Work in Progress: A Comparison of Programming Way: Illustration-based Programming and Text-based Programming

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***Abstract*—Learning to programming language is difficult. One solution is to use a digital game, which increases motivation of first-time learners. In this paper, we were executing programming learning with MincraftEdu of sandbox game and ComputerCraftEdu of expansion function. In addition, learning method to programming has illustration-based programming and text-based programming in ComputerCraftEdu. We compare the programming way of illustration programming and text programming. In this result, there was a significant difference towards the illustration-based programming throughout the comparison. In this paper, we present the results.**

Keywords—digital-game-based learning; Minecraft; programming learning.

I. INTRODUCTION

The biggest problem unlearning to program has difficult learning for beginners [1] [2]. The programming language has visual programming languages (e.g., Scratch and Blockly) as well as text programming languages (e.g., C and Java). It has the diversification of learning environment. We find Digital-Game Based Learning (DBGL) for learning to text-based and Illustration-based programming. Taking advantage of digital game is not limited to programming education has several merits. We are raised as follows in the reference [3]. It is "Motivation for learning", "Suitable for the learning of complex concepts". With this, we can expect a certain effect in programming learning. For example, digital games aid in learning a conditional branch, which is a complex programming concept. Hence, DGBL is appropriate to introduce programming to beginners.

II. BACKGROUND

This research background establishes of usefulness by the programming language education using digital game. As described in the previous chapter, programming learning is difficult for beginners. For example, beginners must understand complex programming concepts before being able to program. Thus, many digital games exist for programming education, including CodeCombat [6] and Lightbot [7]. CodeCombat is a roll playing game to learn to JavaScript, while Lightbot teaches programming concepts.

A. Program Language Learning

As described in the previous chapter, the programming language is very difficult to learning from the learner. When learning a programming language, using an IDE and command environment is generally in the text languages such as C and the Java. In recent years, it has come to be used in the training of beginners for a visual language to programming with illustrations. The visual language can be intuitively programmed. It is possible to say that it suits to understand the concept of the programming. Herein the concepts of sequential execution, conditional branch, and repeat are used.

B. Game based Learning

Game Based Learning (GBL) is method that uses a game for education and learning. For example, GBL has gamification and serious games. The biggest advantage is improved motivation to learn. In this paper, we were using a DGBL using digital game in the GBL. As described in the previous chapter, DGBL has several advantages. Further, this method is very suitable approach to learning of the introduction for beginners.

Fig. 1. Display of Minecraft (Mojang: Minecraft)

C. ConputerCraftEdu

In this paper, we use MinecraftEdu [8] and ComputerCraftEdu [9], which are educational versions of Minecraft and ComputerCraft, respectively. ComputerCraftEdu

executes the Lua programming environment in Minecraft. Furthermore, it has two input methods: illustration-based and text-based (Fig. 2).

Fig. 2. Display of Illustration method and text method

Illustrations method is the programming by using the drawn block of the picture. Text method is the programming by using common programming as well as text. In this study, it is an object of the present invention to verify whether it is suitable which of the methods for beginners. In addition, both methods have the same level of abstraction (Fig. 3). That is the instructions of “put the block” are expressed as one of the function or block. We compared the learning effect of both methods.

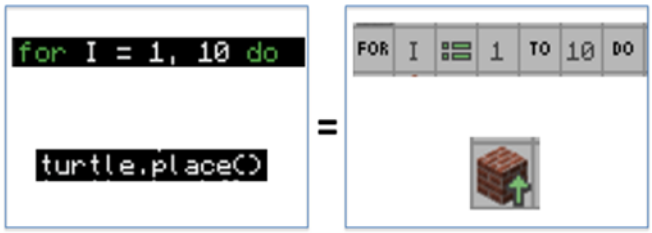

Fig. 3. Text-based programming in contradistinction to illustration-based programming

III. EXPRIMENT

We adopted GBL as a programming language education approach and implemented a workshop to compare the programming way of the two input methods.

A. *Research question and hypothesis*

To determine if there is a difference in the programming way, a workshop was implemented to answer the following research question:

- **RQ1**: Do illustrating-programming and text-programming induce a different programming way?

In addition, our hypothesis for the research question is:

- **H1**: The lecture on illustration programming will induce a larger change in programming way.

B. *About Workshop*

The workshop has two-lecture course at text-based programming and illustration-based programming. The Illustration-based programming group (G1) had 11 people. The Text-based programming group (G2) had five people. The workshop time is three hour. The learning contents had "sequential execution," "conditional branch" and "repeat", to basic of programming. In addition, two questionnaires (before and after the lecture) were executed.

C. *Detail of Learning Contents*

This study focused on the following learning contents:

- **Basic**: Move the turtle and place blocks.
- **Loop**: Using the "for statement", move the turtle and place the blocks.
- **Conditional execution**: Design a block using the "if statement".
- **Free problem**: Create an alphabet letter of the first letter in your name.

D. *Research Contents*

To answer the above RQ, we examined the following programming way: Interest, Difficulty, Usefulness, Fun, and Willingness. (See [1] for more details on the first four items). We added Willingness as an item because in order to measure changes in learning motivation

E. *Questionnaire*

We implemented a questionnaire to investigate Programming way. One was completed prior to the lecture (before questionnaire) and the other at the end of the lecture (after questionnaire) using the six stages on the Likert scale (Table 1). In addition, we were also performed questionnaire to after workshop for “about workshop”. We show the question content (Table 2).

TABLE I. EVALUETION OF QUESTIONNAIRE

Stage	Evaluation
1	Strongly disagree
2	Disagree
3	Somewhat disagree
4	Somewhat agree
5	Agree
6	Strongly agree.

TABLE II. DETAIL OF QUESTIONNAIRE

Programming way question		
Question No	***Question***	***Research category***
Q1	Are you interested in programming?	Interest
Q2	Do you think that learning to program is difficult?	Difficulty
Q3	Do you think that knowing how to program is useful?	Useful
Q4	Do you think programming is fun?	Fun
Q5	Do you want to learn to program?	Willingness
Q6	Are you interested in the turtle program?	Interest
Q7	Do you think that the learning the turtle program is difficult?	Difficulty
Q8	Do you think that knowing how to turtle program is useful?	Useful
Q9	Do you think turtle programming is fun?	Fun
Q10	Do you want to learn to turtle program?	Willingness
About Workshop Question		
Question No	***Question***	
Q11	Did you enjoy learning to program using Minecraft?	
Q12	Also, do you want to study?	

IV. RESULTS AND ANALYSES

Here we show results and analyses based on the RQ.

A. *Analyses of the Questionnaire to Investigate the Programming way*

This section compares and analyzes the survey results on the programming way for proving of H1. The response rate of the questionnaire of illustrations (G1) has 11 people, and of the text (G2) has of five people.

Figures 4 -7 show the results of the before and after questionnaires. Both groups indicate an improved programming way after the lecture. Although not significant, the illustration group (G1) has a negative opinion about programming prior to the lecture. After the lecture, the negative programming way decreased. In addition, the illustration group (G1) has an increased interest and useful in programming compared to the text group (G2).

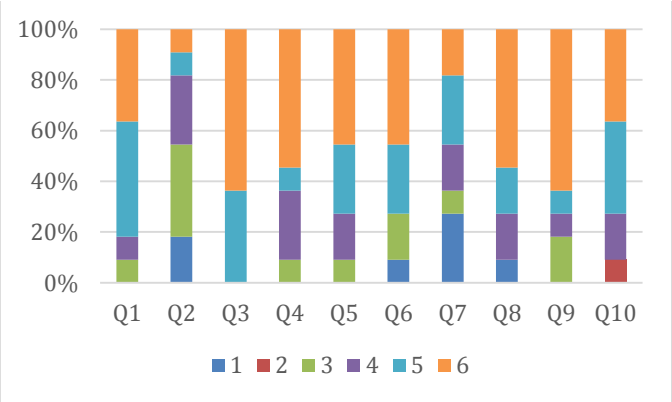

Fig. 4. Result of illustration (G1) in before questionnaire

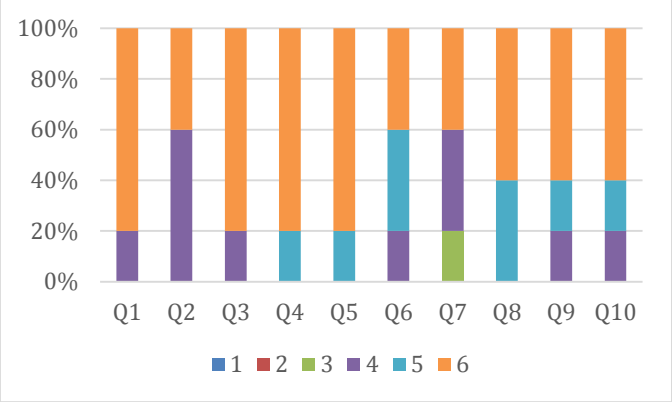

Fig. 5. Result of text (G2) in before questionnaire

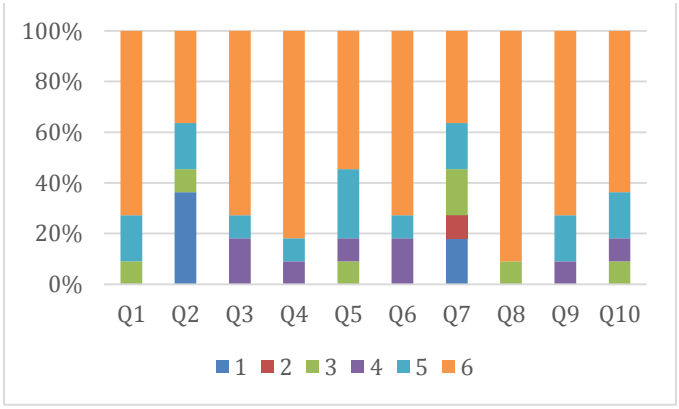

Fig. 6. Result of illustration (G1) in after questionnaire

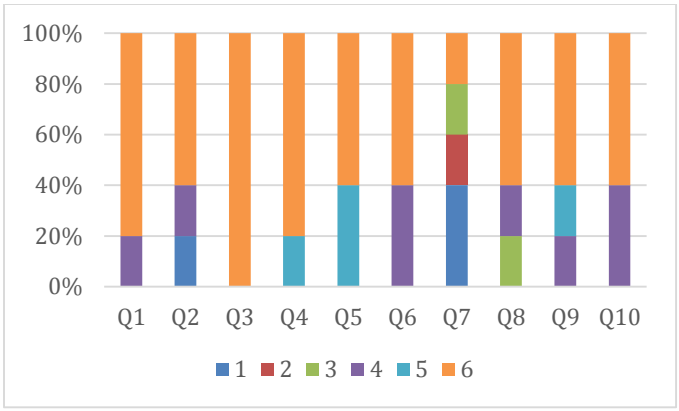

Fig. 7. Result of text (G2) in after questionnaire

B. *Result of Programming Way*

The programming way differed between the two groups. The illustration group (G1) tended to feel turtle programming is difficult prior to the lecture. However, after the lecture, learning by illustration (G1) had a larger improvement in perceived difficulty in programming and interest in programming than learning by text (G2).

We built a hypothesis of H1. G1 was greatly improved than G2 of interest and willingness. It was found from the result that H1 was correct.

C. *About Workshop Questionnaire*

We implemented a two-question questionnaire inquiring about the workshop. The response rate of the questionnaire of illustrations (G1) has 11 people, and of the text (G2) has five people. Figures 8 – 9 show the results. All learners felt the workshop was fun. In addition, all learners indicated a willingness to continue learning to DGBL. There is not the big significant difference in an illustration group and a text group.

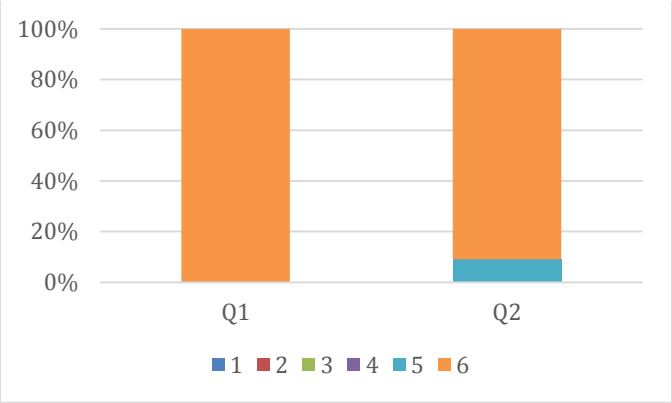

Fig. 8. Result of about workshop questionnaire (G1)

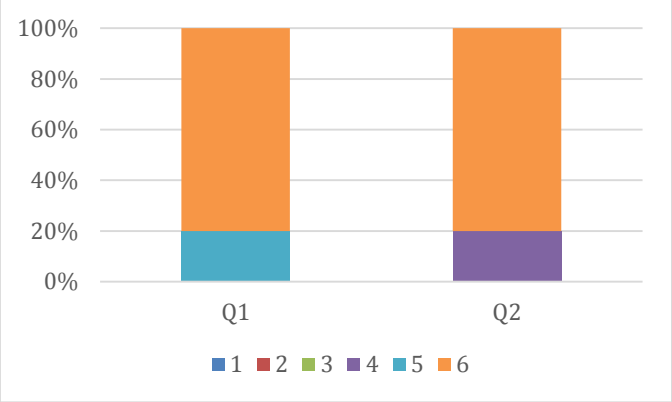

Fig. 9. Result of about wrokshop questionnaire (G2)

V. FUTURE WORK

In regards to the future, we acquired programming way the questionnaire for to reveal the significant difference of change of the original to implement significant difference test. It also carries out a comparison of learning effect of both groups also analyzed artifacts.

VI. CONCLUSION

In this research, we executed workshop using MinecraftEdu and ComputerCraftEdu. A workshop contents have programming learning. This workshop researched difference to input method of illustration and text. Because of investigation, interest to programming improved illustration group in comparison with the text group. In addition, learning about the turtle programming greatly improved the illustration group. Further, All learners enjoyed workshop using DBGL from about workshop questionnaire.

To elucidate the difference in the learning effects, we intend to further analyze the results.

ACKNOWLEDGMENTS

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