the app contained text that is lengthy, there are too many steps required to do some action and the word given to the children is not on par with the children understanding level. This is because, the learning method that they did are based on interaction based on computer named as Neurofeedback Therapy [3]. This therapy focuses on games where no interaction being done. This is because the interaction being done with the brain of the children itself by connecting some sensor directly to their head. Then the children does not require to do any physical activity. This therapy only being conducted in the school. Therefore, there is a gap where the children were not being train while there are not at school. Thus, additional learning tool for improving their sociability skill is requiring.

Hence, the suitable methodology to be used is User Centered Design (UCD) because is suitable to be used because based on the problem that occur and users are always being involved in every stage according to [5]. Therefore, using this method might be able to improve their sociability skill in creating additional learning tool.

B. Topic and Limitation

Based on the background that was explained, how to create model of user interface of web site to improve sociability skills for autism spectrum disorder children?

The limitation for this research the targeted user is for children of autism only and focusing on improving their social skills.

C. Aim

Based on the problem statement, the aim that want to be achieve is giving suitable user interface in creating additional learning tool in improving the sociability skill for ASD children.

II. LITERATURE STUDY

A. User Interface

User interface is an interaction way that someone that are trying to interact with software just like website, application and other form of software that are being display in the monitor [6]. With user interface, user able to achieve their aim in using the software itself because is ease out the work that they should done it. User interface will never be separate with computer system and software. According to [7], a computer system that have good user interface make the work much easier, faster and less frustrated.

This can be proven from an incident according to that, on May 1999, a UK passport agency, they had done some improvement in passport application by introducing the use in computer system and at the same time, it was the introduction in using the computer system [7]. What was happen is, the application process has been delayed for up to 10 weeks. This is because, computer system had a bad user interface therefore making the user being frustrated when the computer.

1. User Interface Suitable for ASD Children

According to the research that done by [8], it is recommended to use short sentences as possible that is less than 15 word for one sentences because exceeding 15 words they are not able to understand easily, the words should be easily understood where it is suitable for the age from 2 until 8 years old. Another suitable user interface for ASD children is the use of font should be appropriate that is in size with 14 and no horizontal scrolling. The layout of the menu must be organized well and simple so that it does not clutter up the user interface hence make user more comfortable and easier to navigate the menu.

B. Website

Website is a collection of pages that are sourced from a domain that is in the Internet so that it can be accessed by other people by using a web browser by typing the domain name in the Uniform Resource Locator in the web browser [9]. The use of web browser much easy because nowadays every smartphone every smartphone had web browser feature hence this enable it to access a website without having to use a computer. Mostly, the application tool are designed for ASD children are in form of mobile application instead of website. Besides, one of the great benefits of using the website is it is flexible to be used across multiple platforms. But the pitfall of mobile application is the user need to always update the application if there are some patches or new feature required. Not only that, mobile applications required some minimum different versions of the operating system whereas with web browsers, you only need to use the web browser without concerning the version of web browsers that you use. This is due to, in mobile applications, there being some mobile applications only supporting different versions of operating systems in order to use the mobile application itself.

C. User Centered Design

User Centred Design is one of the methodology procedures that focuses on becoming the user as the center of the design so that we can achieve what they want and we can meet their requirement [10]. This is to prevent misunderstandings between the developer and the requirement based on the user itself. In addition, UCD is a type of methodology where it is an iterative method because it is user centered focus method that is focused on the actual need from the user [11]. Below shows the flow of the UCD level:

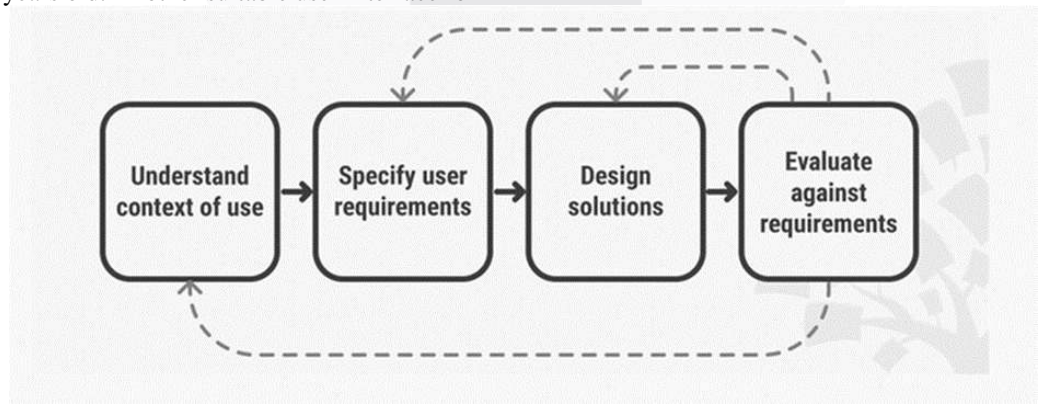

FIGURE 1
LEVEL IN UCD
Source: Interaction Design User Centered Design (https://www.interaction-design.org/literature/topics/user-centered-design)

As shown on the figure 1, it describes the flow of every stages in UCD, therefore below are the explanations of each stage:

1. Understand Context of Use: The developer must understand who the user uses the end product itself and

how they use it. Not only that, they have to do some user requirement to know what they need.

2. Specify User Requirements: Once the previous stage had been done, now we should determine the requirement that can be done. This is because there might be some constraints where some requirements are not able to be achieved due to time constraint nor the limit of the capability of the developer itself.

3. Design Solutions: On this stage, the design process begins where it must focus on the user requirement that had been agreed during the specified user requirement stage. On this stage, prototyping can be done so that they have a clear idea on how the product will look like.

4. Evaluation Against Requirements: On this stage, evaluation will be done based on the design solution that has been proposed where the proposed product itself must be evaluated against the requirement or based on what the user needs.

D. Story Telling

When interacting with people, we have to know what is the situation they are facing. Storytelling had the potential in improving the sociability of children with autism [12]. With storytelling, we let the children learn what actions and reactions they should do. This makes them able to react quickly according to their environment and express their empathy with the situation that they confronting. This is also one of the methods that is derived from Applied Behaviour Analysis (ABA). ABA is one of the methods that are able to help autistic children improve their sociability skills. One of example is showing empathy to others are also considered a sociability skill that humans need to have. This is because showing empathy to others, it is able to improve their sociability skills and makes an interaction with others [13]. By showing picture and show to the children what is the potential social situation [14] that they should react and what kind of action they should take.

III. METHOD

Creating a suitable interface, based on the proposed method that had been discussed, the writer will be using a user-centered design. Below is the detailed process flow:

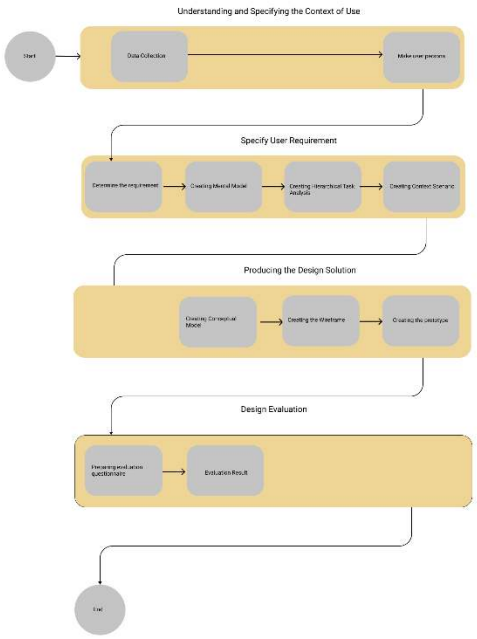

FIGURE 2
DETAILED PROCESS FOR EACH STAGE

Before gathering the information required, writer need to know what are the question that is required to be asked. The questionnaire will be given to 6 trainers and it will be given to the Kuching Autistic Association centre. According to [15], 5 user involved for data collection data that is collected is enough. Hence, the list of question listed as below:

TABLE 1
QUESTION FOR TRAINER

No.	Question
1	How you conduct the treatment for ASD children during the Pandemic
2	What are the problem that you confront when conducting the training
3	What is your goal when conducting the training ?
4	How often the training is conduct ?
5	What do ASD children like to do when they training ?
6	What are the difficulties that ASD children suffering while training ?

Besides asking in depth about autism children, writer try to investigate the problem with Kloog2. Hence below the list of question given:

TABLE 2
QUESTION TO IDENTIFY UI PROBLEM OF KLOOG2

No.	Question
1	Can your child navigate the application without your assistance?
2	What are the feature that your kid did not like?
3	Was your kid satisfied using the application

After collecting the data, writer analyse the data that was collected from the trainer. The trainer most of them conducting their training via whatsapp or video conferencing. Next, most of the training having problem with the behaviour of the children such as they are not paying their attention when training. Next, most of the goal

that the trainer that they want to achieve are maintaining their skills, attending their tasks, being able to learn something that they learn previously and being able to recap what had they learned and giving full attention during online classes and understand what been taught.

Besides that, for the Kloog2 app, the children unable to navigate the application without the assistance. Furthermore, most of the respondent stated some of the word that used were too difficult for the children level. Moreover, there are too many step require to do some action and text are too long. 2 out of 4 respondents not satisfied using the app. Hence, the UI problem that can be concluded is there were too many step require to do some action, and text that was given to be read for the children is lengthy.

A. Make User Persona

Persona serve as to give brief idea on user how their behavioural pattern [16].In other word, persona shows the model of the user in more detail. In addition, the creation of persona is derived from the result of the data collection that was collected previously. Persona consist of attributes such as Demographic, Level of knowledge, Behaviour, Pain Points and Needs. All the content of the persona will be based on the data that was collected previously.

Persona:

TABLE 3
PERSONA

Attribute	Persona
Demographic	Male and Female
Level of Knowledge	1. Able to do their training with the guidance from their trainer or their parents if it was in remote learning.
Behaviour	1. Not giving full attention during their training session
Pain Points	1. Distracted too easily and unable to focus during training session.
Needs	1. Doing their task with less aid from their trainer. 2. Maintaining their social skills.

B. Specify User Requirement

1. Determine the requirement

For this particular phase, we need to get the user requirement. The user requirement will also base on the data that was collected previously. This part of the phase is crucial in order to determine the features that will create for the prototype. The needs and requirement will be written based on the data that was collected previously. Besides that, to determine the needs and requirement must base on the persona created previously.

Below shows the requirement:

TABLE 4
REQUIREMENTS

Needs	Requirements
Maintaining their social skills	1. Giving storytelling to the children. For instance, creating a simple story about what the kid should do in one scenario. Consist of scenario such as empathy and helping each other in needs.
Giving full attention when training	1. Giving more vivid color and attractive images. This is to ensure that they can focus more. 2. Giving rewards when completing task such as complements word “Great Job”.

B. Creating mental model

Once the requirement had been made, the next phase is to create the mental model. Mental model defines as how the user think that the system will work [17]. This mental model created is to get the writer to understand what your users expect from the writer when planning the model of the prototype later [17]. For this case, it shows how the user think when the user to use the kloog2 app.

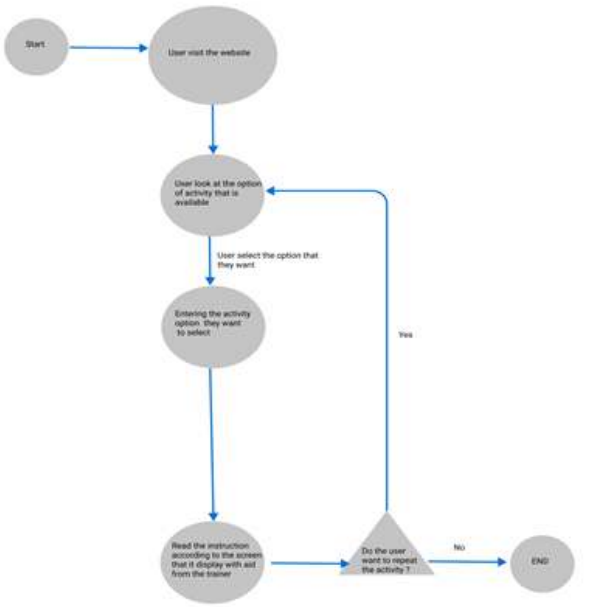

FIGURE 3
MENTAL MODEL SHOWS FOR PERSONA

C. Creating Hierarchical Task Analysis

Hierarchical Task Analysis (HTA) explains that the detailed workflow that is analysed in terms of hierarchy of goals, sub goals, operations and plans [18]. To simplify, HTA describe the detail description of the activity workflow [18] that will be done by the user. Hence the HTA that is created as below:

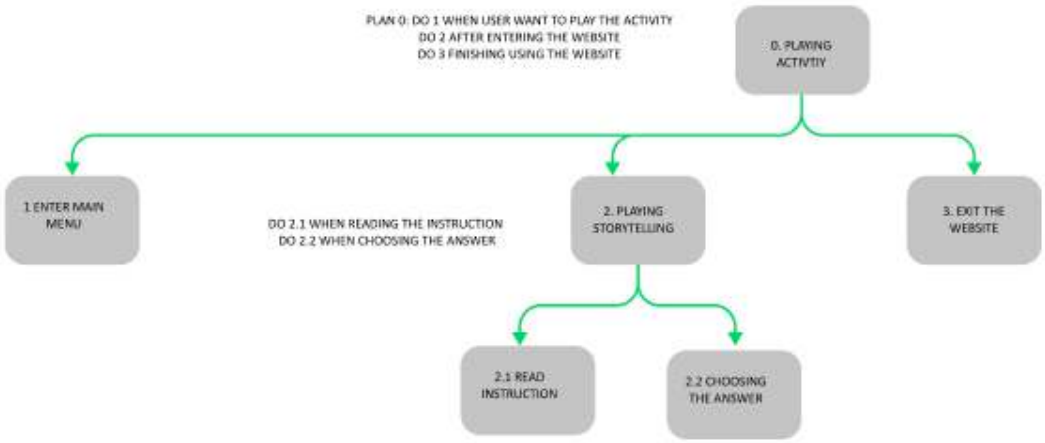

FIGURE 4
HTA

D. Creating the Context Scenario

The purpose of creating the Context scenario is to know in depth the flow on how the user uses the system itself. This mean that, it describes how the user will use the propose product with the ideal user experiences, and shows the product help the user to achieve their need. The context scenario is created based on the persona that was created previously.

TABLE 5
CONTEXT SCENARIO

Task: Enter to the Main Menu				
No	Sub Task	User	Goals	Scenario
1		Children	Open the website	1. The User open the website 2. Enter the URL 2. The main menu will display the option of activity that is listed
Task: Play Story Telling				
No	Sub Task	User	Goals	Scenario
1	Choosing the story telling activity	Children	User to choose the activity of storytelling option from the website	1. Once the user completed entering the main menu, there is two option of activity to choose. 2. User choose the option story telling activity

2.	Read the instruction	Children	User able to understand the instruction to do the activity from the website.	1. User will view the photo from the website showing the activity of the photo 2. A question and list of answers will be display
3.	Choosing the answer	Children	User able to select the correct answer according to the question given	1. The User will see the list of answers is provided. 2. User select the answer listed that is displayed. 3. If user select the correct answer, congratulation message will display. 4. If the user selects the incorrect answer, the correct answer option will be blinking.
Task: Exit Website				
No	Sub Task	User	Goals	Scenario
1		Children	User to exit the website	1. After completing one question, user have the option to go back to the main menu. 2. User click on the close button.

C. Producing the Design Solution

1. Creating the Conceptual Model

A conceptual model is showing how the designer understand and design what will the system will be arrange and what the system will function [19]. The conceptual model is derived from the HTA analysis that was created previously. Conceptual model will consist of task, sub-task, response, layout, visual element and the explanation. Below shows the conceptual model table:

TABLE 1
CONCEPTUAL MODEL

Task: Enter to the Main Menu						
No	Sub Task	User	Response	Layout	Visual Element	Explanation

1		Children	Display the main menu and show the activity option	It will appear once enter the URL	1. Main menu with display activity option to choose	1. Two picture correspond with each activity option.
Task: Play Story Telling						
No	Sub Task	User	Response	Layout	Visual Element	Explanation
1.	Choosing the story telling activity	Children	Shows the storytelling activity option	After entering the main menu	1. A picture with question provided	This page will show a picture with the question regarding to the picture.
2.	Read the instruction	Children	Shows the question and picture that is provided	After entering the main menu	1.A picture will display. 2. List of answer provided	This page prompt the user to select which of the answer is correct
3.	Choosing the answer	Children	Shows the question and picture that is provided	After entering the main menu	1.A picture will display. 2. List of answer provided 3. If incorrect answer is selected, the correct answer option will blink.	This page command the user to click the answer provided.
Task : Exit the Website						
No	Sub Task	User	Response	Layout	Visual Element	Explanation
1	-	Children	Browser tab close	There is a button to exit the website	1. An exit button	To help the user to close the website after finishing their activity.

2. Creating the Wireframe

Once the conceptual model is generated, the next procedure is to construct the wireframe. Wireframe give a clear overview the layout of the page structure, user flow and information architecture [20]. With developing the wireframe, it can help the writer to get clear understand on the layout of the propose prototype. The data that was created from the conceptual model will be converted to low fidelity wireframe. Wireframe can be drawn by hand. A low fidelity wireframe represent the first visual representation from the designer's idea [21] how is the structure and flow of the model of the website later looks like.

a. Low Fidelity Wireframe

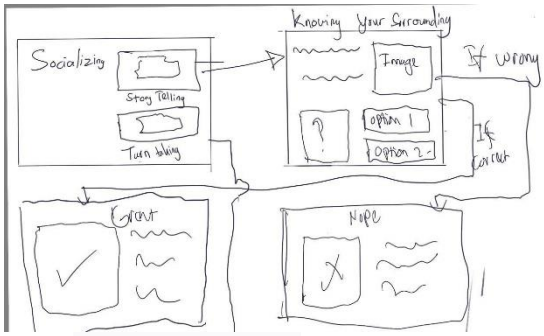

FIGURE 5
LOW FIDELITY WIREFRAME

3. Creating the prototype

Input: The final stage on the design evaluation is to create the prototype. Prototype is the early sample of the product [22] or system. The prototype also represents how the final outcome of the product. To design the prototype, it is derived from the low fidelity wireframe that was created. Hi-fi prototype will include the visual design of the prototype [22] .Hence, the outcome of the model is created below:

a.Hi Fi Prototype.

Main Menu Page

Storytelling Page

IV. RESULT AND DISCUSSION

A. Preparing Evaluation Questionnaire

On this part of the stage, the evaluation of the prototype will be done by using System Usability Scale (SUS) method that will be conducted at Our Dream Indonesia at Jl. Cigadung Selatan, Bandung. There will consist of 10 question that will be given to the trainer and observe the autism children while there using the prototype. The questionnaire will be given to the trainer and the trainer will observe the children when using the prototype

Below the list of question [23]:

TABLE 2
LIST OF QUESTION FOR SYSTEM USABILITY EVALUATION IN ENGLISH

No	Question
1.	I think I would like to use this system.
2	I found the system unnecessarily complex.
3	I thought the system was easy to use
4	I think that I would need the support of technical person to be able to use this system.
5	I found the various function in the system were well integrated.
6	I thought there was too much inconsistency in this system.
7	I would imagine that most people would learn to use this system very quickly
8	I found the system very cumbersome to use.

9	I felt very confident using the system.
10	I needed to learn a lot of things before I could get going with this system.

Below the list of question in Indonesia Language [24]:

TABLE 3
LIST OF QUESTION FOR SYSTEM USABILITY EVALUATION IN INDONESIA

No	Question
1.	Saya berpikir akan menggunakan sistem ini lagi.
2	Saya merasa sistem ini rumit untuk digunakan.
3	Saya merasa sistem ini mudah untuk digunakan.
4	Saya membutuhkan bantuan dari orang lain atau teknisi dalam menggunakan sistem ini.
5	Saya merasa fitur-fitur sistem ini berjalan dengan semestinya.
6	Saya merasa ada banyak hal yang tidak konsisten (tidak serasi pada sistem ini)
7	Saya merasa orang lain akan memahami cara menggunakan sistem ini dengan cepat.
8	Saya merasa sistem ini membingungkan.
9	Saya merasa tidak ada hambatan dalam menggunakan sistem ini.
10	Saya perlu membiasakan diri terlebih dahulu sebelum menggunakan sistem ini.

Besides of the question, to get the values from each question, the scoring consists of 5 level. Below shows the scoring level:

TABLE 4
SCORE FOR EACH VALUE

Strongly Disagree				Strongly Agree
1	2	3	4	5

In order to calculate SUS score, for question on 1,3,5,7 and 9 that was odd number, the score will commit deducted by 1. For question that is even 2,4,6,8 and 10 the score will commit deducted by 5. Once the cumulative score for each question had been calculated, multiply the score by 2.5 to get the result of System Usability(SU) score. The scale of SU score shown as below:

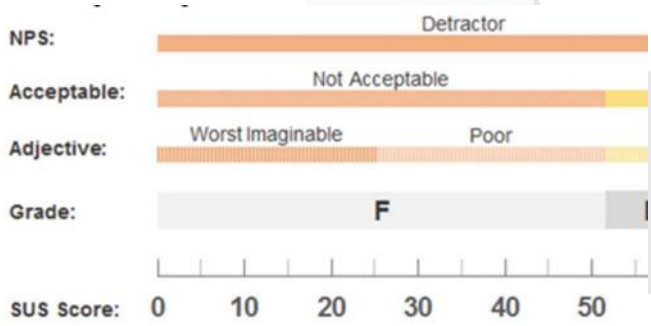

FIGURE 1
SUS SCORE SCALE

For testing the prototype, the trainer will be using the prototype. There will be 5 trainers that will involve to use the prototype. Once the user finished using the prototype, the SUS questionnaire form that was created previously will be given to the trainer.

On the other side, to test the prototype to the children, the writer will do an observation to the children when using the prototype. 5 children will involve in the test. The writer will observe the children whether their having difficulties in navigating the website. In addition, the writer will observe whether the children able to do their task in direct which mean they're not require any aid from the writer and non-direct which means they still require an aid from the writer.

B. Evaluation Result

Once the testing had been done, the final SU score that was obtained was 370. This value is the overall total score from 5 trainers. The total SU for each trainer had been calculate with the formula that was discussed on the previous chapter. Proof of testing can be view at the attachment. Below shows the result:

TABLE 11
SUS RESULT FROM TRAINER

Trainer	**Question Number**										**Total Score**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Nida Ul Hasanah	4	1	5	1	5	1	5	1	5	5	25
Iyad Muahayad	3	1	5	5	5	3	5	4	4	4	32
Imam Nursidik	4	1	5	2	4	2	4	2	5	3	29
Risma	4	3	4	2	5	2	4	2	4	3	27
Azizah Rahmah fajriati	4	1	5	5	4	4	5	1	5	5	35
Total Score											
370											
Average Score											
74											

Based on the average score that was obtained, the average score is 75. According to the SU score that was discussed on the previous chapter, it can be concluded that the prototype is acceptable.

On the children side, 1 out of 5 children are able to use and navigate the prototype without the need of help of writer. Children able to navigate the prototype to where they should do although it had been requiring some help from the writer. Below shows the results:

TABLE 5
OBSERVATION ON CHILDREN OUTCOME

Name	Direct or Non-Direct
Raka	Direct
Khan	Non-Direct
Rafifa	Non-Direct
Afaro	Non Direct
Rasya	Non-Direct

V. CONCLUSION

According to the analysis and result in the research that had been done, it concluded:

1. Improving sociability skills by giving storytelling to teach empathy skills is important.

2. The modelling of better user interface compared to kloog2 make learn social skill is easier.

3. According to the test that was using SUS scale, the result shown acceptable that means that the prototype can be use and accepted by the user.

5.2 Recommendation

Based on research conducted, there are some that can be improve for the upcoming research such:

1. Creating mobile based application.
2. Learning other method other than teaching empathy skills to learn social skills to autism children such as daily routines.
3. Targeted children with autism that those who can read better that ages from 7-12 years' old
4. Identify their capability in using technology.

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