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Design of the Convergence Study Program based Educational-Robot

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Abstract: The purpose of this study is to develop the convergence study program through the educational robot to improve elementary students' problem solving ability and have more confidence about mathematics, science, engineering and computer programming. Nowadays, convergence is a global trend, also the world has been trying to educate the person who adapted well to the fusion circumstances. However, the great majority of curriculum does not reflect this turn that carried new pedagogical trend. Thus, in order to overcome this situation, by making use of convergence study program, students will be easily adapted to the converging circumstances. It is expected to include coverage of resources for teaching of convergence study program through robot - education for instructors who may wish to adapt this new trend of instruction.

Keywords: Convergence Study Program, Educational - Robot, Computer Programming, Problem Solving Ability.

Introduction

Fusion between knowledge is recognized as the keyword of the 21st century. The knowledge of the individual studies alone will be difficult to solve multi-layered problems of modern society. Therefore, a new study through the convergence that breaks the boundaries between disciplines has been receiving attention. Even the world's leading universities, such as Harvard, Stanford, Tokyo are focusing on high-value creation and concentrating on enhancing national competitiveness through converging between the studies seem not to become tied[1].

Natalie Rusk(2008)has presented that many young people become more engaged if they learn engineering concepts in the process of creating interdisciplinary project that combine art and engineering-for example, designing a painting machine, building a machine that can read and play music, or making a programmable water fountain[2]. In other words, people are able to be most creatively and productively when they are adapted well in complex environment.

Nowadays in many countries, the importance of convergence study program is being emphasized. But only a few countries are being used that program. In addition, related programs by using educational – robot are scarce.

When designing convergence study programs, we should consider below.

First, needs of the contents elevating the learner's problem solving ability and creativity.

Second, development of the convergence study program that leads out learner's real active participation. Third, considering the operational stage of elementary school students', it should be appropriate for them about the difficulty to use programming. Considering that presented above, this study is to propose the convergence study program to have student have positive attitudes in robot-education & programming, especially students are naturally

willing to attend the program with interests about various subjects with the standpoint of convergence.

1. Theoretical Contemplation of Convergence Study

1.1 The definition of the Convergence Study

Convergence is the approach toward a definite value, a definite point, a common view or opinion, or toward a fixed or equilibrium state[3]. It's similar with fusion, syncretism. And also it is a convergence study that variety of subjects are converging into a new study[4]. Sung-Ho Kwon(2009)has presented that convergence study is a new study provided by converged two of more areas of knowledge and study[5]. To sum up the above definition, convergence study is the convergence between heterogeneous areas and study to increase flexibility, adaptability, productivity and efficiency with crossing boundaries between individual studies as needed, if the resolution is difficult with individual study alone.

2. Educational-Robot

2.1 Robotics in School

Robots are becoming available as consumer products and walking robot. But these stereotypical images can be misleading. Robotics includes all types of programmable machines that perform actions based on inputs from sensors[6].
In recent years, robotics have become popular as an educational activity internationally. A growing number of schools and other educational organizations are offering opportunities for the elementary school students to build their own computer-programmed robots, using kits such as LEGO Mind storms, Pico-Cricket.

2.2 Features of Pico-Cricket

Pico-Cricket is used in this study and designed for more artistic and expressive projects. The Pico-Cricket can control not only motors but also multi-colored lights and music-synthesis devices, so children can use Pico-Cricket to build their own musical instruments and light sculptures. The Pico-Cricket is also much smaller than other Educational-Robot, such as Mind-storms, so they are well-suited for projects that need to be small and mobile, such as electronic jewelry[2]. Below figures show the sample of programming blocks and Pico-Cricket device made by an elementary school student.

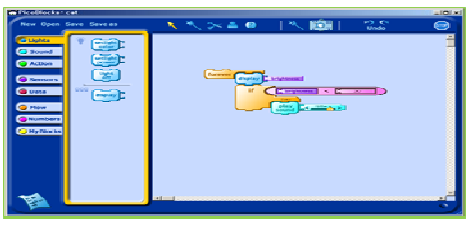

Figure 1 : Programming Blocks

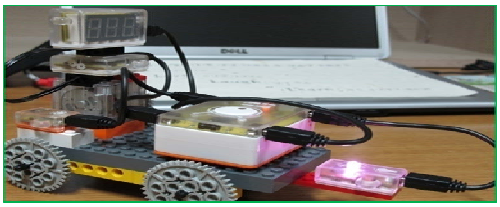

Figure 2 : Pico-Cricket Device

2. 3 Components of Pico-Cricket

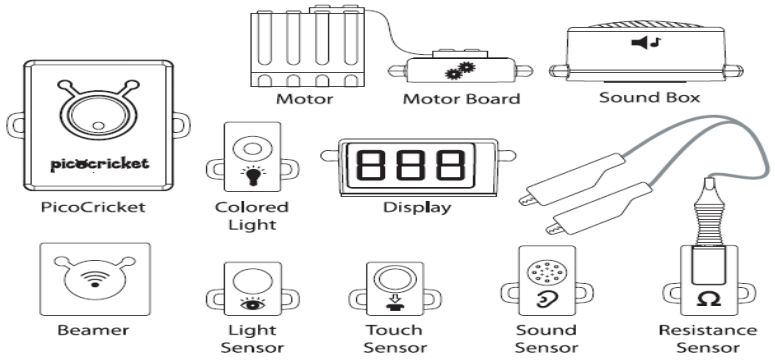

Figure 3 : Components of Pico-Cricket

The Pico-Cricket includes the upper following parts. That is a tiny computer that can control things and has four parts where we can plug in other devices, such as sensors, motors, and lights[7].

3. Methodology of the Convergence Study Program

3.1 Contents of Convergence Study Program

[Table 1] Topics of Convergence Study Program by using Educational-Robot

Topic	Brief Explanation of Topic	Related Subjects
1. A shower booth with auto control lights.	When touching or no sound, light will be off to save Energy	▪E, C, A, M ▪Environments & Green Growth
2. Making green home to save energy.	When getting brighter outside, light will be off, otherwise on.	▪E, C, A, M ▪Environments & Green Growth
3. Making energy saving car which has auto brightness detection function.	When going through tunnel, light will be on automatically, otherwise off.	▪E, C, S, A, M ▪Environments & Green Growth
4. Making smart traffic signal	To save time and energy, it will show counting display when turn light in green.	▪E, C, S, M, A ▪Environments & Green Growth
5. Funny trash can	When putting trash in the trash can, make it sound.	▪E, C, S, M, A ▪Environments & Green Growth

* ▪Engineering=E, ▪Computer Programming=C, ▪Art=A, ▪Math=M, ▪Science=S

Considering the ability of using Pico-Cricket of students (4 grades – 6 grades) in elementary school, we have selected the contents that would be easily programmable and implemented by elementary school students.

3.2 Designing the Model for Teaching

[Table 2] Step of STEM - PBL(Grant, 2002)

Feature	Description
Introduction	Use an introduction that includes "The Big Ideas"
Task	Guiding question or driving question what will be accomplished and embeds the content to be studied.
Investigation	The process and investigation include scaffolding to complete the task and reinforcing participation.
Resources	Resources provide data to be used and can include hypertext link, computer, scientific probes, robot, eyewitness, and so on.
Scaffolding	Scaffoldings are needed at different levels for different students and may include resources help, student-teacher interactions, peer counseling, job aids, project templates.
Collaboration	Many projects include groups or teams, especially when resources are limited, but cooperative learning may be helpful.
Reflection	PBL offer an opportunity for closure, debriefing, assessment, or reflection.

[Table 2] is an extended inquiry into various aspects of a real-world topic that is of interest to students and judged worthy by teachers. Because of real-world appeal, students are motivated to investigate, record, and report their findings. The hallmark of project learning is greater independence of inquiry and "ownership" of the work on the part of students[8]. STEM-PBL has advantages that positive interaction between students and teachers and students and students to maintain a cooperative relationship. For this reason, it was used as the basis of the convergence study program including robot education. Model shown in [table3] is to be remodeled for convergence study program based educational-robot.
To apply the robot-based learning, need to consider real-life. So, we need to get around the idea, using a variety of background information and analysis to identify issues to be placed a greater emphasis. In addition to, if necessary more difficult programming in 'Appointments with others' step, providing additional support of the teachers to students. Additionally, it was designed to solve the problem through coordination with friends. The learning model dealt in terms of convergence study based on the theme of energy saving related to green growth to combine several topics rather than fragmented learning for the production of the robot itself. Through exhibits and presentations after checking as well as the competitive elements of robot-learning in the past. It was developed to be the foundation for effective learning and interest for the elementary school level, taking into account the real possibility.

[Table 3] Model of Convergence Study Program

Step (STEM-PBL)	Process of Learning	Description
Introduction	Searching for around real-life	Motivation, Idea drawn
Task& Investigation	Analysis of activity	Drawn & use the background knowledge
Resources Scaffolding	Appointment with others	Providing resources of teacher Additional programming explanation

Collaboration	Problem solving	Cooperative learning
Reflection	Exhibition & Evaluation	Sharing & Presentation

In this study, we developed the Convergence Study Program to improve problem solving ability about the areas that are related various subjects.

4. Overview of Experiment

4.1 Energy Saving Attitude Test

On a study, we tested Energy Saving Attitude Test to ensure homogeneity. (Comparing to two classes of the same elementary school)

It showed a similar average for Control group and Experimental group ; it didn't show a statistically meaningful difference between Control group and Experimental Group of the Pre-test.($p>0.5$) Thus, they turned to be the homogeneity group. On the contrary, both group had an average increase. But the average of the experimental group was higher than the average of the control group. It showed a meaningful difference between Control group and Experimental group of the Pro- test($p<0.5$) relate to the ($t=3.829$, $p=.001$). Consequently, convergence study program has been verified the higher impact on energy-saving attitude than a general lesson.

[Table 4] Result of pre-test & pro-test

Time	Group	M	SD	F	T	p
Pre-test	Control(n=16)	65.38	14.12	33	1.347	.187
	Experimental(n=19)	71.73	13.75.			
Pro-test	Control(n=16)	75.16	9.28	33	3.829	.001*
	Experimental(n=19)	88.05	10.47			

Pre-test *p<.05, pro-test *p<.05

5. Conclusion

We have presented the use of educational - robot to teach the convergence study program. We count on that the convergence study program suggested would improve elementary students' problem solving skills and have more confidence about mathematics, science, engineering and computer programming. And it was effective to improve students' participation and interests.

Finally, it was positive effects on learner's attitude about converging trend. Furthermore, the experience through the convergence study program would be helpful to be members of converging leader with creativity.

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