Applying User Centered design to Mobile Application for Children

Riyanthi Angrainy Sianturi, Ingrid Sylvia Simanjuntak, Paul Marten Simanjuntak and Gomgom Purba
Del Institute of Technology, Sitoluama, Laguboti, Toba Samosir, Sumatera Utara

Abstract. Smartphone technology is growing rapidly. Children are one of the active smartphone users. This encourages the development of language applications for children. Child Centered Design (CCD) is a methodology used in this development. This methodology involves the child in every stage of development from the data collection stage to testing. The steps contained in the CCD methodology are determining the end user, collecting data or needs. Data obtained through observation and interviews with children and parents. The data were analyzed and the results of the analysis were designed according to the children needs. Designs are evaluated directly by the children. This activity is done in several iterations for usability to be achieved. Usability testing is used to measure application usability. The results of this research is the application of Batak, Indonesian and English language introduction for children. The application has four main content: animals, plants, family, and organs. In addition, there are picture and sound quiz features. Applications have met the children needs, both content and interface design.

1. Introduction

People and technology can not be separated nowadays. The gadget is one of the rapidly evolving technology. Gadget can be used as a medium of communication, search for information and entertainment.

In general, the gadget especially smartphones are used by adults to assist in doing the job. But in this era, the gadget are widely used by children. Children in 5-12 age become the largest users of this technology. Thus labeled as a multitasking generation. Most parents of these children assume that the gadget can be used as a learning medium that appeals to kids. Children can learn through applications available on the gadget. The presentation of each application is colorful, image, and character of the commonly found on the gadget is English language learning application.

Convenience and comfort when using the application is important especially when those applications used by children. Usability testing can be used to test or assess whether these products are easy to use (usable) or not. Nielsen defines usability as the attributes that assess how users using an interface [10]. According to Nielsen, there are five criterias of usability: learnability, efficiency, memorability, errors, and satisfaction.

In an application development that fit the needs of the user, the construction of the application should involve users directly. User Centered Design (UCD) can be used as a to develop applications that involves users in every stage. Developing application that fit the children needs specifically, can use the Child Centered Design (CCD) methodology.
The CCD methodology have the same concept with UCD involving end users in every stage of development. However, the CCD is used because children hasn't been able to deliver what they want and do. The CCD methodology also involve adults who are around the child to find the child's habits related information.

Based on this explanation, it will be built a mobile application for children by implementing child centered design. Usability testing is used to determine whether the application is easy to use or not. Applications to be built is a medium for children to know three languages, namely Batak language, Indonesia, and English

2. Literature Review

A. Gadget
The gadget is a technology that was created to accommodate a wide range of applications such as providers of news, entertainment and social networking. The gadget is also used as a tool to communicate. There are several types of frequently used gadgets, namely, laptops, smartphones, tablet computers, and Mp3 players.

B. Mobile Application and Android
The operating system is a system used to run the existing functions is such a device. Some examples of operating system is android, Apple's iOS, Blackberry OS, and Symbian OS. The most widely used operating system is Android. Android is an operating system for mobile devices.

There are three categories in mobile applications, namely mobile native application, mobile web application, and hybrid mobile application.

C. Child Development
Child development is one of the processes that occur in children on an ongoing basis. Child development can also refer to the non-physical aspect of maturation as intelligence, emotions, behavior and social aspects. According to Erikson's 8 stages of child development there is, namely trust vs. mistrust (0-1 years), autonomy vs shame and doubt (1-3 years), initiative vs guilt (3-6 years), industry vs inferiority (6-12 years), identity vs role confusion (12-18 years), intimacy versus isolation (young adult), generativity vs stagnation (Middle adulthood), and ego integrity vs despair (adult life end).

Children in this era are inseparable with the use of gadgets especially smartphones. Generally they are using smartphones to play or study. According to the Idler, there are five criterias was a good experience while using an application, that is entertaining, visual appeal, usability, age appropriate content, and encourage learning.

D. Usability
Usability is defined as qualitative analysis that determines how easily users use an application's interface. According to Nielsen, there are five criteria of usability, i.e.:

1. Learnability: the system should be easy to learn so that users easily complete the task.
2. Efficiency: the system must be efficient to use so as to increase productivity when the user has studied the system.
3. Memorability: the system should be easy to remember so that when the user has not used the system for a long time then the user can easily reuse the system.
4. Error: the system must have a low error rate so that when the user made a mistake, the user can fix or handle the error easily.
5. Satisfaction, the system should be fun to use so that users feel satisfied when using it and like it.
Usability testing can be used as a tool to gauge whether a system is usable or not. Barnum said that usability testing is the activity that focuses on observing users in using a product \cite{11}. Nielsen says there are four methods that do in usability testing, namely, user and task observation, scenarios, simplified thinking aloud, and heuristic evaluation.

E. User Centered Design

User Centered Design (UCD) is one of the approaches used to design the user interface by focusing and involve the user in each process either in the process of design and development process \cite{12}. UCD generally involves adults as end users. If the end user of a product are children, then the Child Centered Design (CCD) can be used as a methodology to build the product. It takes a special approach to be able to understand the characteristics of the child. That is because the children have not been able to deliver what they want directly. This methodology also involves parents, teachers, or adults who are on the child's environment to get related information habits of children. The CCD methodology has four activities that are performed repeatedly. The fourth activity is specify the context of use, specify requirements, create design solutions, and evaluate designs. The fourth such activity relationships can be seen in the figure below.

3. Analysis and Design

The users are 5 to 12 years old children. The selected location is the village of Sitoluama. The location was chosen so that the developer can often meet and communicate with the user. Collection of information as well as the needs of the child is carried out directly by doing oservations and interviews with the child. Every answer given by the child will then be analyzed and designed. Each design results will be implemented and then tested with children.

When presenting the application for children, things to note in order to attract the attention of children is a compelling look like pictures, music, and color. Proper color selection will improve the quality of delivery of information to the child. Young and warm color is the color most favored child such as red, yellow, Brown, Orange, and also the orche. In the development of this application, the color that will be used is an orange and yellow colors. Orange was able to menimbukan comfort for the user and the yellow is able to engender the feeling better.

The selection of the content contained on the application also becomes important. Based on the results of a survey of some similar applications as well as some website content that appears most often is the family members, animals, plants and a member of the body. The fourth thing is the main content in the application. In addition to determining the content of the application, the number of users who made application testers are as much as 10 people where 8 people will be tested continuously during application development and 2 other people will be tested after the completed application is implemented.
Facial expressions are also noteworthy and analyzed to find out the extent to which children feel satisfied and happy while using the application. Smileyometer can be used as a measuring instrument of expression provided by the child. In addition to conducting analysis of applications need to be also carried out an analysis of the usability testing. Usability testing is used as a gauge to determine whether the application is usable or not. Here are the equations used for usability testing:

**Table 1. Formula of calculation of usability testing**

| Formula | Explanation |
|---------|-------------|
| \( Y = T \times R_s \) | to find score interpretation |
| \( I = \frac{100}{\text{Amount of Score (Likert)}} \) | To search for an interval assessment |
| Total Score/Y x 100% | to know the interpretation of the assessment of the respondent’s response to |

Assessment criteria of usability testing can be seen in Table 2.

**Table 2. Assessment criteria**

| Criteria | Value | Interval | Category |
|----------|-------|----------|----------|
| STS      | 1     | 0% - 19.99% | Very (Disagree/Bad/Less once) |
| TS       | 2     | 20% - 39.99% | Disagree/Less good |
| N        | 3     | 40% - 59.99% | Neutral |
| S        | 4     | 60% - 79.99% | Good/Agree/Like |
| SS       | 5     | 80% - 100% | Very (Agree/Good/Like) |

Description of assessment of usability testing can be seen in Table 3.

**Table 3. Description of the assessment**

| Abbreviation | Definition |
|--------------|------------|
| STS          | Strongly Disagree |
| TS           | Disagree |
| N            | Neutral |
| S            | Agree |
| SS           | Strongly Agree |
| T            | Total number of respondents who chose |
| Rs           | Respondent |
| Y            | Highest score likert x number of respondents |

Setting up a test item for each category of reviewers is also important. Each test item should describe each category tested to obtain a value. Each test item will be filled with the test results performed.

4. Implementation

Implementation and testing carried out seven times and apply the four activities that are present in the CCD methodology. On the first iteration until the fourth iteration is done by involving the children.
When performing testing of children will be directed by the developer when using the application. At the same time the developer also pose questions to the child in accordance with a grain test that had been prepared in advance. In addition, developers also recording every facial gestures as well as the face of the child to be analyzed so that developers get the total value of any criterion of usability testing. On the fifth iteration, testing is done by involving a expert who have expertise in the field of user interface. The sixth iteration is done with the parents of the child to know the opinions of parents and to get advice on the applications dibangung. On the seventh iteration, testing is done by involving the children. The goal is to find out the opinions of children regarding the changes contained in the application after testing by an expert and the parents of the child. Following are the final results of the implementation has been done after doing some iteration.
5. Result and Discussion

The results is a mobile application that introduce the languages to children. The application has four main menu i.e. animals, plants, family, and organs. Each category on the application has a quiz feature, both in image and sound. Based on the results of implementation and testing took place, there have been 7 iterations in the manufacture of the product. On the first iteration until the fourth iteration, and the sixth to seventh iteration is done to the user namely children and the elderly. On the fifth iteration, testing is done to an expert.

Implementation on the first iteration starts with the implementation on splashscreen, start menu, venue information and detail there is still one place location. Testing phase is done with methods, i.e. scenario by showing the results of the mockup to children. The results obtained are applications still look plain and there is only one menu that has been implemented.

On the second iteration is done sound implementation on the application and add a single location on the menu. Testing on the second iteration was contested against content that is contained on the application and voice clarity on the application. The response obtained from the kids is kids look antusia but not the hose how long the kids will feel bored because the available content is still not a lot.

The third iteration of the implementation done by adding animation and sound to make the sound clearer and issued a response faster than ever. Each menu also has several places that have been implemented. Testing phase on the third iteration is performed using a test of grain has been dispersediapka. The entire category of usability will be tested and the results obtained are learnability has an average of 73.03% as much as the results. Efficiency has an average yield as much as 71.11%. Errors have an average yield as much as 68%. Memorability had average results as much as 85.33%. Satisfaction has an average result sebanyakn 85.09%.

The fourth iteration is done adding content quiz on the application. The goal is as one of the measuring instrument in testing usability and kids feel more enthusiastic in his play the the application. The results obtained on the fourth stage of testing is learnability has an average yield as much as 78.88%. Efficiency has an average yield as much as 80.72%.

Memorability had average results as much as 78.88%. Error have an average yield as much as 67.22%. Satisfaction has an average yield as much as 83.26%.

The fifth iteration of testing done by the method of heuristic evaluation by involving an expert. The results of testing on the fifth iteration is color selection on the application that has not been appropriate, content -content that is not used, the kinds of writing on the application are still stiff, time on the quiz still error and not the existence of instructions in the application. The sixth stage of the testing done by the method of thinking aloud by involving the parents of the child. Any feedback provided has been implemented.

The implementation results are used to perform testing of the seventh stage. Testing on the seventh stage of the grain using a test with the following result learnability have averaged 90.46% as much as the results. Efficiency has an average yield as much as 89.99%. Memorability had average results as much as 80.27%. The error has an average yield as much as 75.55%. Satisfaction has an average 83.79% as much as the results. After getting the results of calculation of usability testing, the obtained level of learnability in the application after the last test to children was 90.46%. Based on these calculations, the value of the category of learnability in the application are included in the category of very good or children really like against application if judged from the learnability on the application.

The category of efficiency has values of 89.99% which means the level of efficiency in the application are included in the category are very good and the kids really like on the application if judged from efficiency in application. Category memorability on the application are included in the category of good, i.e. with a value of 80.27%. Error category has value 75.55% which means a category error to the application are included in the category either. The category has value 83.79% satisfaction, which means kids feel very satisfied and really like playing applications.

The results of the testing will be described in the form of a graph as in figure below
6. Conclusion and Discussion

Usability testing is done to determine if the application is already usable and built to suit the needs of the user. The working of this project underway to build an application usable language introduction to the child. This is evidenced from the results of measurements of usability testing on learnability, memorability, and errors are included in the category either; satisfaction and efficiency belong in the category. To make such an application, the methodology of Child Centered Design (CCD) can be applied. Each stage starting requirement gathering up at this stage of testing is done by involving the children. Testing is done by the method of scenarios, simplified thinking aloud and heuristic evaluation. One of the most efficient techniques in counting of usability testing in the development of this application is thinking aloud. That is because the kids are trying to direct applications and their developers, then do the calculations based on a facial of face of the child. Besides testing method heuristic evaluation is important because it is essentially do the children do not understand this aspect of the design of the user interface. Heuristic evaluation carried out by the expert helps ensure the bottom of the user interface and the functions of the application are built according to principles of usability and meet the needs of the user.

Based on the results of the implementation, there are some suggestions for application development:

1. Applications can be developed for users that have different age categories, either strung on each age children as well as adults. The difference in age range can affect the methodology used, the material to be loaded in the application, or how to measure the level of satisfaction of the users.

2. Can be done the addition of a more varied material, such as culture, history, geography or new things that can provide instruction. The material must be adjusted with the category of the selected user.

3. the need for the development of the design of the user interface such as the addition of animation, music, sounds, images, colors, and typography.

References

[1] Ameliola, S. & Nugraha, D. H., n.d. Perkembangan Media Informasi dan Teknologi Terhadap Anak Dalam Era Globalisasi.

[2] Nielsen, J., 1993. Usability Engineering. London Academic Press.

[3] Manumpil, B., Ismanto, Y. & Onibala, F., 2015. Hubungan Penggunaan Gadget Dengan Tingkat Prestasi Siswa di SMA Negeri 9 Manado. eJournal Keperawatan, Vol. 3(2).

[4] F. A. H. B., 2014. SISTEM PENDUKUNG KEPUTUSAN PEMILIHAN GADGET SMARTPHONE MENGGUNAKAN METODE SIMPLE ADDITIVE WEIGHTING.

[5] Redda, Y. A., 2012. Cross Platform Mobile Applications Development. s.l.:s.n.

[6] Murtiwiyati & Lauren, G., 2013. Rancang Bangun Aplikasi Pembelajaran Budaya Indonesia
Untuk Anak Sekolah Dasar Berbasis Android. *JURNAL ILMIAH KOMPUTASI Komputer dan Sistem Informasi*, Volume 12, p. 2.

[7] Nripin, Babu, Bhat & Arun, 2013. Development of Hybrid Applications with HTML. Nripin, Babu, Bhat & Arun, 2013. Development of Hybrid Applications with HTML.

[8] Erikson, E. H., 1950. *Childhood and Society*. London: Harmondsworth.

[9] Idler, S., 2013. *UXkids*. [Online] Available at: www.uxkids.com [Accessed 6 December 2016].

[10] Nielsen, J. 2012. Usability 101: Introduction to usability [cited: 19 November 2016]. Available from https://www.nngroup.com/articles/usability-101-introduction-to-usability/.

[11] Barnum, C. M., 2011. *Usability Testing Essentials*. Burlington, USA: Elsevier Inc

[12] Stone, D., Jarret, C., Woodroffe, M. & Minocha, S., 2005. *User Interface Design and Evaluation*. San Francisco: Elsevier, Inc