INTRODUCING SQUEAK ETOYS TO ENHANCE SCIENCE AND MATHEMATICS LEARNING

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ABSTRACT

There is a greater emphasis on teaching children as young as possible to prepare them for their future. We believe that the best way to engage children in real learning today is through games not only by playing games but also by making them. Allowing children to design games can help them to plan and validate their game plan or special requirements, and to explore possible ways for particular solutions. It will let the children relate to game making activities in a way that also connects them to problem solving skills in their learning. We used Squeak Etoys to introduce game making activities to find a possible way for children to construct learning and to engage them in deep thinking process. The motivation behind using it is to introduce children to programming. We believe that Squeak Etoys can set a great foundation towards a ‘real’ programming language and reflect on children’s thinking. This paper deals with our interest in and intention towards game making activities for children under the age of twelve. Preliminary results showed positive acceptance among the children and revealed that game programming can be useful as a technological medium for the active learning of science and mathematics.

INTRODUCTION

The awareness of children’s thinking skills has mainly been growing due to the technological growth trends in computerized gadgets, networking equipments, communication technologies, and video games. Nowadays, children (also known as the Generation X) are more exposed to these gadgets than adults. The gadgets are used by children to express themselves. The question is how to combine the fast-growing demands of children with the current curriculum especially in school.

Since many years, people talk about educational entertainment or edutainment as a form of entertainment that is designed to educate or to train. Edutainment seeks to instruct or socialize its users by embedding lessons in a more familiar form of entertainment such as television programs, music, websites, multimedia software and electronic games. Researchers believe that successful edutainment is visible by the fact that learning becomes fun and educators can educate learners in a manner that is both engaging and amusing (Kafai, 2006 & Yatim, 2006).

Countering such arguments, there are two perspectives to implement games into the educational environment – games as a learning tool and learning by creating games. One side believes that games can become a useful teaching and learning tool, if educators know how to use them properly as homework or as content of their lessons (Gee, 2003 & Prensky, 2006). In other words, educators should be creative to create a new, evolutionary assessment concurrent with the technology enhancement. The other side believes that by making games, learners can eventually develop other skills and gain benefits for the individual emotional and social development (Kafai, 1995 & Yatim, 2007).

To demonstrate the implication of learning by making games and its possibilities in this paper we merely want to share our experiences in teaching children how to make games. We used one particular educational programming tool, Squeak Etoys, in one study conducted at a
school in northern Malaysia. The goal of the study is to provide a tool for these children to learn how to create games. Furthermore, the goal is not that the children must learn how to program, but rather that the tool should be a vehicle to introduce children to a way of thinking. In certain instances, children are able to explore the underlying programming model of the tool they use to construct games within the selected subject areas – mathematics and science.

LEARNERS AS DESIGNERS

We believe that the best way to engage children in real learning today is through games. In his book "What Video Games Have to Teach Us about Learning and Literacy", James Paul Gee (2003) urged the importance and potential of any gamers to become game producers. He believes that players can redesign games, since nowadays many games include a software that allows them to modify (or mod) and customize new scenarios that fit into their playing styles.

Children are able not only to be users, but also designers and producers who gain, organize and use the valuable information. Designing a game, or in other words, learning by doing, can help children to plan and validate their game plans or requirements and explore possible ways for game solutions.

Seymour Papert (1993) started the constructivist field by introducing Logo – a programming language for children to simulate the movement of a turtle. As one of the active constructivists, he believes that learning can be done when the learners are involved in the constructing process including problems solving and decision making. His work has inspired other researchers that conduct a more in-depth applied research, such as Idit Harel (1990), Yasmin Kafai (1995) and Mikael Kindborg (2003).

During their research, they found out that children learn best when they integrate their own style in game development stages – plan, explore, possible solution, design and develop, test, validate, evaluate and re-design. They also believe that game making activities provide a context for reflection and discussion to enable children to gain a deeper understanding of the ideas that under hands-on activities. These activities also offer bridging interdisciplinary activities together with other concepts in mathematics, science and art lessons.

EDUCATIONAL PROGRAMMING LANGUAGE FOR CHILDREN

There are numerous educational programming language tools that have been used in the last 30 years with one motive: to make the programming environment accessible to novice programmers of all ages (including children). These tools are mainly designed as learning instruments and some of them can be used to write real-programming or application programs. As mentioned above, Logo has become the pioneer of all other programming environments for children, and certainly one of the earliest programming languages designed for children to be used in the classroom. The use of turtle graphics was added to provide a mathematical microworld was known as turtle language.

These educational programming languages, for instance, Logo, ComiKit, HANDS, Kid’s Programming Language, Scratch, Squeak Etoys and Toontalk have their own specialities and focus on different frameworks for children to learn how to program. Some of them embedded mathematics and science methods and lessons, while others focused on drawing and perception towards logical thinking and object manipulation either in two-dimension or three-dimension environments.

It is critical to consider how to choose the appropriate educational programming language for children that are easy to use, age appropriate in content and foster exciting learning experiences. Above all, we believe that by choosing and using the appropriate tool, children will learn more across the subject fields such as mathematics, science, art, storytelling, programming, game design, interface design and others. In this study, we used Squeak Etoys as the language and tool to design games in the classroom with the purpose to learn science and mathematics concepts. We decided to choose it because it provides a visual programming interface on which even children can create their own programmes.
SQUEAK ETOYS AS A LEARNING TOOL
We used Squeak Etoys to introduce game making activities to find a possible way for children to construct learning and engaging them in a deep thinking process. In addition Squeak Etoys can set a great foundation to amplify learning and reflect more on complex aspects of children’s thinking. Squeak Etoys is similar to Logo in its capabilities of a Logo turtle. Furthermore, Squeak Etoys can be treated as a graphical environment that can be used to teach science and mathematics simulation. It runs on many platforms and is multilingual.

Squeak Etoys is readable because it is similar to the English-based language. It is an open source project created by using Smalltalk language. It combines object-oriented programming with a tile-scripting structure and this makes Squeak Etoys easy for children to visually program objects. Program statements are represented as tiles and scripts are created or edited by dragging and dropping the selected tiles into the script (known as scriptor).

Teaching Squeak Etoys in the Classroom
In this study we use Squeak Etoys, which is an educational programming language tool for children aged from seven to twelve. The children learn how to program, since programming should be a vehicle to introduce formal ways of thinking to the children. At the same time, by designing games, children can learn how these games are working. The aim of the workshop was to give children an opportunity to design and create games as an approach to develop literacy skills, and to discover the strengths and weaknesses of game authoring tools. The workshop comprised 18 learning hours and eleven fifth graders and twelve sixth graders participated in it.

The following section briefly describes samples of projects that were developed in the workshop. As space is rather limited, we will not explain in detail how these games have been developed. Instead we will only focus on describing the game features, showing motivating screenshots and the integration of science and mathematics lesson in these games.

Example Projects (Science and Mathematics Selected Topics)
Here are some examples of projects that indicate the capabilities of Squeak Etoys as a tool for teaching science and mathematics to children:

1. **An Ant Crawling Project**
   This project derived from the famous Squeak Etoys’ example – the car that can be simulated using tile scripting codes. In the beginning, we introduced the car tutorial that only consists of two scripts - a “forward by” tile and a “turn by” tile. From this basic tutorial, one group came out with the ideas that an ant will crawl from the starting point until the end, and the movement of the ant was set-up by using colour coordination and logic programming. This project showed that those children were able to think outside the box. They showed us that whenever they increased the value of 5 in the script, the ant moves faster and vice versa. We believe that by allowing the children to experiment and involve them in these kinds of activity, highly and deeply, they can play with mathematics and think like a mathematicians.
2. Basketball Project
This project was developed by two boys. They explored Squeak Etoys themselves and found a feature how to plot a graph for any animation or how to simulate an object. They draw a basketball and tried to move it in various ways. They were able to capture the movement and plotted it in a form of a graph. Their intention to explore the Squeak Etoys features brought them into the world of incidental learning. This also has to do with the “a-ha effects” or the “wow factors” that suddenly embraced them to use the tool more frequently and in-depth. From here, they had the knowledge how to plot the object's movement and use it to create science and mathematics simulations in their next game.

3. Walking Down the Stairs Project
Three girls aimed to let a ‘stick-man’ walking down the stair. They did not only succeed implementing their aim, but they made the ‘stick-man’ walking down the stairs smoothly. They managed to implement it by using an animation style. Furthermore, they changed the colour of the ‘stick-man’ and brought more fun into the designing process of the game. They also implemented a simple geometry by visually seeing the effect of the direct manipulation by using positive and negative signs (+ / -).
4. SpaceShutter Project

Four boys implemented the game far beyond our expectation. The game has one goal which is to guide the spaceship to the sky and land it without crashing it. The spaceship is controlled by using a joystick and the tricky part happens at the end of the mission. The gamers really need to concentrate and control the movement of the joystick in order to land the spaceship safely. In this project, they expressed their knowledge and critical thinking by implementing it. They discussed the impact of speed that could lead to a crash. They also mentioned the acceleration and momentum aspects, which are slightly covered in their curriculum at their age.

DISCUSSION

Coming up with a good game idea is often the easiest part and children can start by creatively designing a simple game and be proud of their creation. However, implementing these ideas is an incredible challenging task. The premise is to use the right tools and synthesize the point that they are actually in the process of learning by doing and thinking through making their games (Yatim et al., 2006). In other words, designing games and learning interact with each other.

Making games can be a medium of expression which means that children are able to create new contents which are most probably inspired by their surroundings (Yatim & Masuch, 2007). During the game making process, the children have to solve problems, whereas each
Creativity is not just a question of creating new solutions for problems, but creating better solutions, and it requires a critical judgment. We believe that education which only focuses on one way of thinking would be unbalanced and incomplete. Thus, we will show how children can achieve the educational objectives by creating games. They only need appropriate tools to let their creativity flourish.

The idea behind transferable comprehension skills is that children adopt skills in areas such as mathematics, science, art and even computer literacy while creating games. In the game making workshop, the children showed how they understood the relationship between measuring the car's speed with the action happened after that. This also included the score in the game play. The relation between numbers and actions had to do with their way of programming games. These skills can be transferred to more traditional areas with results that can be measured. Without a doubt, these skills develop when the children are learning. They understand the meaning of the instructions and interpret them in their own way.

In the beginning, we briefly explained them how to create a car and control it by using the mouse. Subsequently, we announced the basic idea and established minimal basic rules for the realization of the game. The children had to apply their knowledge in a new situation by putting the game into the context of a story. Surprisingly, all groups came out with different ideas and managed to bring their original ideas into a new form. For instance, one group applied its storyline and visualized it in a very creative way. Instead of letting two cars race against each other, they also integrated mini-quests into the game, like the solving of puzzles and the collection of items. This game project is not covered in this paper.

Mathematics of space and movement, and repetition patterns of action are often natural to children. They start thinking about and analyzing different problems and discuss their solutions with other children to come out with a common solution. Although the design and programming of a game is not common to them, the children have experienced and adapted an easier and faster way to design a game. There are many new things to discover, solutions to explore, and things to do and the children are also confronted with the range of design problems.

The transfer of knowledge typically requires children to think on a design level, to think about how problems are structured and to find new ways, maybe by incidental discovery. This can be seen as an innovative learning strategy. The concept of combining ideas and constructing them during the game design process enables the children to work together in a team and communicate their ideas to achieve good solutions. The activity of trial-and-error will show them that making mistakes is part of the learning process before the goal is reached and a running game is finally produced.

During the game design session, the children are not criticized for an error neither in drawing nor in programming. The process of debugging is a normal part of the process to understand a program. Since children are good pattern recognizers, they could later facilitate the finding of the correct patterns and generalizations in more complex cases. We believe that the possibilities to integrate any subject lesson in game making activity are endless, especially when it comes to using Squeak Etoys in the classroom.

**CONCLUSIONS**

People should look at how game developers get their ideas working, especially how they deliver a game that can actually motivate players to start playing games and stay playing them. The role of mistakes when playing a game is different compared to creating a game. When playing, people just try things and mistakes are expected but creating a game can be like a sandpit or sandbox: a place where they can make mistakes, but where the emphasis is more on creativity and the achievement of own goals (not the goal set up earlier by the game developers).
designers). Our experiences with children showed that they are able to construct quite advanced programs, language and actions but with the support of educators and human / artificial tutors.

Children are able to explore and learn about the underlying programming model of the tool they used to construct and the most important fact is that they have fun! And perhaps, by understanding this, learning while making games can really both enhance the experience and also connect “motivations from making games” to “motivations for learning science and mathematics”.

REFERENCE


