MEASURING USABILITY AND CHILDREN'S ENJOYMENT OF VIRTUAL TOY IN AN IMAGINATIVE PLAY SETTING: A PRELIMINARY STUDY

[1]KHAIRUNNISA MISPA, [1,3]EVI INDRIASARI MANSOR, [2]AZRINA KAMARUDDIN, [4]JOANNE HINDS

[1]Department of Multimedia, Faculty of Computer Science and Information Technology, Universiti Putra Malaysia, UPM Serdang, Malaysia

[2]Department of Software Engineering and Information Systems, Faculty of Computer Science and Information Technology, Universiti Putra Malaysia, UPM Serdang, Malaysia

[3]Department of Computer Science, College of Computer and Information Sciences, Prince Sultan University, Riyadh, KSA

[4]Department of Computer Sciences, University of Bath, Bath, United Kingdom

E-mail: [1]khai.mispa@gmail.com, {[1]evi, [2]azrina}@upm.edu.my, [3]emansor@psu.edu.sa, [4]J.Hinds@bath.ac.uk

ABSTRACT

This paper recounts a preliminary evaluation of children's imaginative play whilst interacting with a virtual toy. Children aged 5-8 years old played with a virtual toy with a friend and their enjoyment and satisfaction of playing with the toy were evaluated. The complexity of social pretend play and the involvement of communicative strategies were taken into consideration to assist the inquiry of identifying the ability of the virtual toy to support children's imaginative play. Our analysis demonstrated that children who managed to play imaginatively applied the social pretend play complexity and communicative strategies during the play session. The virtual toy supported children's imaginative play, hence these findings can help to stimulate future research and the design of virtual toys to support play for remotely separated children.

Keywords: *Children, children's enjoyment, communicative strategies, imaginative play, social pretend play, usability, virtual toy.*

1. INTRODUCTION

Children are usually associated with play in which by playing, children are seen to have reached their first cultural and psychological achievement [3]. Children's play may take place indoors or outdoors [17] and playing activity can occur alone, in pairs or in groups [22]. Playing activities can take many forms, including sports, creative or imaginative activities like arts and crafts, games, and social-relational activities like socializing with friends [22]. Nowadays, children tend to play outdoors far less than they used to [17] where they typically played with physical toys and other objects to support playing activities [29]. Their play has become influenced by television and computers, and children often choose to play indoors, engaging with technology instead [2]. Children often have favorite playing partners, (e.g.

friends, siblings) who make play more exciting [22]. However, researchers have described how advances in technology have caused many children to spend less time participating in social activities with their family and friends, which can have a negative impact on their relationships [19].

Children's play activities are limited by parental restrictions, physical and environmental limitations and general distractions, for example misbehaving animals or siblings' interruptions [22]. Some children may feel alone when they do not have their friends to play with, if their friends are not available or if they have moved away [28]. Technology has helped to overcome these limitations by allowing people to stay connected via phone calls, multimedia messaging, Internet access and online games [24].

This paper reports a preliminary evaluation of children's acceptance of technology in supporting their play. This was measured using [15] Smiley-o-meter, which is frequently used to measure fun in child computer interactions. The rationale for using the Smiley-o-meter was to provide a measure that could indicate whether the children were dissatisfied or pleasantly surprised with the activity [14]. Further, we wanted to investigate the extent of children's involvement in imaginative play when interacting with technology by taking into account the complexity of social pretend play [4, 5] and communicative strategies [30] adopted by the children while playing. To support the study, we designed a prototype of a virtual toy, which was deployed in an Apple iPad. In order to assess children's ability to socialize while playing, the children were allowed to select a partner to play with, and we encouraged them to interact with each other while playing. The result from the study highlighted the positive side of mobile technology in children's play. Further, these preliminary findings can be used as guidelines for mobile applications' designers and developers in producing communicable and sociable playing settings for children.

2. RELATED LITERATURES

Usability and enjoyment

Usability of a prototype is an important factor in order to establish whether the prototype will facilitate the acquisition of knowledge [27]. Traditionally, usability is associated with work systems, and the extent to which a product helps users to achieve specific goals with satisfaction [13]. In order to measure the usability from a pedagogical perspective, [8] suggests focusing on the user interface, design and determination of whether the objectives have been met, as well as taking a measure of the user's performance [26].

There are several practices that should be conducted when measuring the usability of a prototype. These include, asking the children what was successful and what was not; asking what the 'bugs' of the tested prototype were, and analyzing stories created by the children while testing the prototype [23]. These practices can also be used to measure children's enjoyment while playing imaginatively with the virtual toy. [11] outlined some approaches to measure the usability and enjoyment, which include; observing everything that happened during the interaction between the children and the prototype; taking note of all evidence of the usability or enjoyment that occurred

during the interaction and asking the children for their own assessments of the usability or enjoyment in the interaction.

Virtual toy and imaginative play

Toys and play cannot be neatly separated with children [12, 25]. The term *'virtual toy'* is used when children play and interact with a custom-built, simulated world using two- or three-dimensional graphical models, which have recently become increasingly popular among children when they spend more time online. This may indirectly continue to create a significant change in social practice, which was constructed through interaction with others [16]. For example, a multi-user virtual environment that presents complex online worlds, which enable the player to create their online representation, new identities and socialize with other players by chatting or playing online games [31].

Imaginative play is a type of play that children may engage in. Imaginative play is also known as pretend, dramatic, make-believe, role or fantasy play that requires children to use their imagination involving objects, actions and situations [21]. Through this type of play, children will be able to practice and strengthen newly acquired representational schemes as well as contributing to children's cognitive and social skills [20]. Normally, when children perform an imaginative play, they usually recreate familiar activities such as going to school, driving to the supermarket like their father, or imitating their mother's actions like feeding or bathing a baby [7].

Previous research investigating children's imaginative play implemented virtually includes; *The Fantasy Table* that encourages children's imaginative play, which was implemented in a multi-user interactive tabletop device [9]; the *StoryMat* that offers a play space, which allows children to record and recall their voice narrations played on the mat [18]; and the *Dolltalk* that captures children's gestures and speech and then plays back the children's imaginative play in different voices, which represents the character in the children's imaginative story [6]. However, these technologies are limited, in that they required large spaces for interaction, whereas users prefer to use technology that is portable and easily transportable.

3. METHODOLOGY

This study aimed to evaluate the usability of the designed prototype, to investigate the ability of this prototype in supporting children's imaginative play

as well as measuring children's enjoyment while playing imaginatively, supported by the prototype. The experimenter (first author) conducted this study with children from a local nursery. The nursery was located in a middle-class residential area and was attended by children aged from 5 months to 12 years old. We decided to conduct this study at the nursery itself because; participants would be more comfortable with the atmosphere at their own school since they are familiar with the surroundings [10]. Previous studies using this approach have found that children have been able to give more attention to the activities carried out and cooperate with the experimenter [10].

Participants

A total of 14 participants (9 females, 5 males) between 5 to 8 years old took part in this study. Participation was on a voluntary basis and dependent on parents/guardians' permission to participate. The experimenter made several visits to observe the class beforehand, so all participants were familiar with the experimenter when they study was conducted.

Settings

In order to avoid possible interference from other children, the study took place in a private room in the nursery and all required equipment such as table, stools and cameras with tripods were set up in that room. The table was placed in the middle of the room with a device that consisted of the virtual toy prototype and two stools placed next to each other. Two cameras were used to record the sessions; one was located opposite the stools and the other was placed at the side of the table. The front camera was used to capture the whole session, including scripts and facial expressions while the side camera focused on the gestures and movements on the device.

Materials

A mobile-based game prototype was designed using Adobe Flash CS6 supported by Adobe Air and ActionScript 3.0 was deployed in an Apple iPad. The application called *"Your Choice"* encourages participants to play imaginatively in virtual settings where they are provided with an interface of an empty landscape that needs to be filled with various selections of objects such as buildings, transport as well as additional accessories for the scenery (Figure 1). Using the interface, they are able to create their own environment of *town* and create stories or scenarios using the provided objects. Additionally, there are four characters available that allow the participants to choose any of the characters to represent them in their play (see the red circle in Figure 1).

Figure 1: Interface Of An Empty Landscape And Characters (In Circle).

Procedures

Permission from the nursery and parents/guardians are requested before conducting the study. Information sheets were distributed to the nursery manager as well as consent forms to the children's parents/guardians for their approval. The forms were subsequently signed and returned to the experimenter.

Before the study began, participants were instructed to form their own pair based on friendship or kinship. As a result, seven pairs were formed with four categories as shown in Table 1:

Table 1: Pairs Formed By The Participants

Category of pair	Number of pair(s)
Friends of different gender	1
Friends of same gender	2
Siblings of different gender	2
Siblings of same gender	2
Total	7

To ensure confidentiality, each participant was assigned an alphanumeric code name – PM for male participants and PF for female participants followed by a number (e.g: PM1 assigned for the first male participant and so on). The participants were also given a demonstration on how the prototype worked to aid their understanding before they began to play.

Playing session

During the play session, participants were required to play simultaneously as a pair (Figure 2) by completing a few tasks. First, participants were asked to choose one of the available characters to represent themselves:

Experimenter: *As you can see on the screen, there are four characters provided. Each*

participant is required to choose one of the characters as your representative.

As soon as they finished selecting their character, the experimenter continued the session by issuing the next instruction that read:

Experimenter: *Assume that you were given an empty land and you are free to build your own town. Together with your partner develop your own preferable town by adding as many objects provided as possible and create a story using those objects that you have added in your town.*

Figure 2: Participants Play Together In Pairs.

All pairs were given 15 to 20 minutes (mean = 1019.86 seconds, SD = 158.41) to complete the tasks and they were observed as well as video recorded while performing the tasks.

Interview session

In measuring the usability of the prototype, we performed the guidelines suggested by [23] as mentioned in the previous section, where participants were asked about their experiences regarding any problems encountered while playing with the prototype as well as their recommendations to improve any perceived weakness in the prototype. The experimenter assumed that most of the participants at this age are still not proficient in reading/writing and they may consume some amount of time in answering written questions. Therefore, an *interview schedule* [1] was devised, where the experimenter read the questions to the participants and wrote down their answers.

Meanwhile, to measure their enjoyment in playing with this prototype, they were asked to rate each of the prototype's interface and their experience towards the entire prototype using 5-point likert scale, Smiley-o-meter (Figure 3)**.** The Smiley-o-meter was used because it consists of interesting graphical emotions (scored from 1 to 5) namely; *1 = awful (very unlikely), 2 = bad*

(unlikely), 3 = good (neutral), 4 = very good (likely) and *5 = awesome (extremely likely)* which helps the participants to express their insights and indicate their feelings towards the prototype instead of only using written sentences [15].

Figure 3: The Smiley-O-Meter Was Used In This Study.

In this session, participants took approximately 7 to 10 minutes (mean = 513 seconds, SD = 66.69) to complete the questions and answers and this session was also recorded for analysis purposes.

Data analysis

The experimenter conducted *video transcription analysis* in performing the data analysis phase. A total of 21 videos (14 videos from the play sessions and 7 videos from the interview sessions) was transcribed and analyzed. From the play session, two main variables were coded, including (a) *social pretend play complexity* and (b) *communicative strategies*. We outline these in further detail below:

Social pretend play

In observing social pretend play conducted by the participants during the session, the experimenter measured the complexity of the social pretend play by adapting the idea from [4, 5] where they performed this idea to evaluate the degree of integration of pretense into the social play including:

- *Solitary pretend play.* This occurs when participants perform a fantasy action while the partner ignores but still proceeds with the turn-taking structure. It can be demonstrated when participant A said something related to the game play, but did not receive any response from participant B.

- *Simple social pretend play.* This was coded if both participants engaged in social play and both performed a fantasy action and used the same object to support their play without speaking. For example, participant A moves an object from one place to another and the participant B also move the same object to another place without saying anything to participant A.

- *Associative social pretend play.* This was coded if participants engaged in social play and there were conversations related

to the game play, but not involving roles that related to each other, such as participant A playing a role of a policeman while participant B acted as a doctor.

Communicative strategies

The experimenter also investigated how the participants share their ideas so that their actions can be understood by others. Thus, communicative strategies were measured [30], which included the ideas partners expressed to each other during the play session, categorized as follows:

- *Paralinguistic cues.* These involve changes of intonation and use different pitches, for instance using different voices to differentiate characters or creating sound effects such as *"streeeeetchhh…"* as well as changes of facial expression to express different emotions such as *"hah?!..."* followed by a shocked facial expression.

- *Description of actions.* These include declarations of ongoing actions or where participants mention their next action before performing it, e.g, *"I am going to the school…"* at the same time; he/she moves the character to the object known as school.

- *Calls for attention.* During the play session, not all participants can maintain their concentration towards the game play. Sometimes, their partners need to encourage them to continue playing like *"Hey, look at the…"*

- *Directives.* There will be participants who tend to control the game play and their partner's actions. For example, *"...you take the bench and put it next to the fountain…"*

Recorded videos from the interview session were viewed several times to ensure that we did not miss any information conveyed by the participants during the session. As we viewed the videos, we wrote down important details from their responses and answers for our references.

4. RESULTS AND DISCUSSION

Usability

To present the usability results, we referred to the information gathered in both the play and interview sessions. There were some deficiencies and problems identified during the play session that

we discovered from the observed videos and that were also mentioned by the participants during the interviews:

- The participants found some of the objects difficult to click. It is likely this is due to the size of the objects that are slightly small and were placed close to each other.

- Due to some technical errors in the prototype, there were also a few objects that participants were unable to drag around the screen which limitating the story they constructed.

To analyze the imaginative story built by the participants in the playing session, each variable in the *social pretend play complexity* and *communicative strategies* were scored in one-minute intervals. If one of the variables occurred more than once in a minute, the instance was coded as one. For example, if participant A performed *paralinguistic cues* twice in one minute, it was counted as one. The result of the analyzed data as displayed in Table 2:

Table 2: Frequency Of Involvement Of Social Pretend Play Complexity And Communicative Strategies.

	N	Freq	Mean (SD)
Social pretend play complexity			
Solitary pretend play	12	68	4.70 (3.98)
Simple social pretend play	14	83	5.93 (3.10)
Associative social pretend play	12	88	6.29 (4.58)
Communicative strategies			
Paralinguistic cues	13	37	2.64 (2.62)
Description of action	11	99	7.07 (5.49)
Calls for attention	13	54	3.86 (2.77)
Directives	10	41	2.93 (2.64)
*N = Number of participants (out of 14)			

All participants managed to perform at least one instance of *simple social pretend play* ($N = 14$, mean = 5.93, SD = 3.10). This demonstrates that social pretend play occurred when participants played imaginatively by taking turns and without producing any dialogue. *Associative social pretend play* demonstrated the highest frequency in social

pretend play complexity (mean = 6.29, SD = 4.58). This indicates that participants determined their own role without depending on their partner, as evidenced by the following:

[PF8 (girl, 7 years 3 months) and PF9 (girl, 8 years and 10 months) are pairs of siblings, play together:

PF9: *Are you still at the mosque? You have not gone yet?* (PF9 asked PF8's character, whether she still at the object declared as a mosque).

PF8: *No. I am in the hospital.* (PF8 responds to PF9's question and informed that she is in the object declared as a hospital).

PF9: *Oh! Really? Pity you. Are you sick? I'm coming to visit you.* (PF9 reacted to PF8 answer and drags her character to the object declared as hospital to visit PF8).

In the findings for communicative strategies, *description of actions* demonstrated the highest frequency of instances (mean = 7.07, SD = 5.49). Participants tended to describe their actions indirectly highlighting that they were able to imaginatively plan their next move and share their actions with their partner. An example of this type of action is as follows:

[PM2 (boy, 5 1/2 years) and PM3 (boy, 6 years) are pairs of friends, in a process of choosing desired objects to be added on the screen as they mentioned each object they intended to add:

PM2: *I want to choose.... lorry* (PM2 wanted to add object known as lorry to be appear on the screen).

PM3: *I want to choose...I want to choose... police car* (PM3 wanted to add object known as a police car to be appear on the screen).

Enjoyment

Table 3 displays the average scores rated by participants using the Smiley-o-meter. From these results, we can assume that the interfaces of the prototype were good and suitable for the participants.

Table 3: The Average Score For The Interfaces Using Smiley-O-Meter.

Smiley-o-meter rate	Main page	Menu page	Town scene
Awful			0.29
Bad		0.86	
Good	1.42	1.43	1.43
Very Good	0.86	0.86	0.57
Awesome	1.71	0.86	1.71

* Average score = Total rated score x 4 / Number of participants (N)
** Number of participants (N) = 14

The *main page* received positive points as most of the participants rated it as *awesome (average score* = 1.71), *very good (average score* = 0.86) and *good (average score* = 1.42). We believe this is because the animation on the *main page* was attractive and welcoming, which encouraged the participants to begin playing. Since there was only one scene available in the *menu page,* the average scores were evenly spread across the Smiley-o-meter ratings apart from a higher average score for *good (average score* = 1.43) which demonstrated that the participants still liked the interface in that page. Meanwhile, the *town scene* was highly rated as *awesome (average score* = 1.71) and *good (average score* = 1.43) which indirectly demonstrated that the interface of the *town scene* also have a place in the participants' heart.

Further, the experimenter found that most of the participants enjoyed playing with the prototype based on the feedbacks from the participants where, six of them expressed their enjoyment as *awesome* and three rated as *very good.* Moreover, they were enabled to maintain their engagement with the play session throughout the given time and there were also pairs who requested for additional time to extend their play. This provides evidence that this type of mobile-based game was positively accepted by the participants.

In contrast, there were also a few participants who seemed unhappy as three of the participants rated their enjoyment as *bad* and one rated it as *awful.* When this happened, the experimenter investigated the cause and found that this occurred when their partners were more likely to conquer the device and control the play which eventually led to frustration among these unhappy participants. In addition, the experimenter also noticed that the limited numbers of objects available in the prototype also led to their dissatisfaction. This was supported by complaints that there was only one scene provided in the prototype (the town scene) which caused some of them to become bored. Nevertheless, they completed the task without asking to withdraw in the middle of the session. This demonstrates that they were still excited to play, despite experiencing disappointment during the play session.

Participants' recommendations to overcome the weaknesses spotted in this prototype were overwhelming. They suggested using larger objects so that they could easily point at them without any errors. Moreover, they also requested more options of *scenes* with a higher variety of objects to choose from in order to support their imaginative play.

Some of the responses were based on their gender, for instance, females requested more feminine objects, whereas the male participants preferred action and sports objects.

Their shared ideas provided some directions in preparing materials for future study. Additionally, these ideas can also be used as guidelines for designers and developers in designing and developing mobile-based game or application for children in the future.

5. CONCLUSIONS

This study revealed that the game prototype deployed in an Apple iPad gained children's attention to play imaginatively together with their partners. They did not show awkwardness when using the device since most of them owned at least one such device at home. This fact was declared by the participants during the interview conducted. There were several lessons learned from the discovered deficiencies during the study, including:

- The size of the objects must be compatible with the children's fingers to facilitate their interaction with the device.

- The diversity of selections is essential to attract children's interest and attention as well as to ensure the playing session last longer.

- Mobile-based games must be appropriate for both genders (male and female) in order to avoid refraction towards any gender.

Our next plan is to implement the findings from this study in the design of a new mobile-based game application that creates a supportive and engaging environment for children to play in.

6. ACKNOWLEDGEMENTS

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