Usability and Fun Evaluation of a Game Authoring Tool

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Abstract: This paper discusses findings from tests of usability and fun in evaluating a game authoring tool named Gatelock. The tests were conducted with five children from different schools and each child was interviewed and observed previous to the use of the game authoring tool. For the usability test, the effectiveness, efficiency and children's satisfaction in using Gatelock were discussed. Concerning the fun aspect of Gatelock, the children showed a great interest and enjoyed the game design activities in a non-threatening way. Results from these tests confronted us with some problems in Gatelock and guided us to redesign Gatelock in order to achieve the right environment for fun and enjoyable activities. We believe that the game authoring tool could offer better opportunities for children to explore new and exciting ways to engage and nurture their learning in the classroom.

Background

Today, children grow up in an environment full of technological gadgets such as computers, mobile phones, Internet facilities and computer/video games. They have the need to adapt to the environment surrounding them, which is full of excitement and entertainment. But when it comes to learning, they tend to stay and experience the same situation that their parents have faced before (Prensky, 2001). One key question is how to connect the fast-growing demands of children today with the current curriculum offered in school. Furthermore, the transformation of how teaching and learning can be implemented in school could lead to the development of a dynamic curriculum in the information and communication technology (ICT) era.

In Malaysia, curricula in schools have been revised and established to be accredited in the ICT field in order to provide children with these basic skills. The Ministry of Education has indeed realized the invasion of computer technology and the information globalization starting in the early 1990s (Ahmad, 1998). The Ministry has put major efforts in introducing Smart School initiatives, centres around the concept of teaching through integrated usage of modern technology in teaching. A wide range of teaching and learning materials and tools has emerged to support teachers and students particularly in teaching and learning in any subject domains in the classroom. These tools, including the digital form of study materials such as multimedia and educational software, computer-assisted instruction and electronic learning (e-learning), offer great opportunities to engage the children in learning.

One of the thriving areas of creative multimedia software and application currently deals with digital constructing or authoring tools that promote fun in learning. Constructivists believe that learning can be done when the learners are involved in the constructing process including problem solving and decision making. Furthermore, constructivists believe that children are not only considered as users, but also as designers and developers of applications (Papert, 1993 & Kafai, 1995). Hence, with the right and appropriate tool, the idea of applying this tool in the classroom can be carried out.

By taking these ideas into account, a game authoring tool was developed with the motive to urge the children to learn game design as one of many learning activities through meaningful and playful interaction. Two ideas have been proposed. Firstly, the intellectual power that programming representation in the game authoring tool can nurture learning while making games. Secondly, the game making activities can promote creative thinking skills towards problem solving and decision making. But before looking at the effects of this tool on children's learning, the game authoring tool must be tested and explored, in particular relating in particular to usability and creativity in learning issues.

This paper examines a game authoring tool named Gatelock currently being designed and developed to assist children to design games, exploring issues related to usability and fun, and this could also include the aspect of creativity. More specifically, this paper will report on usability tests that were conducted with children working with Gatelock. These tests also include reports on the results, some conclusive considerations, and future works.

Assessing Usability and Fun

The word usability simply means easy-to-use. But this term sometimes over simplifies the problem and offers little guidelines for any user interface designers. ISO 9241-11 defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO, 1998). This definition can be expanded by including five characteristics which must be met by a product – effective, efficient, engaging, error tolerant and easy to learn. Finding the right balance between these characteristics is an important part of the user analysis.

But the definition of usability mostly focuses on applications for adult or mature users. In fact, other researchers have come out with other solutions for testing the usability of children software. Druin (1999) provides a classification of involvement where children can play four roles – users, testers, informants or design partners. These roles involve different levels of engagement and enforce different opportunities and limitations. The segregation of children's roles also means different or similar usability test methods that can be used to measure products for children.

Carroll (2004) suggests that the usability concept should be extended to include the element of fun, since fun is not the same as satisfaction (in the definition given by ISO9241-11). Others state that satisfaction involves progress towards goals and that fun is not goal-oriented (MacFarlane et. al. 2005). More and more people consider the importance of the fun element as one of the critical success factors in determining the usability of children application software. Since the objective of software for children is to provide an engaging learning environment, it urges to keep their attention by providing fun and exciting environments.

In fact, there are no specific usability guidelines (yet?) to measure the effectiveness, efficiency and satisfaction or fun in any game authoring tool or similar. But it should be noted that there are several approaches to measure the usability within the frame of a user study. The first way is to observe what happens. Secondly, it is to note any evidence that occurs during the interactions, and thirdly the users must be asked for their own assessments of the usability in the interaction. For this study, we use the ISO definition of usability (effectiveness, efficiency and satisfaction) and treat the fun element as another independent measurement.

Effectiveness is often measured by reduction of mistakes or errors that users make. A presumption is that such errors indicate problems in the design of a software product. Effectiveness also indicates the accuracy and completeness of users to achieve a set of goals. This is what we aim for when carrying out the usability test with children. Generally, *efficiency* equates with expanding the least amount of resources to complete an end goal. While iterative rounds of usability tests help identify problems with a software design and contribute to its improvement during the development process, such results do not imply that the software is effective in helping users to accomplish their goals with the software.

Measuring *satisfaction* is hard to accomplish since it involves with multiple dimensional concepts including an immersive environment and compelling experiences. As mentioned above, the element of satisfaction involves a progression towards the achievement of goals which may vary considerably by different users. Malone (1980) indicated that the balance of intrinsic motivator elements results in the game being *fun*. These elements are challenge (the level of difficulty), fantasy (the scenario in which the activity is embedded) and curiosity (the introduction of new information and non-deterministic outcomes). Later he added another element – control – which makes the players feel in-charge (Malone & Lepper 1987). These motivator elements focus on motivational support and have become the key aspects of design of any entertainment software products, especially in game design that fostered engagement.

The Game Authoring Tool: Gatelock

Gatelock is a game authoring tool developed under a project named Gatelock project – a **g**ame **a**uthoring **t**ool for **e**ducational **l**earning for **O**LPC **k**ids. OLPC is a One Laptop per Child project initiated by OLPC Foundation. The Foundation aims to design and develop a low cost laptop, currently named OLPC XO, for children in the developing and emerging countries to use as a supportive tool for learning not only in school but also as

independent learning. The initiative by the OLPC Foundation has attracted us in designing a game authoring software that are compatible with its current development.

Gatelock is a content-based visual programming language developed in Squeak and suitable for children aged six years and above. Our aim is to measure the implementation of Gatelock as well as its capability for the development of simple games. Another purpose of Gatelock is to teach children how to program games visually. Gatelock is supposed to be designed for an OLPC XO machine, but fortunately it can also be used with a normal computer due to the capability of Squeak. The design and development of Gatelock is guided and influenced by the needs and the ability of the tool itself.

We have identified the following three contexts as most relevant to initiate our tool design: programming context, computer game context and game design context. Firstly, in the programming context, we aim to shape the process of programming more like the thinking of children. Children are given programming tasks designed to investigate their understanding of mechanisms in a form of game making that they have to program and design. The purpose is that children develop skills that are related to programming including learning about mechanisms and behaviours. These programming skills can be seen as the target domain of the children's way of learning. Secondly, in computer games, children will learn the basic aspects and rules of the game itself very fast. By creating edutainment games, children do not only gain authoring or programming skills whilst participating in the development process, but they will also learn about many aspects of the edutainment domain, such as physics, mathematics, arts and science. In other words, learning programming while creating a game is not only good to increase their problem solving skills, but it is also good since it requires knowledge about the games' topic and thus motivates learning. Lastly, in game design, children will use the basic elements of project management in their game making. These elements include planning the games, design, build, gameplay testing, and re-design. Designing a game can help children to validate their game requirements and explore possible ways for particular solutions.

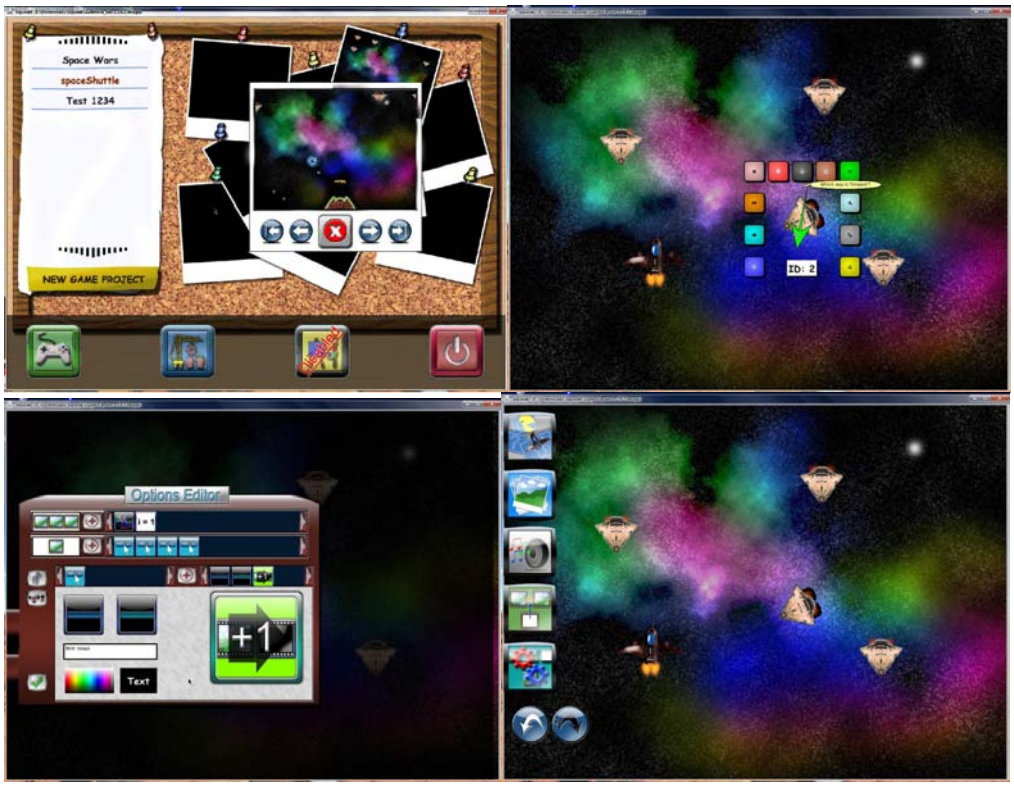

Figure 1: Some screenshots of Gatelock and game designed by a nine-year-old child.

From these three contexts – programming context, computer game context and game design context – used in design of Gatelock, we have plan future studies including evaluations not just on students' programming skills, but also on their attitudes and interests in game making activities. But in this paper we only describe the usability test conducted in Malaysia.

The Study

Sample

The sample consisted of five children of both genders, aged between 9 and 12, from five different primary schools in Malaysia. As mentioned above, only five children were selected in the study mainly because the study was treated as the first 5-users study and the goal of this study is to catch 85% of the usability problems and to improve interaction design and user interface of Gatelock. The sample covered the normal range of ability including basic computer literacy. All children had English as their second language and they did not have any language problem since the tool provided visual understanding and most of them received help from the instructor. All students participating in this study passed their basic requirements in the computer literacy requirements. Hence, all students were familiar with the computer terms and had basic experiences in using standard application software and playing computer games. As the contribution from this study, in addition, several other user studies will follows after Gatelock has been re-designed and the final user study will be conducted in the month of July and September 2008. The method used for testing multiple groups of five users is based on Nielsen´s article (Nielsen, 2000).

Procedure

The study was conducted in the presence of the researcher. Gatelock was installed on one notebook and each child had two hours of time to use Gatelock assisted by the researcher. Each child was asked to design a game and this include a game plan, using Gatelock to design it, trouble shooting, decision making based on numerous possible solutions and testing. We did not specify any time limits or perfect outcomes from the task, but the children were asked to solve the task. An assistant, whose job was to note the children's reactions and engagement with the tasks, accompanied the researcher. All children were keen to take part and seemed to enjoy the experience. At the end of the study, we distributed a set of usability questions that the children had to answer.

Instrument

For the evaluation protocol, we adapted the guidelines for usability testing with children proposed by Hanna et. al. (1997), especially on greeting, stressing the importance of the participants, explaining the purpose of the study and making sure they know that they were not treated as the object of the test. As mentioned above, a set of usability questionnaires was given to the children. The questionnaire was a mixture of several usability methods since evaluations on usability on any game authoring tool (specifically) are still unclear (as described in Section 2).

We posed questions regarding three main aspects in usability which are effectiveness, efficiency and satisfaction. Some of the questions were structured into the organization of information, highlighting the easy way to perform tasks, understanding the information on the screen, sequences of the screen, messages on the screen, easy to understand the scripts and structures of visual information. To measure the fun aspects, we asked questions concerning creativity works, styles of artwork, pleasant surprises and enjoyment.

For both instruments – usability and fun questionnaire – we adapted the smileyometer methods, replacing the traditional discrete Likert type scale. The smileyometer has been used for different research before and is said to be one of the most appropriate indicators to be used when the testers are children (Read et. al., 2006). We gave the children the smileyometer emoticons (emotion icons) in form of stickers and asked them to stick or paste them at the appropriate scale that shows their true emotion and feeling about the tool. This method was revised from the Fun Sorter tool which allows children to rank items against one or more items and was intended to record the children's opinions about the game authoring tool. This also means that Smileyometer and Fun Sorter tools can be used to measure the child's engagement (Read et. al., 2006).

Figure 2: Smileyometer (adapted from Read et. al., 2006) indicates emotions of children when using Gatelock upon answering the questionnaire. From left to right: awful, not very good, good, really good, and brilliant.

One researcher conducted all five usability test sessions while one assistant observed and noted the children's reactions and engagement with the tasks. The assistant used a checklist to simplify his tasks. The checklist consists of behaviour and acting reaction during the use of Gatelock including affective reactions such as

gestures and facial expressions, laughing or frustration, expressing pride, verbal communication, self-exploring and self-discovering. The behaviour indicators were marked and analyzed for frequent occurrences according to a given time scale given due to any action happened and can be notified.

Results

We have analyzed the usability and fun instruments and compared them with the observation data. From these, we report the findings in the next sections. Since the number of samples is small, it is not that appropriate to draw a generalization out of them. The test involves only five participants, therefore, the data analyses are limited to descriptive statistical analyses. Our main aim is to focus on the design and development of the game authoring tool itself. Meanwhile, anecdotal comments, as described in the next section, are valuable and sufficient to identify a possible usability problem.

Gender	Age	Having own computer	Hours per day playing games	Most favourite games genre	Person influencing the playing of games	Features in games you like most	Interest to develop own game
G1	10	Yes	< 2	strategy	brother, father	challenge	yes
B2	9	Yes	> 3	action, sport	friends	challenge, graphic	yes
G3	12	Yes	< 2	puzzle, strategy	friends	story, graphic	yes
B4	11	Yes	2 – 3	simulation, racing	uncle	challenge	yes
B5	9	Yes	2 – 3	action, racing	brother	challenge, music	yes

Table 1: The children's personal data (B = boy and G = girl)

The figure above shows the children's personal data. As a result, computer games are more embedded into the boys' leisure culture than the girls'. Boys are more in favour of games that are associated with their other interests such as sports. They spend more than two hours per day playing computer games and they like to play challenging games. When we asked the children on their leisure activity, boys consider game playing as a first choice activity, whereas girls are more likely only to play games when they are bored or have nothing else to do. When we asked the children to identify the best features of their favourite games, they named features such as challenge, story, graphics and music.

Usability and Fun Results

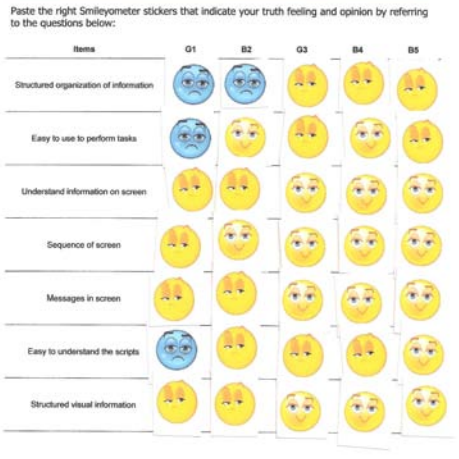

Figure 3: The children's information and rating of difficulty referring to questions asked in the usability questionnaire. The diagram consist answers for the same question answered by participated children.

In general, all children found the designed game authoring tool is easy to use with little instruction. By running the test, some key problems were identified at an early stage and various usability issues could be fixed prior to the actual deployment of the game authoring tool.

The structured organization of information and their sequences in the screen are easy to understand and to follow, but two children seemed to have some difficulties especially when exploring the information by themselves. They needed guidance to move from one screen to the other. But after knowing how to use the information on the screen, they knew how to proceed independently. From the observation, all children spent less than 5 minutes to understand the structure flow of Gatelock.

The tool uses a visual environment where children can perform click-and-drag activities for any action or script that they want to add to the objects. But all children had difficulties to understand the scripts. They argued with some of the images used in the tool and started to comment based on their understanding of it. This also included the understanding of some instruction text that related to game design and development terminology used on the tools. Perhaps, the most interesting aspect is the capability and ability of children to understand metaphors, language tools, design environments and iconic instructions embedded in the tool.

In general, there were several high-ranking usability problems that needed to be solved:

- 48 out of 64 buttons did not work constantly;
- the children did not pay attention to navigation buttons, so the buttons need to be more noticeable;
- the children still confused by different modes of operations (object-action-object model),
- the children frequently clicked on objects and expected something to happen; and
- the use of better language for the text, iconic layout and interface design for a better understanding.

As mentioned before, these problems will become the guidelines in re-designing Gatelock. Then, further test will be done with other children in the month of July and September 2008.

Gatelock is purposely aimed at engaging children with game design materials in a non-threatening and enjoyable way. The study shows that the children enjoyed using Gatelock and that they were able to think and create a creative work in their own style. They enjoyed their game design activities and showed it by laughing and smiling. There were times when they were frustrated because they did not get what they intended to do. But they were willing to share and ask us how things can be done and they showed us their ideas by drawing them on paper.

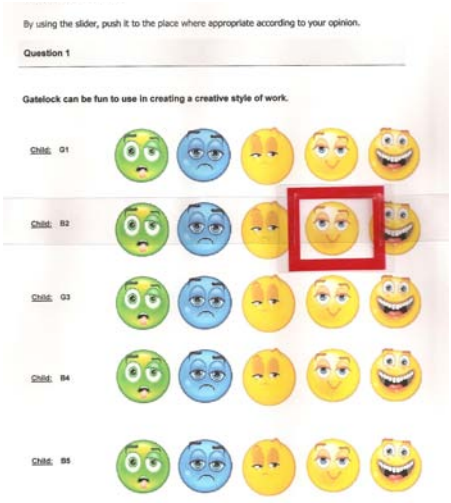

Figure 4: A fragment of the table showing Fun Sorter rankings for Question 1 in the fun questionnaire.

During the game making process, children have to solve problems, whereas each step involves to find solutions and to get along with the process of refinement. For the games, no one tells them the rules of the play in advance. They must figure them out themselves by observation, trial and error, and a process of hypotheses testing. The rules go beyond the decoding of the meaning of individual icons on the screen. Besides figuring out what the symbols mean, the players must discover how they act. However, all children attempted to ask questions and they have been guided directly before proceed to the next levels.

The children were asked a few questions concerning their interest level in game making activities in the classroom, and especially about what they have learned from Gatelock. Here are some of the quotes given by them at the end of the test:

G1 – "I wanted to know how a game can be developed. Before this, I only knew how to play."
B2 – "I have learned something new and I feel good about it. And it is fun."
G3 – "I wanted to develop my own games and asked my brother to play them."
B4 – "If I know how to make a game, I do not have to spend my money buying one."
B5 –"I think we need more games that relate to learning so that we will sit in front of the computer all day in school."

We believe that the possibilities to integrate any subject lesson into game making activities are endless, especially when it comes to the idea of using a program such as Gatelock in the classroom. Creativity is not just a question of creating new solutions, but creating better solutions and this requires a critical judgment. By understanding this, learning while making games can really connect motivation towards learning, perhaps in any lessons taught in the classroom including science and mathematics or even creative thinking.

Conclusions

A game authoring tool has different design considerations and usability issues than other types of software. In the case of usability for a game authoring tool, the elements of effectiveness, efficiency and satisfaction must be accompanied with the element fun. The usability test was conducted to get some input from children which revealed some of the interface problems of Gatelock. These findings can be used by the designers of the tool to create a better and acceptable game authoring tool for the actual users, the children. The game authoring tool can become a good platform for children to perform computational activities especially in the classroom.

One of the problems in designing a collection of activities for computer systems is that learners engaged in those activities have to achieve given educational goals. Thus, the design challenge for computer-assisted or supported educational activities includes the design of tasks as well as of the system. The measure of success is not considered simply, but as a more complex evaluation of the effects of performing the task, for example, an educational activity that learners complete quickly and accurately has no value, if they learn nothing from it.

By using this game authoring tool, we emphasize the fact that in effective technology integration, teaching the curricular content is more important than using the technology. But, on the other side of a coin, the use of technology should support the teaching of the content and make learning more meaningful for students. Hopefully, the game authoring tool can be used with lessons that are already included in an integrated curriculum guide or it can be used as a tool for the design of new lessons.

Acknowledgement

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