

Creative Problem Solving Programming Class Design Including the Divergent Thought Strategies^{*}

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Abstract. This paper introduced a divergent thought strategy that repeats the divergent and convergent thoughts at the same time while including the divergent thoughts for the elementary school students in convergent programming education development. The application of the study targeted the elementary school students and the control group received a general programming education while the experimental group received the programming education that included the CPS model of divergent thought to analyze the effects.

Keywords: CPS, Creative Problem Solving, Elementary education, Creativity

1 Introduction

To cultivate the creative problem-solving, a robot programming education model was applied. However, whether the experiment activated the expansive thoughts to improve creative problem solving, or whether the programming education activated the convergent thoughts to improve creative problem-solving needs to be analyzed. When the creativity is approached in two different perspectives, divergent and convergent thoughts, the improvements in programming education approach, creativity measurement, and detailed teaching strategies can be found. The programming education until now has focused more on the convergent thought that finds the optimal solution, but this researcher believes that such an approach needs to be differentiated based on the learners. The programming education has the characteristics of considering convergent thoughts to find the best answer and possible alternatives and also utilize the divergent thoughts while proofing and correcting the errors. However, the elementary school students need to precede such activities with experimental surroundings to learn how to find the most efficient

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problem solving methods. To improve the creative problem-solving, the problem-solving process needs to include the divergent and convergent thoughts at the same time.

This paper designed a program that introduced the divergent thought processes that can repeat the divergent and convergent thoughts simultaneously in elementary school students for their highly convergent programming education.

2 Suggested CPS programming class design

2.1 Class **Organization Strategies**

To minimize the recognition burden for the students who encounter programming and various creativity methods for the first time, the learning contents are organized in three steps.

The first step, "Learning the Basics of Programming" introduces the programming language scratch and allows the students to learn the basic concepts and functions. The second step, "Learning Simple Programming" is a stage to learn the programs that can be made with scratch and uses various strategies to promote the divergent thoughts. The third step, "Learning Various Programming" suggests the educational situations to create various programs and improves the creative problem-solving skills by gradually suggested more open problems.

2.2 CPS Step-by-step Teaching Strategy

The creative methods were used in the entire CPS model to promote the divergent thoughts and to maximize the programming education and divergent thought promotion strategies, the characteristics of each stage and programming education were reflected to deduce the entire program development.

1) Fact Discovery Stage

It is a stage to collect and analyze the information and data to understand the problem and is an introduction to the class. Therefore, this stage should allow the student to find out what is going on by collecting the information. The premade questions to elicit curiosity and motivation were presented.

2) Problem Discovery Stage

This is a stage to explore the problem from various perspectives while defining and recognizing the problem. Based on the facts found in the previous stage, the problem is stated in various ways during the divergent thought process and the convergent thought process is used to find the best way to state the problem. Therefore, the brainstorming method was used to create possible alternatives.

3) Idea Discovery Stage

This is the stage to think of the ideas to solve the problem stated in the problem discovery stage. This stage focuses on the divergent thought process and many ideas should be produced using the divergent thought strategies.

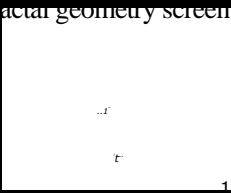
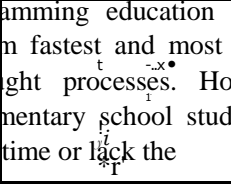
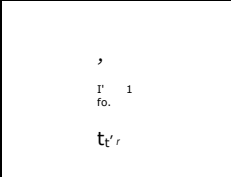
4) Solution Discovery Stage

This is the stage to select the best idea based on certain standards and evaluations. This stage should also evaluate whether the idea can be actually realized using scratch. This stage can use SCAMPER, morphological analysis, or PMI to find the solution.

5) Receipt Discovery Stage

This is a stage to plan the actual task based on the chosen idea. In other words, this is confirming the result after programming with scratch. When an unexpected error occurs during the program execution, the student can use various divergent thought processes to solve the error and also can use the PMI method to compare the products of other students to determine strengths and weaknesses.

Fig. 1. Fractal geometry screen developed by LOGO Programming.

<p>3 Conclusion</p>	
<p>Generally, the programming education aims to realize the can solve the problem fastest and most efficiently. In other the convergent thought processes. However, whether to efficiency to the elementary school students who encounter education for the first time or lack the</p>	
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point of recursive call

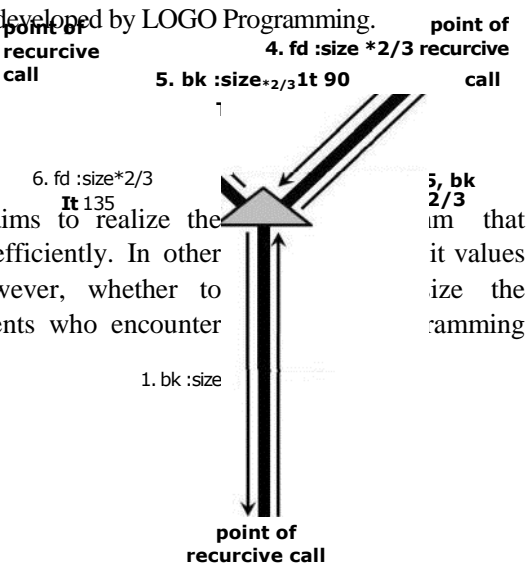
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5. bk :size*2/3 recursive call

6. fd :size*2/3 recursive call

1. bk :size recursive call

5, bk 2/3 recursive call



experience should be reconsidered. All education, including programming education should consider the situations and developmental stages of the learners. The elementary school students should be allowed to experience various explorative environments, rather than pursuing efficiency. The elementary school students do not want to learn how to do something more accurately and faster just by being told. Of course, it is important to analyze whose product is more efficient and what its strengths and weaknesses are. However, the divergent thought process allows the process to reach that goal more diverse, which is an important factor in learning development of elementary school students.

This paper designed a program that introduced the divergent thought processes that can repeat the divergent and convergent thoughts simultaneously in elementary school students for their highly convergent programming education.

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