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Usability Testing with Children: BatiKids Case Study

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***Abstract*—**Usability testing with children is similar in many aspects to usability testing with adults. However, there are a few differences that one needs to be aware of in order to get the most out of the sessions, and to ensure that children are comfortable and enjoying the process. This paper presents the need to acquire methodological knowledge for involving children as test users in usability testing, with consideration on Piaget's theory of cognitive growth. As a case study, we use BatiKids, an application developed to evoke children's enthusiasm to be involved in culture heritage preservation. The usability test was applied to 24 children from 9 to 10 years old. The children were divided into two groups; one interacted with the application through a graphic tablet with pen, and the other through touch screen. Both of the groups had to accomplish the same amount of tasks. In the end, children were asked to give feedback. The results suggested that children who interacted using the graphic tablet with pen had more difficulties rather than children who interacted through touch screen. However, the difficulty brought by the graphic tablet with pen is an important learning objective in order to understand the difficulties of using *canting*, which is an important part of batik.

***Keywords*—**BatiKids, children, child-computer interaction, usability test

I. Introduction

AN important phase of product development is to examine the usability of a product by using usability evaluation methods [1]. A widely used and very effective usability evaluation method is the usability test, sometimes also referred to as user tests [2]. The basic idea of the test is to evaluate an application or system by having the target group to interact with the application and test it. Usability tests look to evaluate many dimensions of the user experience of a product, service, or technology to understand user behavior and identify problems. It assesses how user-friendly the overall functionalities of the system are. It aims to evaluate the product by setting up a realistic task scenario for product usage involving prospective users [3].

Usability test is a significant process in Human Computer Interface design. Ghasemifard et al. [4] clearly defined that usability test is a process to systematically collecting the usability data of interface then assessing it. Designers can enhance the usability of an application through testing and improving the current interface; they can also evaluate it, borrowing its strongpoint, improving its shortcomings, and applying in the new design. By doing this, the design of the interface can achieve its usability goal more effectively, reduce the learning time of users, and improve the efficiency and satisfaction regarding the application. On the other hand, the usability test can also help designers highlight the interface characteristics of the application, decrease the expenditure of development and support, and boost its market competitiveness [5]. One of the factors that affect the acceptability of software is its usability. Usability is a very vital factor in determining the success of any new application or computer system.

Having children as target user of an application or a system requires the involvement of children themselves within the user testing. Usability testing with children can be enjoyable, but it also presents challenges, especially when children are able to neither understand what is being asked from them nor express and communicate their answer correctly. Motivation and concentration are also common problems the tester should be prepared to deal with [6]. When testing with children, we need to consider their ages in order to be aware to the level of their cognitive, communication, social and motoric skills. It also helps us to tailor the tasks they will do with the application and what methods we can use to gather valuable information from them. Designers have to understand this in order to manage the interviews with children.

According to Piaget's Theory of Cognitive Growth, described by Idler [6], children at the age of 8-11 years old are in the level of concrete operations development. For children at this age group, language develops and reading skills are acquired. They are able to go through the question-answer process and ready to participate in the usability test. Methods can be used are surveys, semi-structured or structured interviews as well as focus groups. It is very important to keep the process simple, visual, and most of all fun.

II. BatiKids Usability Test

BatiKids is an application designed especially for children. The main goal of this application is to support them in learning the complex process of making Indonesian batik. The detailed description of the batik making process is explained by Rante et al. [7]. BatiKids is a result of longitudinal studies and iterative testing of design changes in the last three years, which we did in collaboration with Museum Batik Pekalongan in Pekalongan District, East Java, Indonesia.

A workshop of BatiKids usability test was conducted on 22-24 March 2016 in Museum Batik Pekalongan. We installed the application on a touch-screen computer in the museum. We tested the tool with 24 children from an elementary school grade 4. Their age ranged from 9 to 10 years old.

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Before starting the workshop, with the support from the museum staff, we carefully set up and planned the environment so children would feel comfortable when performing the test. We placed the computer in a proper desk to be suitable to the children's height, and provided them with the necessary tools for the test: pencil, pen, questionnaire papers, photo camera, video camera, graphic tablet with pen, touch-screen display, and BatiKids stickers to be given at the end of the test. We prepared also scenarios for running the test, and divided the workshop into four phases: introduction, pre-test questionnaire, usability test, and post-test questionnaire.

In the introduction phase we tried to establish a close relationship with children in order to make them feel more comfortable. We introduced ourselves, the application, the tasks, and the learning objectives. The application has four main learning objectives: motivate children to learn the real process of making batik, understand the philosophy of the batik patterns, teach how to mix colors, and teach hand movements in relation to the use of *canting* in the real process. Due to the limited time, we were not able to talk deeper to find out more about the children. If more time were available, we would have tried to engage children in evoking joyful memories in order to make them feel more comfortable [8].

After the introduction, we began with short interview with the pre-test questionnaire. Each child was given the questions:

1. Have you ever played any computer game? If yes, what kind of game?
2. Do you know the real process of making batik? Have you try it?

For the question 1, all children answered positively. The game played most were racing car games for male students and dress-up games for female students. For the question 2, most of them have seen or ever heard of the batik process. Since the museum provided a short batik workshop covering partially the process, 50% of our test users had the chance of trying it before the test.

In the usability test phase, the tester had to stand next to the children and support them in accomplishing their tasks, which consisted of watching video tutorial, choosing a pattern and learning its meaning, drawing the pattern following dots on the screen, mixing colors and applying colors on the pattern, giving the fills (*isen-isen*) to the pattern, multiplying the pattern, rotating and flipping the pattern (only in the second level), saving the final result and printing it. In this phase, we separated children into two groups. The first group consisted of 12 children who interacted with BatiKids using a graphic tablet with pen. The main objective using the graphic tablet with pen was to give children a tangible impression of using *canting,* which is a tool used in the real process. The other group consisted of also 12 children interacted with BatiKids through the touch screen.

The last phase was post-test questionnaire. We interviewed children using a post-test questionnaire we organized in three parts. 1) General questions: asking children the general use of BatiKids. 2) About the tasks: asking children about the tasks on BatiKids. 3) About the environment: asking children about the interaction and supporting elements on BatiKids. Results of this questionnaire are presented in Figs. 2 and 4.

When doing the interviews, it is very important to watch and listen to children carefully in order to collect relevant data of their difficulties and successes along the test. Recording the children while interacting with the system is also very relevant, because recordings can be useful for perceiving events and behaviors not noticed during the test. From the video recordings, we identified which of the tasks children had more difficulties with, and how well they successfully completed them. This observation helped us to think of alternative designs that better supported the application's workflow [9].

III. Evaluation

According to Piaget's theory of cognitive growth in Section I, children in age range of 9 to 10 years old are already able to perform concrete operations. They are already able to read and understand the tasks, and have also strong curiosity, which is a good motivational factor that drives them to get to the end of the application's phases. Concentration, however, is an issue at this age. Therefore, during the test, it was necessary to create a relaxing and calm atmosphere.

Depersonalized or indirect questions are still critical at this age. We avoided using phrase such as: "I would like to know if you understand the real process before using this game". Instead we used simpler and direct phrase such as: "Do you understand the real process before using this game?" For this age group, simple yes/no questions about doing something are better understood. In addition, Hanna et al. [8] explained that children at this age range are relatively easy-to-handle participants in usability tests, because they are used to follow directions, and deliver what they are asked for. Moreover, they are generally not self-conscious about being observed as they play on the computer. They spontaneity while operating the system may provide important insights. Finally, in this age range, children are able to describe their experiences with more sophistication, especially if they already have experience with computers.

The ethical culture background of children should not be ignored. Children included in this test are born in Indonesian and growth up in politeness Eastern culture. We observed that Indonesian children used the application cooperatively and were shy to answer the questions. If they struggled at a certain task, they kept trying it without asking any further help. However, in few cases we offered help upon their request.

After analyzing the pre-test questionnaire and putting it in perspective with our other results, we observed that there is no significant difference in performance between children who have experienced batik and children who have not. Both of these groups obtained similar results when using the application. Both have similar difficulties and spent equivalent time when performing the tasks.

We found out that children at the age of 9 to 10 are suitable to be considered in the usability tests, because they can correctly understand and execute what is being asked from them. They are in the appropriate level of cognitive,

communication, social and hand motoric movement skills to adequately fulfill information necessary to draw relevant conclusions from the application's usage.

There is one important part missing on BatiKids. Wax is one of the main tools in making batik, but the use and function of wax was not embedded in the application. We have noticed that the role of wax is an important aspect of the batik process and must be considered in a next version of the application.

A. Children Interacted with BatiKids through Graphic Tablet with Pen

The graphic tablet with pen used in this usability test enabled children to see what they draw directly on the screen. The graphic tablet with pen immediately provides handwritten input to the screen of the computer. We observed that this interaction was not easy due to the separation between the eye reference and hand movements. Children had to move their hand on tablet while keeping their eyes on the screen. Sometimes, they lost the sight of the cursor on screen, and consequently had to try harder to coordinate their movements with the pen. Fig. 1 is showing children using the graphic tablet with pen to interact with BatiKids.

The result of 12 children interacting with the application through the graphic tablet with pen is shown in Fig. 2. The task of creating or drawing the pattern was the most difficult part for children in this group. Half of the children in this group had to spend more time to complete this task. Hand movements with pen on the tablet required patience and concentration from children.

Fig. 1 Children used graphic tablet with pen to interact with BatiKids

Children who have seen the real process before could easily draw a parallel between the pen tablet and *canting.* The same was not true when children drew the patterns with the finger using the touch screen. However, in both cases, by the end of the application's phases, all children were aware of the importance of *canting* to batik. Nevertheless, in order to allow a more tangible experience, the employment of the graphic tablet with pen is essential, because it drives the children to perform similar hand movements as if they were using *canting*. Using tangible interfaces can also be more engaging and keep children interested in using the application [10]. In addition, the benefits of tangible interfaces in learning have been already well demonstrated by many researchers [11]-[13].

In general, children were satisfied with BatiKids, but we realized that the application needs more improvements.

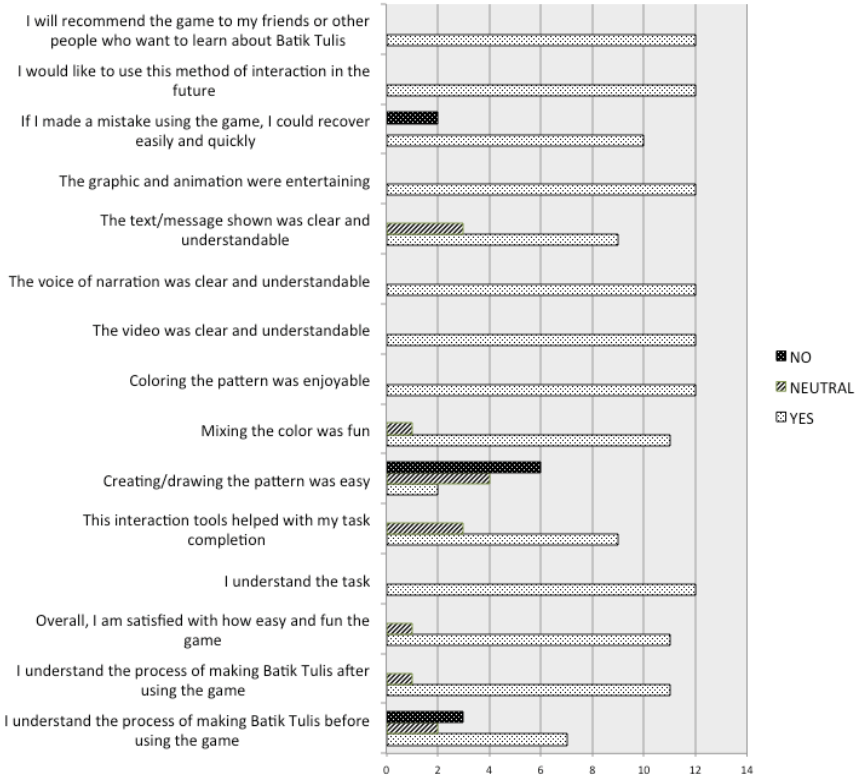

Fig. 2 Group of children interacted with BatiKids through graphic tablet with pen

Fig. 3 Children interacted with BatiKids through touch screen

B. Children Interacted with BatiKids through Touch Screen

Touching the finger to the screen to interact with the application is easier than using a graphic tablet with pen. A touch screen display can also benefit the application user-friendliness since it requires less concentration to use than a graphic tablet with pen or even a mouse and keyboard. It is more effective in combining children's eyes reference and hand movement on screen. Additionally, touch screens can increase the speed of completing the tasks. Fig. 3 shows children interacting with BatiKids through the touch screen.

Fig. 4 shows result of 12 interviewed children. The graph shows that the tasks children had difficulties with were the ones related to the pen tablet. The same tasks did not present the same level of difficulty when performed through the touch screen.

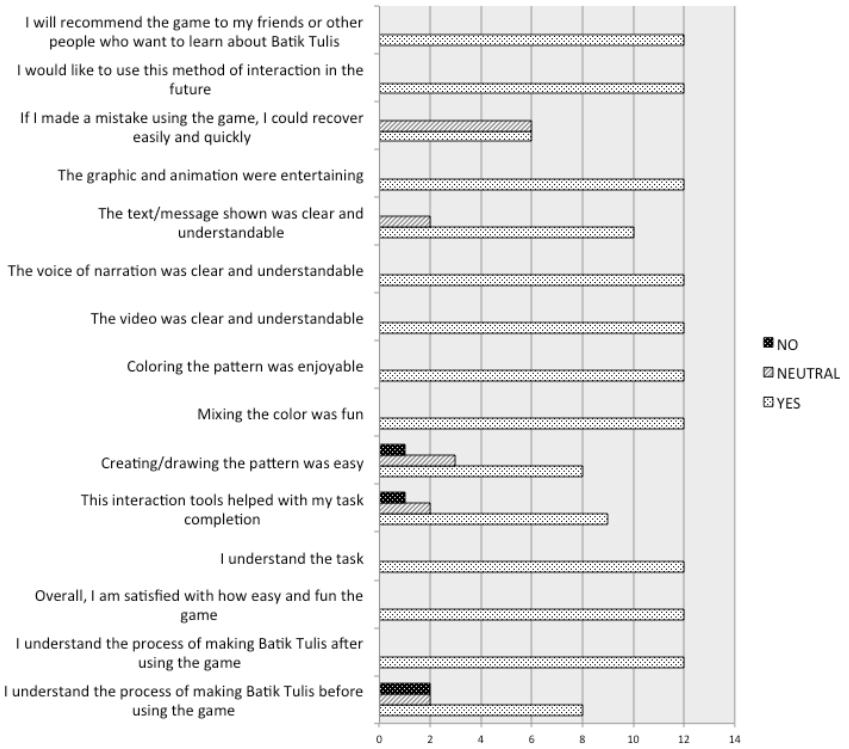

Fig. 4 Group of children interacted with BatiKids through touch screen

Nowadays children are using mobile devices of their own or their parents′, on which they play and interact with applications by means of touch input. This technology allows children to manipulate digital content in a direct manner with great flexibility. Touch input allows a multitude of possible outcomes for finger actions, ranging from simple taps, pinches, and swipes up to complex gestures with meaningful mappings to application functions [14]. Even though this touch user interfaces technology can solve many issues, it is not suitable with the learning objectives of this application. Children need to learn and cope the difficulty of drawing the pattern as if they were using *canting*.

Children in this group were satisfied with BatiKids and were keen to try it again but unfortunately we had limited time in the museum.

IV. Conclusion and Recommendation

The fluency children display in manipulating touch screens has a direct link with two main factors. On one hand, these devices are highly intuitive, in that their interaction is based on direct touch of the finger against the screen and user interfaces that count already on a rich language of metaphors that enable pinches, swipes, and taps. On the other hand, the fluency in commanding touch user interfaces goes also along with the increasing popularization of smartphones and tables. Children are well accustomed to these devices. However, although our target group completed the task of creating and drawing patterns with ease by using touch screen rather than a pen tablet, we observed that hand movements are an integral part of the batik process that could be better learned when children tried to mimic the hand movements of the artists displayed on the video tutorials.

One of the problems with the graphic tablet with pen is the dissociation between the movements performed with the pen and the generated images as a result of this movement. The visuals are displayed on an ordinary monitor far from the pen. We believe that better results can be achieved with the use of smart tablets that allow drawings to be created through direct contact of a stylus against a screen. The child, therefore, would be able to see the drawings as a result of the path through which the pen touches the monitor. In this way, the *canting* process can be represented with a higher degree of likeliness.

Likeliness between action and representation is an important factor especially for children in phase of concrete operations, as they would experience the application with a better understanding of the overall batik process, which is mainly manual. The application would neither be over simplified by touch user interfaces, nor too confusing because of dissociation generated by pen tablets.

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