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The Development of STEAM Education Model to Enhance Thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th Grade Students

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Abstract: The purposes of this research were to develop and determine the efficiency of a STEAM education model to enhance thinking skills of grade 5 students, and to compare thinking skills before and after learning with STEAM education model of grade 5 students. The sample of the study were 27 students of 5th grade at Srinakharinwirot University Prasarnmit Demonstration School (Elementary) in 2nd semester of 2019, which was obtained by cluster random sampling. The tools used were 7 STEAM education lesson plans for grade 5 students (10 periods) and 20 questions thinking skills test of grade 5 students. The research design was the one group pretest-posttest and the statistics used were efficacy determination E1/E2, mean ($\bar{x}$), Standard Deviation, and t-test Dependent Sample. The research results found that, the STEAM Education model which was developed for grade 5 students' efficacy of process value was 86.27 and efficacy of product was 81.30 which complied to the defined criteria of 80/80. After learning with STEAM education model, grade 5 students have higher thinking skills than that of before learning at the statistical significance level of .01

Keywords: STEAM education model, Thinking skills, Elementary students

Introduction

Thinking is the most important aspect reflecting human potential because thinking ability will lead to endless developments in many areas. In the learning process, students can apply their ideas to increase efficiency in studying various subjects and to use their thinking skills to solve problems and create innovations and improve their quality of life. Thinking is an important tool in life empowering them to seek knowledge and learn about environmental changes. Each child has different thinking process. To have flexible thinking, children need thinking experience that help them to accomplish their activities. Situational trainings are designed for the child to guide in correcting or developing innovations. Practice for developing their thinking process is not about letting them do what teachers tell as this will affect the child's thinking system. Instead, strengthening intellectual learning process, curiosity, and lifelong continual learning will be able to bring new knowledge to them.

Thinking is fundamental of intelligence. It can build a cognition that is expressed through speech and action. Thinking allows people to improve things and create new knowledge endlessly by linking new experiences with existing experiences. Thinking is also the basis of decision making to determine what is the most appropriate. Thinking can create power of change making them to be successful at work and create competitiveness in learning society especially in the information age nowadays.

Over the past decade, innovations and technological developments are changing rapidly and tend to continue to evolve. As a result, teachers must provide instructions to prepare learners with necessary skills for 21st century learning consisting of collaboration skills, retrieval skills, communication skills, and problem-solving skills (Chalatip Smathito, 2014). Organizing activities for active learning will create necessary skills, emphasizing that children will learn from real practice and problem situations that teachers set up or actual problem situations in daily life to practice thinking skills with the conditions and rules for

participating in the activities. Those learning activities will encourage learners to practice group work process, listening to others' opinions as well as communication skills that are essential and very important in today's life.

Srinakharinwirot University Prasarnmit Demonstration School (Elementary) recognizes the importance of organizing learning activities to focus on developing children' thinking skills through problem-solving process, critical thinking, collaboration, creative communication, and creativity to create new innovations or develop innovations. Therefore, STEAM education model has been organized by allowing students to look at problems or analyze problems or projects or innovations that they want to create by granting them to think about what to create and how to solve the problem by organizing learning activities that focus on learners enabling students to build knowledge, participate, and interact between learners and teachers by using thinking skills and applying knowledge for practical use and enabling learners to develop integrated learning skills according to STEAM education, which is organizing learning activities for learners to develop integrated learning skills consisting of Science, Technology, Engineering, Arts, and Mathematics for developing students to be able to think, solve problems, create innovations as valuable citizens in the 21st century. The steps of organizing learning activities in STEAM education are as follows;

1. Define the problem
2. Conduct a research / brainstorm for solutions
3. Design the best solution
4. Test solutions
5. Evaluate solutions
6. Present / publish solutions

Creating a project or innovation starts at defining problems and analyzing them by allowing students to think what to create and how to build them. Then, they need to gather knowledge by searching for information to bring knowledge to create works. Brainstorming with colleagues will produce creativity, reasoning, and problem-solving ideas, based on the principles of science and mathematics. Then, technology is applied for solving problems. Projects or innovations will require an engineering and artistic structure, enhancing their creativity, inspiration, and joy in learning.

From the reasons and importance of the concept of learning management and the STEAM management process, the researcher believes that STEAM education model can improve the thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) students because STEAM education model is a learning format that focuses on students' problem solving as a priority. In addition, the findings of Fatmaaswaini Taye et al. (2017) have suggested that STEAM education can improve the creativity of fifth-graders. Therefore, the researcher is interested in developing the learning management model in STEAM education to enhance thinking skills of grade 5th students.

The objectives of the research were 1) To develop and determine the efficiency of STEAM education learning management model to enhance thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students. 2) To compare thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary)'s 5th grade students before and after applying STEAM education model.

The population was Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students in the second semester of the academic year 2019, consisting of 208 students in 8 groups with mixed abilities. The samples were a group of 27 students in grade 5 obtained by cluster random sampling. Independent variable was STEAM education

model and dependent variable was thinking skill. Experimental content was STEAM education lessons consisting of 7 learning units: What is STEAM, STEAM technology and design, STEAM product creating and problem solving (1), STEAM product creating and problem solving (2), STEAM Presentation, STEAM knowledge integration, and product design.

Regarding the development of a STEAM education model to enhance thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students, the researcher has reviewed the literatures related to the meanings and concepts of the important persons as follows:

Georgette Y. (2008) defined STEAM as an activity to encourage students to develop creativity and practice linking between Science and Liberal Arts by focusing on creativity. As a result, students are more durable in their science knowledge. Also, it encourages students to be independent in their work. Yulip & Namje (2012) also gave corresponding meaning that STEAM education is the integrated teaching across 5 subject areas: Science (S), Technology (T), Engineering (E), Art (A) and Mathematics (M) to train learners to apply knowledge, strengths, nature, and teaching methods of each subject to use in research, problem-solving, and developing things in today's world. In addition, Park, et al. (2012) has given the concept of STEAM learning model as a teaching model developed from STEM education learning model as it integrated knowledge from science, technology, engineering, liberal arts and mathematics to create a unified relationship and help science learning to connect knowledge and comprehension. As integrated teaching in STEAM education approach will help students to connect five disciplines with their daily lives and careers. It emphasized on developing critical skills in 21st century challenging students' thinking and providing opportunities for students to express their opinions and accordingly understand 5 subjects which were organized to train thinking and planning by using a step-by-step process that covered 3 areas: attitude, process skills, and knowledge.

Research methodology

Regarding the development of the learning management model based on STEAM education for developing thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary)'s 5th grade students, the researcher conducted the following research: The population was Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students in the second semester of the academic year 2019, consisting of 208 students in 8 groups with mixed abilities. The sample group was a group of 27 students in Srinakharinwirot University Prasarnmit Demonstration School (Elementary) grade 5 in 2nd semester of 2019, obtained by Cluster Random Sampling, being a sampling unit.

Research Tools

1. STEAM education model for Grade 5 in the 2nd semester of 2019 consisted of 7 learning units: What is STEAM, STEAM technology and design, STEAM product creating and problem solving (1), STEAM product creating and problem solving (2), STEAM Presentation, STEAM knowledge integration, and product design, totaled 10 lessons, 45 minutes each. At the end of each unit, there was an assessment form to assess post-study thinking skills for each unit.

2. Thinking skills test of 5th grade students included 20 questions with four choices (Multiple Choice) as students received one score for one correct answer and no score

for wrong answer. The validity value came from Index of Item-Objective Congruence (IOC) between .67-1.00 and the difficulty between .28 and .79, the classification between .35 and .79, and the confidence value of .804.

3. Conducting an experiment. The researcher conducted the experiment by using the One Group Pretest-Posttest Design approach as in Table 1 (Burke Johnson & Larry, 2004)

Table 1 An Experimental Model for the Development of STEAM Education Model to Enhance Thinking Skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th Grade Students.

Pretest	Experiment	Posttest
T_1	X	T_2

when T_1 represented pre-experiment test
X represented teaching experiment using STEAM education model
T_2 represented post-experimental test

From the experimental model, the researcher conducted an experiment by testing thinking skills of 27 elementary 5th grade students prior to the experiment (Pretest) with a thinking skills test of 20 items, a score of 20. Then, applying 7 learning units of STEAM education model, a total of 10 lessons, 45 minutes each. There was an assessment of thinking skills at the end of each learning unit and a test for thinking skills after the experiment again (Posttest) with a thinking skills test of 20 items, a score of 20. Data collected will be used for further analysis.

Data Analysis

The researcher analyzed data obtained from the experiment as follows:

1. Analyze the efficiency of STEAM education model by determining Efficiency of Process (E1) and Efficiency of Product (E2) with a minimum threshold of E1/E2 equal to 80/80 as acceptable efficiency for STEAM education model.

2. Analyze thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students before and after applying STEAM education model by calculating the mean (Mean: $\bar{x}$) Standard Deviation (Standard Deviation: SD) and t-test for dependent sample (George A. Ferguson & Toshio Takane, 1989)

Research Results

1. The results of the development and efficiency of STEAM education model to enhance thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students show that the developed model of STEAM education consists of six stages: defining problems; researching/brainstorming solutions, designing the best solutions, testing solutions, evaluating solutions, and presenting them. Once it's taken to figure out the effectiveness of the model, the results were shown in Table 2.

Table 2 The Results of Efficiency Test of STEAM education model to Enhance Thinking Skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th Grade Students

Variables	n	Efficiency of Process (E1)	Efficiency of Product (E2)
Thinking skills	27	86.27	81.30

From the table 2, it showed that STEAM education model to enhance thinking skills of STEAM education model for developing thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) has efficiency of process (E1) of 86.27 and efficiency of product (E2) of 81.30, which met the specified criteria E1/E2, 80/80.

2. Comparison of thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) grade 5th students before and after applying STEAM education model were shown in the Table 3.

Table 3 Mean, Standard Deviation, and Test Results of the Difference of Thinking Skills before and after Using STEAM education model.

Experiment	n	M	SD	t	p-value
Before class	27	11.74	5.62	8.21**	.000
After class	27	16.26	3.50		

* with statistical significance at the 0.1 level

From the Table 3, it was found that before applying STEAM education model, Elementary Grade 5 students had average thinking skills of 11.74 ($\bar{x}$ = 11.74) with a standard deviation of 5.62 (SD = 5.62). After applying STEAM education learning management model, 5th grade students had average thinking skills of 16.26 (M= 16.26) with a standard deviation of 3.50 (SD = 3.50). When comparing the mean before and after applying STEAM education model, students had higher average thinking skills after applying STEAM Education learning management with statistical significance at 0.1 level (t =8.21, p-value < .01)

Discussion

The analysis results of STEAM education model to enhance thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students had efficiency of process of 86.27 (E1 = 86.27) and efficiency of product of 81.30 (E2 = 81.30) which met the specified criteria E1/E2 at 80/80. That showed STEAM education model to enhance thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students had acceptable efficiency. The reason was the development and efficiency of STEAM education model to enhance thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students was conducted by following principles of development and effectiveness measurement of educational innovation, starting from studying basic information to discover definition and characteristics of STEAM education model, then proceeding to create the model, attaining expert reviews, and improving the model. It was then experimented with

Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students and analyzed the results for determining efficiency further.

The results of a comparative analysis of thinking skills of 5th grade students before and after studying by using STEAM education model for improving thinking skills was that 5th grade students had higher thinking skills after studying than before with a statistically significant difference at the 0.1 level. This is because the researcher has developed a learning management plan by using STEAM education model to enhance thinking skills as an assumption of thinking is the most important thing that reflect human potential and thinking ability will lead to endless development. Students can apply their thinking skills to increase efficiency in studying various subjects, solving problems, creating innovations, and improving the quality of life. Therefore, Thinking is an important tool in life. In addition, the STEAM education model is a learning management process consisting of 6 stages that focus on the learner's problem-solving ability. At each stage, learners will use their thinking skills at all times. Therefore, it is another important reason that students' thinking skills can be developed to a higher level as Georgette Y. (2008) has noted, STEAM is a learning management to encourage students to develop their creativity. This is consistent with the research of Natthaphong Thetthong (2021) that compared the learning achievements in science subjects of 7th Grade students before and after receiving STEAM education model. The results showed that students had higher learning achievement after applying STEAM education model than that of before applying the model at the statistical significance level of .05 which was consistent with the research of Fatmaaswaini Taye, Nattinee Mophan & Mahdi Vedramae (2017) who compared science learning achievement of 5th grade student before and after applying STEAM education model. The results showed that students who participated in STEAM education model had higher learning achievement than that of before learning at the statistical significance level of .01.

Conclusion

In conclusion, the development of STEAM education model for enhance thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students has efficiency of 86.27/81.30 complied to the criteria of 80/80. After experimenting STEAM education model, 5th grade students had higher thinking skills than that of before at the .01 level. By using STEAM education model for enhancing thinking skills, teachers should organize learning and teaching activities continuously, and have a clear agreement with students so as not to waste time. When students understand the agreement, activities will be successful and clearly benefit students. Organizing learning activities by using STEAM education model for enhancing thinking skills can improve learning achievement and computational skills. Therefore, STEAM education model for enhancing thinking skills should be applied for improving other skills such as problem-solving, analytic thinking, etc. In addition, the research on the development of a STEAM education model for enhancing thinking skills of Srinakharinwirot University Prasarnmit Demonstration School (Elementary) 5th grade students results in new knowledge as an educational innovation that can be applied in teaching and learning management, especially for elementary students for enhancing their thinking skills, which is STEAM education model.

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