

Development creativity of grade 5 students on electricity through STEM education

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Abstract. The research aim was to develop creativity of grade 5 students through STEM education in electricity. There were 15 students of Grade 5 in Khon Kaen Province in 2020 participated in this study. The action research was implemented to this study with three loops of action research to improve creativity of students. The physics contents consisted of simple circuit, conductor, insulator, switch, connecting battery in a series circuit and a parallel circuit, series and parallel circuit and the motor connection. The fifteen lessons were separated into three loops of actions. Each loop of lessons consisted of three Predict-Observe-Explain (POE) lessons, and a lesson which is an Engineering design process lesson for designing product to improve student's creativity in electricity. The students were fluent in designing various tasks to solve problems arising from a given classroom situation and had flexibility and elaboration in given reasons in selecting the materials to create the works. At the last lesson of the each action loops the data was collected to show how students improved their creativity. The student's work and their presentation were evaluated by the creativity's rubric scores in four dimensions of Originality, Fluency, Flexibility and Elaboration. The results show that student's creativity were improve by STEM education in electricity. All dimension of creativity which are originality, fluency, flexibility and elaboration were improved from loop 1 to loop 3 of action research.

1. Introduction

In the 21st century, the organizing of learning activities needs to change to develop the learner. We are in the 21st century, Learning is not just for understanding but for improving process skills of learning. Therefore, the ability of a person to live in the present and in the future consists of three skills, Learning and Innovation Skills, Media and Technology Skills, and Life and Career Skills. In order to develop people in the 21st century, the development of knowledge and creativity is very important to provide the development of innovations [1]. A psychologist, Guilford, said in 1967 that creativity is divergent thinking which is multi-directional, multifaceted, and broad. This kind of thinking leads to the invention of novelty as well as the idea of successful solutions to problems. It includes 1) Fluency, 2) Flexibility, 3) Originality, and 4) Elaboration [2]. In medically, our brain is divided into two hemispheres that work together but exhibit different characteristics depending on the individual's aptitude. Its left hemisphere controls thinking, reasoning, language, logic, critical thinking, and number, and the right hemisphere controls creative thinking, imagination, synthesis, appreciation for music and art, and making use of forms and geometries. STEM education is a teaching and learning approach in which science,

technology, engineering, and mathematics (STEM) are purposely targeted to connect the real-life that provided the learners developed or created the new processes or new products along with the development of 21st-century skills. STEM education aims to motivate learners to work on real-world problems by generating ideas and designing relevant products based on integrated STEM knowledge and STEM skills [3]. Additionally, STEM education which is focused on the process of engineering design consisted of identifying problems, finding related concepts, designing solutions, planning and implementing the solutions, testing and evaluating, presenting results or solve the problem [1]. The electricity for elementary school students is important because in learner’s daily life involved with using electronic devices. Therefore, the students are necessary to understand the electrical circuit components, including explaining the connecting of a simple circuit and writing circuit diagrams. Moreover, the electrical experiment must be designed with the appropriate way, whether the circuit designing of series, parallel, or mixing, which will provide the learners understanding of the electrical devices and the ability of using appliances efficiently. These are the indicator of learning in the core of sciences [4].

Therefore, to develop the creativity of student STEM education was used on electricity in order to encourage students to apply their understanding and to realize creativity of designing products.

2. Methodology

This is an action research consisted of three loops of action with fifteen lessons totally [5]. There were fifteen Students in grade 5 participate in this research. They were separated into five groups.

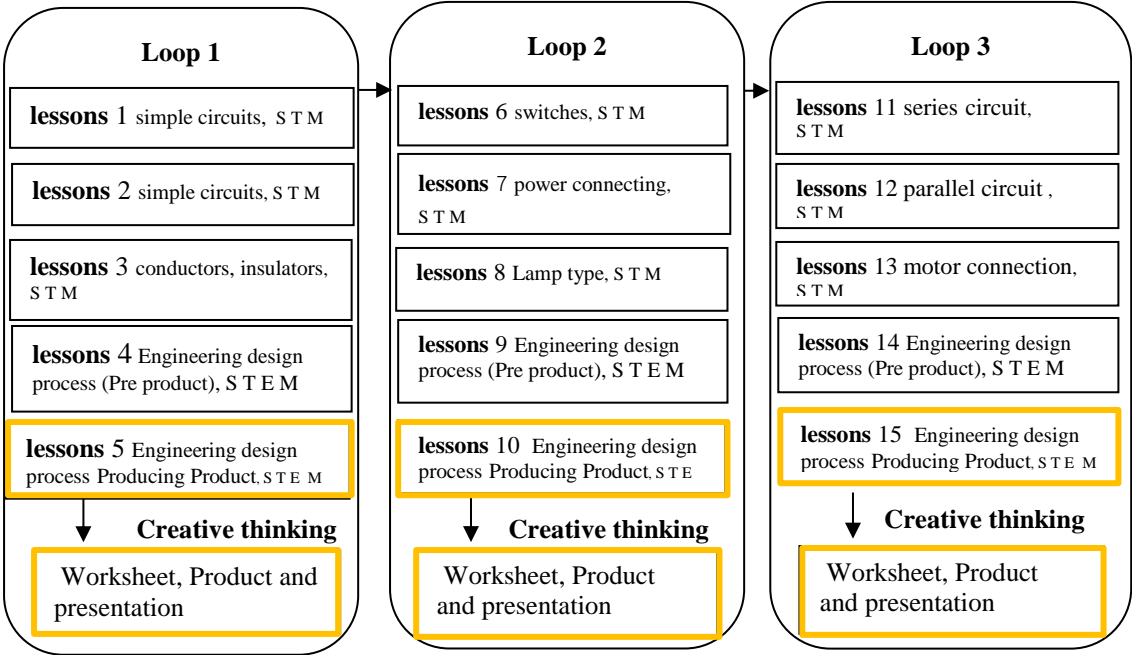
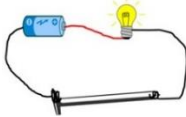







Figure 1. Research methodology design.

From the figure 1, in each loop of action, there are three POE lessons in lessons 1-3. More addition the fourth and the fifth lessons were constructed following engineering design in order to let students design and produce their products. Then in the last lessons of each loop which are lessons 5, 10, and 15 the data was collected from worksheets, products, and presentations of students. In table 1 shows conception of electricity in activity and example products in loop 1 to loop 3.

Table 1. Conception of electricity and example product in activity in loop 1 to loop 3.

Loop	Conception of electricity	Product
1	<p>simple electrical circuit Conductor and insulator</p> 	<p>The invention of waste separator. conductor or insulator ?</p> 
2	<p>switch circuit</p> 	<p>city road switch</p> 
3	<p>motor circuit</p> 	<p>toys and appliances from garbage</p> 

3. Data analysis

The student's worksheets, Products, and presentations in lessons 5, 10, and 15 were collected and interpreted by the rubric score to show the creativity of students following criteria used in table 2 [2].

Table 2. Rubric score for the creativity.

creativity	Description	Scores
Originality	Concept of designing is different from friends in class.	Student answers, more than 61% gets 0 points 21-60% gets 1 point, less than 20% gets 2 points
Fluency	Number of designing concept difference in the class in 10 minute for the activity.	Student answers, more than 61% gets 0 points 21-60% gets 1 point, less than 20% gets 2 points
Flexibility	Reasonable of choosing material in design product.	1 point for each alternative approach
Elaboration	The abilities to add details of designing product, for example; fill the gaps of products attaching, distance measurement, size indication, beautiful color rendering, and explanation for the material of producing.	1 point for each alternative approach

4. Results

This study developed creativity of Grade 5 students on electricity through STEM Education. The finding shows that the characteristics of creativity increased from loop 1 to loop 3.

Figure 2. Shows the designing concept of product in loop 1-3.

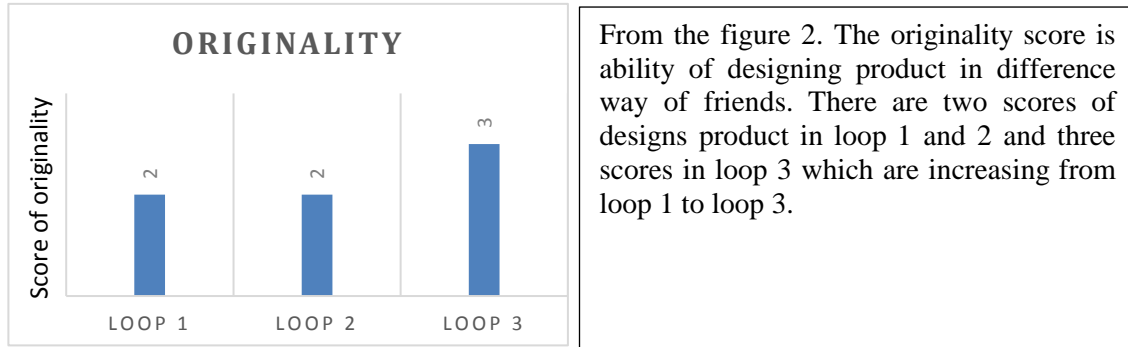


Figure 3. Shows the idea of design fluency in 10 minutes of loop 1-3.

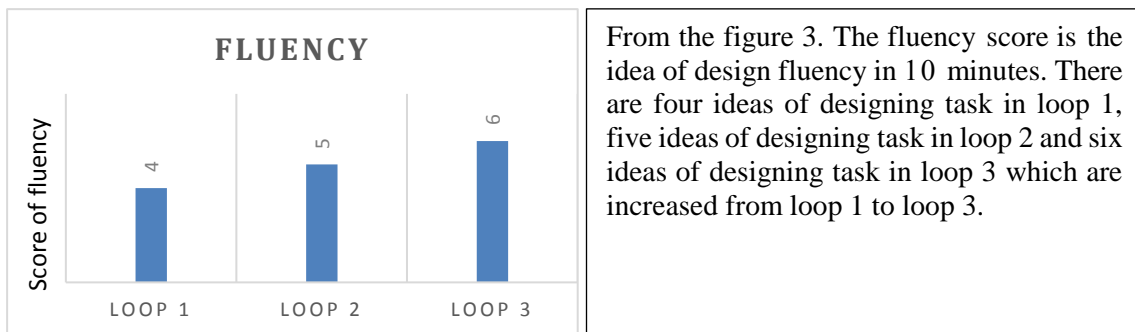


Figure 4. Shows the guidelines for choosing and reasoning materials of flexibility of loop 1-3.

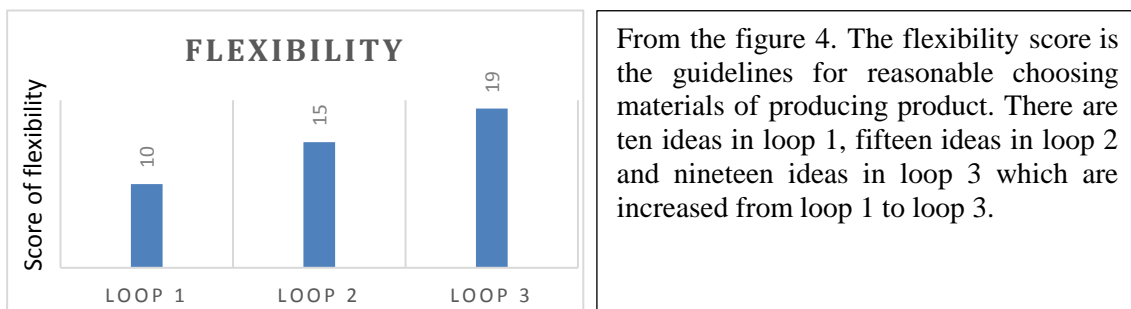
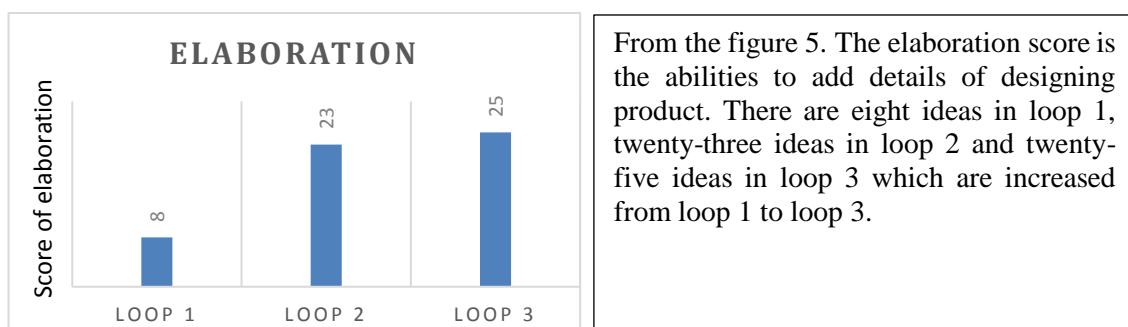


Figure 5. Shows the elaboration of product in loop 1-3.



5. Conclusion and discussion

The results showed that creativity was developed by STEM education which led learners to understand the content and integrate knowledge with the electrical engineering design process. Moreover it was found that; six step of engineering design process to developed creativity as following;

1. Problem Identification, the students share idea and use the content and integrate knowledge for identify the problems in electricity.
2. Related Information Search, the students share ideas of science, technology and mathematic for inventing product that can be accomplished with the limitations of equipment for each problem.
3. Solution Design, the student are fluency increasing idea in 10 minutes.
4. Planning and Development, students have reasonable in choosing material for creating products and can invent suitable product.
5. Testing, Evaluation and Design Improvement, the student can testing and edit product. They can choosing suitable material to create product.
6. Presentation, the student can present ideas of inventing product and explain reasonable in choosing material for product.

According to the results, STEM education focused on engineering design process encouraged students to able to design products in variety of way. In this research students worked together in group and share opinions with their classmates. These kind of activities help them to develop their creativity in creating products.

References

- [1] Ministry of Education (Thailand) 2017 *Educationplan 2017-2036* vol.1 (Bangkok: Office of the Education Council) pp 15–6
- [2] Genek S E and Küçük Z D 2020 Investigation of scientific creativity levels of elementary school students who enrolled in a STEM program *Elem. Educ. Online* **19**(3) 1715–28
- [3] Chamrat S 2017 The definition of STEM and key features of STEM education learning activity *STOU Educ. J.* **10**(2) 13–34
- [4] Ministry of Education (Thailand) 2017 *Indicators and subjects of knowledge in the science center (Revised version 2017) are follow up the core curriculum of basic education* vol.1 (Bangkok: The Agricultural Co-operative Federation of Thailand, Ltd.) pp 68–9
- [5] Intharaksa P 2019 Active learning management for creative problem-solving *UDRU Educ. J.* **1**(1) 35–43