The Effects of an Information-Technology Gifted Program on Friendship Using Scratch Programming Language and Clutter

Seungki Shin, Phanwoo Park, and Youngkwon Bae

***Abstract*—This paper seeks to examine the effects of an information technology gifted class on friendship through the use of the scratch programming learning environment connected via the clutter website. Scratch is an educational programming language developed by MIT Media Lab. The strong points of Scratch include a framework based on Piaget's constructivism, its development of 21st century skills, enhancement of problem solving abilities, and so on. However, Scratch only allows for limited collaborations. As the module is used individually, groups of people cannot simultaneously create a program. Furthermore, gifted children find it difficult to make friends due to their lack of sociability in contrast to their excellent study results. Fortunately, the Clutter platform as part of the Scratch educational program allows for collaboration and thus, enables students to develop friendships. In this context, we sought to improve the friendship of gifted children using a teaching-learning method based on the Scratch educational programming in tandem with clutter. Our findings support the idea that effective pedagogical programming in 21st century emphasizes collaborative learning skills. Furthermore, this approach increases our expectations about educational effects of Scratch 2.0, which is soon to be released.**

***Index Terms*—Gifted children, friendship, clutter, scratch.**

I. Introduction

In 21st century, we live in an information-knowledge-based society, which is based on diversified and creative knowledge combined with information technology (IT) [1]. Students living in the 21st century society are required to assimilate various learning skills: critical thinking, communication, collaboration, and creativity (the 4Cs) [2]. In this context, it makes sense to teach programming to improve the 21st century learning skills of students, which allows them to develop creativity and their problem-solving abilities by learning programming [3]-[6]. Scratch is one such educational programming language (EPL) used to enhance creativity and problem-solving techniques, which can be easily learnt by programming language using numerous blocks [7]-[9].

In Korea particularly, many gifted classes operate on the basis of Howard Gardner's Multiple Intelligence Hypothesis. Our IT-gifted class is one of the well-known gifted education programs in Korea, which uses Scratch in its program. However, as the latest version of Scratch (1.4), it has limited collaboration possibilities. As the module is for individual use, several people cannot simultaneously create a program.

In general, gifted children find it difficult to make friends due to a lack of sociability compared to their excellent study results [10]. In addition, as the information society endures and individualism grows stronger, the Organization for Economic Co-operation and Development (OECD) emphasizes the importance of collaboration and interpersonal skills, which will be reflected in the OECD's education systems assessment, known as PISA, in 2015 [11], [12].

The Clutter collaborative interface, however, is expected to help develop friendships: it contains Scratch's educational effect, but complements the lack of collaboration in the latter. Clutter is supported by MIT Media Lab to compensate this weakness in Scratch.

Therefore, in this paper, we tried to assess the changes in students' friendships after adapting Clutter to an IT gifted class.

Manuscript received October 5, 2012; revised January 18, 2013.

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II. Related Research

A. Scratch Programming

Scratch is aimed at programming language education and designed by Lifelong Kindergarten, MIT Media Lab. The name, Scratch, derives from the music turntable technique of scratching, which means that we can program freely using blocks by just combining elements [13]. Scratch has many advantages, three of them being listed below.

Firstly, Fig. 1 shows Scratch is a framework based on Piaget's constructivism, meaning that it can be programmed by a drag and drop of blocks, similar to putting the pieces of a puzzle together [14].

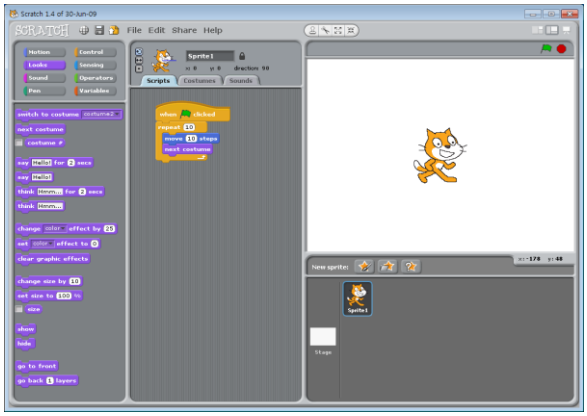

Fig. 1. Screen from the scratch programming [17].

Secondly, the program is adapted to Kindergarten to Year 12 students, with characteristics for mixing various media types (image, sound, video, *etc.*) to help to develop 21st century skills [15].

Lastly, Scratch is effective for enhancing problem-solving abilities and it supports the understanding of mathematical concepts. Moreover, it is intrinsically motivating for students and allows them to develop rational thinking, as the program permits programming processes and results to be checked instantly [16].

B. IT Gifted Students

Korea has set a goal in its elementary school curriculum to promote the "Global Creative Person" in an effort to nurture versatile, talented children [18]. In particular, education for gifted children is implemented in various fields based on Gardner's Multiple Intelligence Hypothesis, because giftedness exists in all areas of intelligence [19].

The definition of gifted children differs between scholars, and that of IT-gifted children in particular is not clear yet. Above all, Renzulli suggested a definition of gifted children based on *The Three Ring Conception of Giftedness*, "Giftedness: above-average ability, task commitment, and creativity" [20]. Thus, IT-gifted children can be defined as those who are above-average in ability, task commitment, and creativity in computer or IT field.

The temperament of IT-gifted children is distinguished by a curiosity about information science, excellent generalization abilities, and a brilliant capacity for algorithm development and IT literacy [21].

C. Clutter

The purpose of Clutter is to support the linking functions between one Scratch project and another. Although various Scratch projects can be shared through the Scratch homepage, collaborative work is not possible.

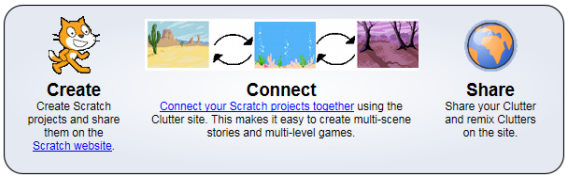

Fig. 2. How to make a clutter on clutter website [22].

Therefore, as shown in Fig. 2 and Fig. 3, Clutter provides three ways to link Scratch projects in cooperation. Firstly, the story type supports sequential connections. Secondly, if a secret word is typed, another project will be connected. Finally, links words allow jumping to a relevant project using a particular keyword.

Fig. 3. Clutter type on the clutter website [23].

It should be noted that Clutter is a test-bed for Scratch 2.0, which will be released in 2013 [24]. Consequently, we can witness some of the effects of Scratch 2.0 through this study.

III. Teaching-Learning Methods Using Clutter

Research on the signification of teaching-learning methods based on Clutter can be found in the recent study of Seungki Shin, Youngkwon Bae, and Phanwoo Park, *Study on the Teaching and Learning Model of Clutter*. The procedure used in this study is shown below in Table I [25].

TABLE I: Teaching and Learning Model of Clutter

Procedure	Contents
Plan and make a storyboard	Design how to make a project
Decide on connecting	Decide how to connect with Clutter
Role sharing	Decide who does what
Make a Scratch project	Create a section according to each role
Connect with Clutter	Combine each project into a story
Share	Post a story on the Clutter website

In our study, the Scratch programming education used in an IT-gifted class was based on the Teaching and Learning Model of Clutter designed by Seungki Shin, Youngkwon Bae, and Phanwoo Park.

The topic of the storyboard was decided by each team based on a ready-made story, which had the effect of saving time.

IV. Experimental Design

Our study aimed to verify changes that occurred in the friends of IT-gifted children. We expected the Scratch programming education using the Clutter platform to have positive benefits.

As shown in Table II, the study group comprised 20 IT-gifted children enrolled in a gifted education program in Korea, consisting of 11 boys and 9 girls. There are 7 elementary school students from 5th grade and 13 from 6th grade.

TABLE II: Composition of Study Group

Classification		Number of Children	Total
Gender	Boys	11	20
	Girls	9	
Grade	5th	7	20
	6th	13	

The study was conducted over the course of 2 months from September to October 2012.

The study method was based on the collaboration model of the Teaching and Learning Model of Clutter developed by Seungki Shin, Youngkwon Bae, and Phanwoo Park.

A friendship survey was utilized as an assessment tool, involving 5-point Likert scales as previously utilized by Hwa-Ok Lee in 2005 [26]. This is an appropriate testing tool with a reliability of 0.88. Furthermore, it is composed of

positive and negative questions. In order to calculate the total score, negative responses are subtracted and positive things are added.

We verified the difference between pre- and post-test results in order to analyze the testing results using a dependent sample t-test. For statistical analysis, SPSS V18 was used.

V. Results

Comparing the mean of the pre-test with the post-test results, an increase was observed: pre-test score of 19.90 versus post-test score of 24.35 (Table III). The compared results of the pre- and post-tests identify an improvement in the mean regardless of school grade and gender.

Table IV presents the results of the dependent sample t-test, which were statistically significant between the pre- and post-tests, with a p-value of 0.034.

As shown in Table V, the results of the independent sample t-test were not statistically significant between the pre- and post-tests according to grade. As the p-value for the pre-test was 0.064, for the post-test it was 0.169, thus >0.05.

TABLE III: Comparison of Pre-Test and Post-Test Results

Section			Mean	N	Standard Deviation	Standard Error Mean
Pre-Test	Gender	Boy	16.55	11	15.877	4.787
		Girl	24.00	9	6.364	2.121
	Grade	5th	12.71	7	16.080	6.078
		6th	23.77	13	9.185	2.547
	Total		19.90	20	12.814	2.865
Post-Test	Gender	Boy	22.09	11	13.172	3.971
		Girl	27.11	9	7.061	2.354
	Grade	5th	19.71	7	10.210	3.859
		6th	26.85	13	10.808	2.998
	Total		24.35	20	10.903	2.438

TABLE IV: Results of the Dependent Sample T-Test

Paired Differences					t	df	Sig. (two-tailed)
Mean	Standard Deviation	Standard Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
-4.450	8.730	1.946	-8.523	-0.377	-2.287	19	0.034

TABLE V: Result of the Independent Sample T-Test by Grade

Section		Levene's Test for Equality of Variances		T-Test for Equality of Means		
		F	Sig.	t	dt	Sig. (two-tailed)
Pre-Test	Equal variances assumed	2.829	0.110	-1.976	18	0.064
	Equal variances not assumed			-1.678	8.167	0.131
Post-Test	Equal variances assumed	0.113	0.740	-1.434	18	0.169
	Equal variances not assumed			-1.460	13.050	0.168

TABLE VI: Result of the Independent Sample T-Test by Gender

Section		Levene's Test for Equality of Variances		T-Test for Equality of Means		
		F	Sig.	t	dt	Sig. (two-tailed)
Pre-Test	Equal variances assumed	3.610	0.074	-1.319	18	0.204
	Equal variances not assumed			-1.424	13.655	0.177
Post-Test	Equal variances assumed	5.085	0.037	-1.026	18	0.319
	Equal variances not assumed			-1.087	15.819	0.293

As shown in Table VI, the results of the independent sample t-test were not statistically significant between the pre- and post-tests according to gender. The p-value for both tests was >0.05, being 0.204 for the pre-test and 0.319 for the post-test.

All of the results reveal that Scratch language programming using Clutter improved the friendships of IT-gifted children regardless of gender or school grade.

VI. Conclusion

In our rapidly changing IT-oriented society, every country strives to nurture talented people. In Korea, especially, education programs for gifted children are used widely, while there is a growing interest in IT-gifted children. In addition, language programming education emphasizes creativity and problem-solving abilities, which are 21st century skills. Scratch is one such educational tool for learning language

programming and it is utilized in many educational institutions as it is easy to learn and express one's ideas.

However, Scratch is limited in terms of its collaborative functions and possibility for cooperative learning. To compensate this weakness, the Scratch team supports the Clutter service, which is a kind of test version before the release of Scratch 2.0. Additionally, in many cases, IT-gifted children find it difficult to form friendships because of their lack of sociability.

Therefore, we predicted that the use of Scratch in tandem with Clutter would be an effective teaching-learning method for student collaborations. The results of our study are statistically significant, indicating that Scratch programming used in tandem with Clutter improves the friendships of IT-gifted children. Furthermore, these results are promising before the release of Scratch 2.0. The study also shows that it is beneficial to teach 21st century skills, as they can have a positive effect on a personal level.

Individualism has greatly intensified in our IT society with the use of smartphones and tablets. At the same time, the importance of collaborations should be emphasized. For this reason, we suggest using Scratch programming along with Clutter to improve creativity and develop the personality of young people.

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