

The Spiral-Tuck Model: Promoting Creative Thinking with a Sharing and Reflecting System in Creating Activity

TATSUYA MORIMOTO¹ HIDEYUKI TAKADA²

Abstract: Recently, classes and workshops using GUI-programming-environment have been being introduced in elementary education. As a model for promoting creative thinking, a process consisting of *Imagine*, *Create*, *Play*, *Share* and *Reflect* is proposed. However, it is difficult to perform processes such as *Share* and *Reflect* which are essential in the model. In this paper, we propose a model on which children perform *Share* and *Reflect* in creative activity, and describe the development of a system to support achieving the model in workshops. To consider developing the system, we need to clarify what kind of *Share* and *Reflect* children perform will produce good effect on study. To satisfy this need, we developed a system to share with other children drawn pictures or constructed scripts, and made an experiment to clarify what kind of *Reflect* occurred using this system.

Keywords: GUI-programming-environment, sharing works, promoting creative thinking

1. INTRODUCTION

In 2002, the Japanese government course guideline was changed, and there are some significant modifications such as the elimination of learning contents or the operation of five-day school week. In addition, a new subject called "period for integrated study" was established. According to the teaching guidelines for elementary schools[1], a purpose of this course is to promote "reproductive thinking" and "creative thinking". Recently, classes and workshops using GUI-programming-environment such as Squeak Etoys and Scratch have been being held in elementary education[2]. The goal of these classes and workshops is promoting children's creative thinking and logical thinking. A process model for promoting creative thinking is proposed in the learning using this environment by Mitchel Resnick[3]. This model claims that children's creative thinking is promoted by children's repetitive five step processes, namely *Imagine*, *Create*, *Play*, *Share* and *Reflect*.

The workshop in this research assumes that children do creative activity receiving the support by facilitators and supporters, and give a presentation to other participants to introduce their works. These workshops have some problems that there are few opportunities of *Share* or *Reflect*, and it is difficult to apply experiences gained through these processes to the future creative activity. In consequence, it is difficult to apply the model proposed by Mitchel Resnick to the workshop. In this paper, we propose a model, called the *spiral-tuck model*, on which children perform *Share* and *Reflect* in creative activity, and describe the development of a system to support achieving the model in a workshop.

To consider developing the system, we need to clarify what

kind of *Share* and *Reflect* children perform will produce good effect on study. To satisfy this need, we developed a system to share with other children drawn pictures or constructed scripts, and made an experiment to clarify what kind of *Reflect* occurred using this system.

The rest of the paper is organized as follows. Section 2 presents the workshops using GUI-programming-environment and problems of promoting children's creative thinking. Section 3 introduces a model on which children perform *Share* and *Reflect* in creative activity. Section 4 describes the experiment and makes some discussion. Finally, Section 5 concludes the paper.

2. GUI-PROGRAMMING-ENVIRONMENT AND PROMOTING CREATIVE THINKING

2.1 A Learning using GUI-Programming-Environment

The purposes of the period for integrated study are to promote "reproductive thinking" and "creative thinking". Reproductive thinking is a skill to solve problems using knowledge which has been acquired by studying definitions and theorems in mathematics or science. On the other hand, creative thinking is a skill to solve problems by finding issues, studying, thinking, and judging[4][5]. In current elementary education, reproductive thinking is promoted in the classes such as mathematics or science, while creative thinking is promoted in the classes such as drawing and manual arts.

Moreover, GUI-programming-environment such as Squeak Etoys and Scratch is gaining attention as a tool to promote a skill in which these two thinking skills are integrated. In Squeak Etoys, children can create their own programming project by assembling programming parts called *tiles*, each of which has a designated function such as moving forward, rotating, branch-

¹ Graduate School of Science and Engineering, Ritsumeikan University

² College of Information Science and Engineering, Ritsumeikan University

ing and repeating. Children give a motion to self-drawn sketches by making *scripts* with these tiles in the drag-and-drop manner. This feature of GUI programming is now promoting the employment to the elementary education fields because even children who are not familiar with computer programming and keyboard typing become to be able to construct programs easily. Children can do creative activities through trial-and-error, because changes are reflected quickly and visually when children make changes to a *script*. Therefore these tools can be a suitable environment to promote children’s creative thinking[6].

2.2 A Model for Promoting Creative Thinking

The model for promoting creative thinking is proposed in the learning using GUI-programming-environment by Mitchel Resnick. This model claims that children’s creative thinking is promoted by children’s repetitive five step processes, namely *Imagine, Create, Play, Share* and *Reflect*.

Mitchel introduces Scratch[7] which is an application to achieve these processes. Scratch has the *share button*; when a user clicks this button, the works created by the user are uploaded to the Scratch site. People throughout the world can see the uploaded works and give feedbacks to users who created the work by writing comments. Children can perform processes such as *Share* and *Reflect* using this function of Scratch, and reflect feedbacks to the future creative activity.

2.3 Problems in Workshops using GUI-Programming-Environment

Mitchel’s model described in 2.2 is suitable for promoting children’s creative thinking. However, there are some problems when the model is applied to the workshop in practice. There are few opportunities of sharing works in the workshop using GUI-programming-environment. First, children need to walk to other children’s PC during creative activity to watch other children’s works. There is a presentation session which is held at the end of workshop, but it is little time for children to watch other children’s works. Moreover on the presentation, children are given the role as a presenter and audience. Therefore, there are few opportunities of exchanging opinions with other children. Children also need to finish creating one work on each workshop unlike a class where children finish creating one work through some classes. Children may not be able to even reflect feedbacks to the future creative activity, if children have gained feedbacks by sharing works with other children after creative activity.

If children use the sharing function of Scratch, they can do activity such as *Share* and *Reflect*. However, about 2.7 million of works have been uploaded so far. In this situation, it is difficult to find works which are created by participants of the workshop. Moreover, it is difficult for children to use the comment function of Scratch, because this function needs keyboard typing. In addition, the workshop is an environment where children can talk with other children. Returning feedbacks by the comment function is not enough to be utilized in this workshop, because it leads to the reduction of the conversation.

3. SUPPORTING SHARE AND REFLECT IN CREATIVE ACTIVITY

3.1 The Spiral-Tuck Model

Applying Mitchel’s model to the workshop using GUI-programming-environment has some problems that children cannot reflect feedbacks to the work in creative activity, because the workshop is divided into the creative activity and processes such as *Share* or *Reflect* as described in 2.3. To solve this problem, we propose a model on which children perform *Share* and *Reflect* in creative activity as shown in Figure 1. The creative activity in the current workshop consists of repeating *Imagine, Create* and *Play* in *spiral*. *Share* and *Reflect* are performed after this creative activity. *The spiral-tuck model* is a model that these processes which are performed after creative activity are *tucked* into the creative activity.

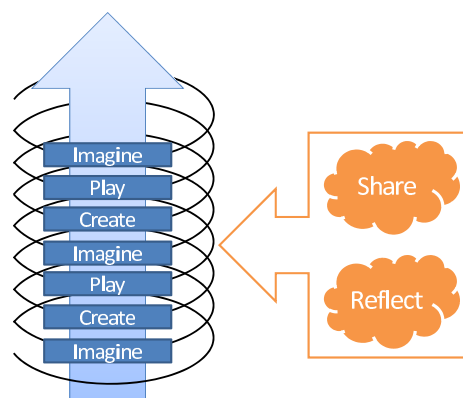


Fig. 1 The spiral-tuck model

If this model is applied to the workshop, children can gain feedbacks with participants of the workshop while doing creative activity, they can share and perform mutual evaluation on created works, and they can reflect new ideas and feedbacks in the work which they are creating.

3.2 Share and Reflect in the Creative Activity

To consider applying *the spiral-tuck model* to the workshop using GUI-programming-environment, we need to clarify what kind of *Share* and *Reflect* children perform will produce good effect about promoting their creative thinking.

On the workshop using GUI-programming-environment, the following elements can be raised as what to be shared by children.

- an entire screen of the running application
- a sketch drawn by children
- a script constructed by children

Moreover, there are some ways of sharing them as follows.

- to display them a pop-up on children’s monitor
- to display them on small terminals such as iPod touch
- to project them on the screen at the front of the classroom

Therefore, there are two aspects, "an element which should be shared" and "a way of sharing elements", on the workshop using GUI-programming-environment. In this paper, we need to clarify

that what and how to share will produce good effects on promoting their creative thinking.

It is not clear that what kind of *Reflect* happens among children when children perform *Share*, because there have been few opportunities for children to perform it in creative activity in the workshop. If a conversation occurs naturally, we should provide them with a trigger which increases the activity. On the other hands, if a conversation is not occurred, we should provide them with a trigger which assists conversation.

3.3 Development of a Verification System

We developed a system which enables children to share a drawn sketch and a constructed script because we should clarify relevant *Share* and *Reflect* in creative activity as described in 3.2. In this system, when children want to share sketches or scripts with other participants of the workshop, they click the "share button". Then, sketches and scripts are displayed in other participant's terminals in a pop-up window. The pop-up window disappears gradually over a certain period of time. The sharing system has a function which keeps the pop-up showing for children who want to watch sketches and scripts more.

An image of the running system is shown in Figure 2. In this implementation, the "share button" is placed on the application of Squeak Etoys. The selected sketch or script is uploaded to the server, when this button is clicked. A folder on the server is mounted on every PC which is used in the workshop. When a new file is created in this folder, the file watcher notifies it to the pop-up displaying system. The pop-up displaying system is running as a background program, and it shows sketches and scripts whenever it is notified. Transparency of the pop-up increases gradually over three seconds, and finally the pop-up gets transparent. The system has a function to reduce the transparency of the pop-up by mouse over, and keeps showing sketches and scripts. Children can watch sketches and scripts as long as placing the mouse over the pop-up if they want to watch them more.

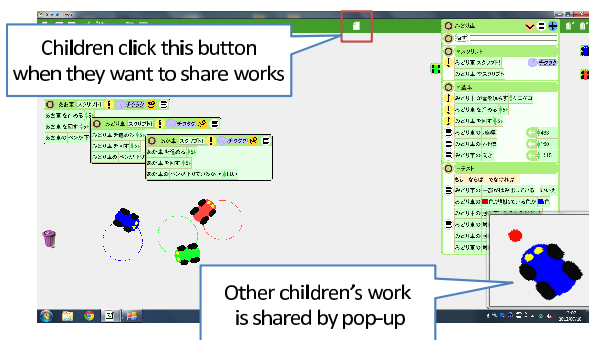


Fig. 2 Sharing the work by pop-up

4. EXPERIMENT

4.1 Setup of the Experiment

The system which is described in 3.3 was applied to a workshop using Squeak Etoys which was held on July 8, 2012. Eleven children participated in this workshop, and their grade is second to fourth. Ten out of eleven children used Squeak Etoys for

the first time on this workshop. Children created the work using Squeak Etoys following a topic "Let's create racing game." This workshop proceeded as a schedule shown in Table 1. Children used the sharing system during time periods from 3 to 5 shown in Table 1.

This time we tell children how to share works, and children shared their works freely. The sharing system counted the number of sharing works and the number of referring works. We regarded clicking the "share bottom" as the number of sharing works, and placing the mouse on the pop-up window over more than three seconds as the number of referring works. We observed the children's reaction when the works were shared.

Table 1 Time schedule of the workshop

time	content
①13:00 ~ 14:00	Self-introduction & Explanation of basic direction for Squeak Etoys
②14:00 ~ 14:10	Break
③14:10 ~ 15:00	Explanation of advanced direction & Programming
④15:00 ~ 15:10	Break
⑤15:10 ~ 16:20	Free work
⑥16:20 ~ 16:40	Presentation

4.2 Observation Result

The number of sharing works was 44, and the number of referring works was 29. Only sketches were shared, but scripts were not. We observed how long children referred to other children's works, and most of children were found to refer to them during three to five seconds. One of the children watched one of the works for 44 seconds. By observing children's reaction when they perform *Share*, the following conversations were found.

- "Look!! It is my sketch!!" (Appeal)
- "What did you think when you drew?" (Question)
- "Nice!!" (Evaluation)
- "How about using more colors?" (Advice)

However, conversations occurred only between children sitting next to each other. Moreover, conversations only occurred when children who have uploaded the work spoke to a child sitting next.

4.3 Discussions

Children used the sharing system for 2 hours in this workshop. It was more than we expected that the average number of sharing works was 4 times in such a short time. A scene where children enjoyed that own work was displayed on other children's terminals was also observed. Therefore, the way of sharing works using the pop-up is found that it has a certain effect on children's sharing activity. If conversations occurred among children, they are effective on children's creative activity. For example, children evaluated works each other, asked what other children thought when they drew, and returned advices and comments. However, the way of sharing works using the pop-up is not enough to support *Reflect* because conversations did not occur without children's appeal when children upload the work, and conversations with children sitting apart did not occur. The sharing system used in this workshop did not show who shares the work. If children want to ask and evaluate uploaded works, they had no idea on

whom they should perform *Reflect* to. For this reason, there is few chance to perform *Reflect* with children. If the system can show who uploads works, there are risks that children are ashamed and do not share. Therefore, it is necessary to consider if the system should show who has uploaded works or not, with continuing future experiments.

We observed a scene where children stop creative activity with the pop-up appearing suddenly when they operated a mouse pointer in the area where the pop-up is shown. On the other hand, children continue to do creative activity when they do creative activity out of the space where the pop-up is shown. It is thought that this problem can be solved by providing an area for sharing activity separately from creative activity.

5. CONCLUSION

In this paper, we proposed *the spiral-tuck model* which enable children to perform *Share* and *Reflect* in creative activity. To consider applying the *spiral-tuck model* to the workshop using GUI-programming-environment, we developed a system to share with other children sketches or scripts, and make an experiment to clarify what kind of *Reflect* occurred using this system. As a result, there are effective conversations such as appeals, questions, evaluations and advice occurred among children by sharing works. However, these conversations did not occur without children's appeal when children upload the work.

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