Meta-Analysis of STEM Education Approach effected on Student’ Creative thinking skills in Thailand

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Abstract. The objective of this research synthesis is to synthesize research about STEM Education Approach effected on students’ creative thinking skills in Thailand. Period of published research papers from 2010 until 2019 in education field. The related literatures used in this study were chosen from Thai Digital Collection and Thailand Library Integrated system by using the meta-analysis research method. The research tool used was the synthesis record form. Research results can be summarized as follows; They are 10 STEM Education researches, where frequency published in 2017 (80%), the most researchers were female who studied in master degree of Science Education at Rajabhat Mahasarakham University. The most research objectives were about to study and to compare achievement and creative thinking skills of students by using STEM instruction model with Science content. The most research instruments were lesson plans and creative thinking skill measurement form. The most samples were purposive sampling of lower secondary school students with experimental research design. The effect size (d) of research = 0.307 indicating that the STEM instruction model has a positive impact on students’ learning achievement more than control group.

1. Introduction

Creative thinking skills is an idea that is different from the original. It gives benefit to society because it causes progress in producing innovative products that are useful [3]. A country with very creative personnel will result in an opportunity to bring resources to develop a lot of creativity along with the development of the human brain that occurs with age depending on the teaching and learning process and the appropriate environment. Which means that if we don't have creativity, we will not be able to bring together the skills and knowledge that we have to apply. If a complex problem or a new problem that we have never faced, we may not be able to think of ideas to get through this obstacle. And finally, this world will, but the same thing, will be very boring [11].

The concept of STEM education is an instruction model that integrates various sciences, including Science, Technology, Engineering and Mathematics. STEM education will link the concepts in various subjects, make meaningful learning possible and apply in learner’s real life. According to US Education seen that STEM Education can build a strong tomorrow’s work forces, driven economics and leading the innovative [1]. So Ministry of Thailand Education recognizing the importance of STEM Education, which is defined as an important project in the curriculum and learning process, focusing on 6 strategies of the Ministry of Education. To be an innovation in the management of science and technology
education for the creation of new generation Thai people and support the development of human resources of the country appropriately [6].

However, it is found that teacher still focused on content and giving priority to the teacher’s role. It intercepts the opinions causes decreasing creativity of the learner [13]. In accordance with the Thai PISA assessment results that are lower than the OECD average [9], as well as the low national achievement test of Thailand, (ONET) [10]. Further more the result shows that the basic education schools had lower average than higher education schools, reflects the problem of teaching, learning and educational disparity.

Therefore, in order to promote instruction of basic education in Thailand, the researcher wanted to study the progress of STEM education model that promotes creative thinking skills of student in Thailand. The purposes of this study were to synthesize research about STEM Education or STEM instruction based that promote creative thinking skills of students in Thailand.

2. Objectives of the study
This research aims to synthesize research about STEM Education Approach effected on students’ creative thinking skills in Thailand.

3. Data of the study
3.1 The Keywords are STEM Education and Creative thinking skills or ability.
3.2 Resource Information includes TDC (ThaiLIS).
3.3 Period of published research papers are not exceeding ten years in education field (2010-2019).
Results of searching base were shown in Appendix.

4. Materials and Methods
The research methodology of this study was divided into three stages adjusted from S Srikoon, T Bunterm, J Samrajai and J Wattanathorn [12]: Preparation, Data Collection, and Data Analysis.

4.1 Preparation
All available information were collected and were analysed by focusing on STEM Education Approach effected on students’ creativity skills which many scholars discovered in graduate researches in Thailand. The related literatures used in this study were chosen from TDC (Thai Digital Collection), ThaiLIS (Thailand Library Integrated System).

4.2 Data Collection
Variables consisted of two sets. The first set is a unit of variable which included 15 variables consist of 1) year of completed research, 2) institute, 3) major, 4) office, 5) gender, 6) type of research, 7) objectives, 8) research design, 9) sampling method, 10) status of sample, 11) educational level of sample, 12) analysing methods, 13) research instrument, 14) content. The second set is 15) a unit of effect sizes of research which were coded to types of independent and dependent variable ,and the analysing results.

Tool for collecting data was the recording data form for research synthesis which adjusted from the recording data form of the Office of Education Council in Thailand [5].

4.3 Data Analysis
This research synthesis is the quantitative research; using frequency and percentage analyze the research description. Meta-analysis was used to analyze the effect sizes (Δ) of independent variables by the methods which was  \( \Delta = \frac{X_1 - X_2}{s_{control \& sample}} \) proposed by Glass [2].

5. Results
The results of this study were as follows;
5.1 Description of Research
The data analysis results explain about the nature of 10 research. The details are shown in Table 1-15.

**Table 1.** Percentage of research categorized by year.

| Year of completed research | Frequency | Percentage |
|----------------------------|-----------|------------|
| 2015                       | 2         | 20         |
| 2017                       | 7         | 70         |
| 2018                       | 1         | 10         |
| **Total**                  | **10**    | **100**    |

Table 1, shows that the researches on STEM Education approach affected on students’ creative thinking skills in Thailand from 2010-2019 were published mostly in 2017 (70%) and followed by 2015 (20%), and 2018 (10%).

**Table 2.** Percentage of research categorized by institute.

| Institute                      | Frequency | Percentage |
|--------------------------------|-----------|------------|
| Naresuan University            | 1         | 10         |
| Rajabhat Mahasarakham University | 8         | 80         |
| Kasetsart University           | 1         | 10         |
| **Total**                      | **10**    | **100**    |

Table 2, shows that the institutes which conducted the researches on STEM Education approach affected on students’ creative thinking skills in Thailand, mostly come from Rajabhat Mahasarakham University (80%), Naresuan University (10%) and Kasetsart University (10%) respectively.

**Table 3.** Percentage of research categorized by major.

| Major                      | Frequency | Percentage |
|----------------------------|-----------|------------|
| Sciences Education        | 9         | 90         |
| Early Childhood Education  | 1         | 10         |
| **Total**                 | **10**    | **100**    |

Table 3, shows that most of the majors which conducted the researches on STEM Education approach affected on students’ creative thinking skills in Thailand is Sciences Educations (90%) and Early Childhood Education (10%).

**Table 4.** Percentage of research categorized by office.

| Office                        | Frequency | Percentage |
|-------------------------------|-----------|------------|
| Office of the Basic Education Commission | 8         | 80         |
| Office of the Higher Education Commission | 1         | 10         |
| Office of the Local Government Organization | 1         | 10         |
| **Total**                     | **10**    | **100**    |

Table 4, shows that the percentage of the researchers who conducted the researches on STEM Education approach affected on students’ creative thinking skills in Thailand is Office of the Basic Education Commission (80%), Office of the Higher Education Commission (10%) and Office of the Local Government Organization (10%).

**Table 5.** Percentage of research categorized by gender.

| Gender     | Frequency | Percentage |
|------------|-----------|------------|
| Female     | 8         | 80         |
| Male       | 2         | 20         |
| **Total**  | **10**    | **100**    |
Table 5, shows that the researchers on STEM Education approach affected on students’ creative thinking skills in Thailand were female (80%) more than men (20%).

| Table 6. Percentage of research categorized by type of research. |
|---------------------------------------------------------------|
| **Type of research** | **Frequency** | **Percentage** |
| Thesis | 10 | 100 |
| **Total** | 10 | 100 |

Table 6, shows that all type of researches were thesis (100%).

| Table 7. Percentage of research categorized by objectives of research. |
|-----------------------------------------------------------------------|
| **Objectives of research** | **Frequency** | **Percentage** |
| Develop | 8 | 23.523 |
| Study | 9 | 26.471 |
| Compare | 9 | 26.471 |
| Analyze | 7 | 20.588 |
| Predict | 1 | 2.941 |
| **Total** | 26 | 100 |

Table 7, shows that the highest of the objectives of researches on STEM Education approach affected on students’ creative thinking skills in Thailand are to study (26.471%) and to compare (26.471%) followed by to develop (23.523%), to analyze (20.588%) and to predict (2.941%).

| Table 8. Percentage of research categorized by research design. |
|---------------------------------------------------------------|
| **Research design** | **Frequency** | **Percentage** |
| Experimental design | | |
| -One group pretest-posttest design | 7 | 70 |
| -Pretest-posttest control group design | 3 | 30 |
| **Total** | 10 | 100 |

Table 8, shows that most of research design in the STEM Education approach affected on students’ creative thinking skills in Thailand was one group pretest-posttest design (70%) and pretest-posttest control group design (30%).

| Table 9. Percentage of research categorized by sampling methods. |
|---------------------------------------------------------------|
| **Sampling methods** | **Frequency** | **Percentage** |
| Purposive sampling | 7 | 70 |
| Cluster random sampling | 1 | 10 |
| Multi-stage sampling | 2 | 20 |
| **Total** | 10 | 100 |

Table 9, shows that the sampling methods which were used in STEM Education approach affected on students’ creative thinking skills in Thailand mostly were purposive sampling (70%), multi-stage sampling (20%) and cluster random sampling (10%) respectively.

| Table 10. Percentage of research categorized by status of sample. |
|---------------------------------------------------------------|
| **Status of sample** | **Frequency** | **Percentage** |
| Students | 10 | 100 |
| **Total** | 10 | 100 |

Table 10, shows that all status of sample were student (100%).
Table 1. Percentage of research categorized by educational level of sample.

| Educational level of sample | Frequency | Percentage |
|-----------------------------|-----------|------------|
| Childhood                   | 1         | 10         |
| Primary level               | 1         | 10         |
| Lower Secondary level       | 5         | 50         |
| Upper Secondary level       | 3         | 30         |
| **Total**                   | 10        | 100        |

Table 1 shows that the educational level of sample in the researches on STEM Education approach affected on students’ creative thinking skills in Thailand, mostly were in lower secondary level (50%), followed by upper secondary school (30%), childhood (10%) and primary level (10%).

Table 2. Percentage of research categorized by analyzing methods.

| Analyzing methods                | Frequency | Percentage |
|----------------------------------|-----------|------------|
| Descriptive statistics           | 10        | 30.303     |
| Efficiency Test                  | 7         | 21.212     |
| t-test                           | 9         | 27.273     |
| f-test                           | 1         | 3.030      |
| Correlation                      | 6         | 18.182     |
| **Total**                        | 33        | 100        |

Table 2 shows that the analyzing methods which used in STEM Education approach affected on students’ creative thinking skills in Thailand, mostly were descriptive statistics (30.303%) followed by t-test (27.273%), Efficiency Test (21.212%), Correlation (18.182%) and f-test (3.030%).

Table 3. Percentage of research categorized by research instruments.

| Research instruments            | Frequency | Percentage |
|---------------------------------|-----------|------------|
| Lesson plans                    | 10        | 33.333     |
| Achievement Test                | 6         | 20         |
| Creativity Measurement form     | 10        | 33.333     |
| Attitude Test                   | 3         | 10         |
| Interviews form                 | 1         | 3.33       |
| **Total**                       | 30        | 100        |

Table 3 shows that the research instruments which used in STEM Education approach affected on students’ creative thinking skills in Thailand, mostly were lesson plans (33.333%) and creative measurement forms (33.333%) followed by achievement test (20%), attitude test (21.212%) and interview form (3.33%).

Table 4. Percentage of research categorized by content.

| Content  | Frequency | Percentage |
|----------|-----------|------------|
| Science  | 7         | 70         |
| Physics  | 2         | 20         |
| Career   | 1         | 10         |
| **Total**| 10        | 100        |

Table 4 shows that the content which were used in STEM Education approach affected on students’ creative thinking skills in Thailand mostly were Sciences (70%), Physics (20%) and Career (10%) respectively.
Table 15. Percentage of research categorized by effect size.

| Instruction Model | N  | d   | SD |
|-------------------|----|-----|----|
| STEM              | 1  | 0.307 | -  |

Table 15, shows that the mean of effect size (d) from STEM instruction model = 0.307. That means STEM instruction model can influence the scores of the experimental group more than the control group. Hence, the finding indicates that STEM instruction model has a positive impact on students’ learning achievement.

Conclusion and Discussion

Research found that researches complete in 2015-2018 and most in 2017, there were 7 researches (70%), published by Rajabhat Mahasarakham University with 8 authors (80%). They are all Master degree of teaching science. The study about science content in 7 researches (70%), there are female researchers (80%), have all thesis (100%), research objectives for study (26.417%), and comparison (26.417%), using one group pretest-posttest research model (70%), specific sampling model (70%), all sample were students that studied in the lower secondary level (50%), the most statistical method is descriptive statistics (100%), the most commonly used research tool were lesson plan and creative thinking measurement form (100%). Results of research analysis with meta-analysis classified by research methodology found that the average influence was 0.307.

General characteristics of synthetic research. The most research found that in 2017, there were 7 researches, most of which were from such data. The concept STEM education has been supported and pushed to be widely organized in accordance with the policy of the Ministry of Education, and held in Mahasarakham Rajabhat University which promotes Science and academic research.

Most researches are intended to study and the most comparative and experimental research form one group pretest-posttest research model because it is a research plan that is the cause of the early and dependent variables. Therefore, it is seen that the STEM education instruction model is full of promoting creativity. There are guidelines for analysing relationships properly and consistent with the objective. Focus on the developing of Science teachers and Mathematic teachers, to integrate technology and knowledge for teaching or organize activities for students to learn simultaneously. Relating to Sunee Klainin said that the expected goal while teaching Science was learning to think, learning to do, learning to solve problem [13].

The research uses sample groups as upper secondary school students under the most basic education office. The most content of instruction is Science, in accordance with the requirements of the institute for the promotion of teaching science and technology (IPST) want to encourage learner about Science literacy. Causes the ministry of education was established STEM center all over Thailand [7]. The data collection were lesson plan and creative thinking measurement form because it is a form of instruction and is measured in a test style which can store a lot of data at the same time suitable in accordance with the sample in the research. The most used statistics are descriptive statistics because they are convenient to lecture and interpret data [4].

Synthesis with meta-analysis techniques. From the research, meta-analysis has 1 study using meta-analysis method. It was found that the average influence was 0.307. The STEM instruction model has a positive impact on students’ learning achievement. that means STEM instruction model have a slight influence the scores of the experimental group more than the control group [5]. The result of researches shows that Science achievement is relate with creative thinking skills according to Ozlem and Mustafa said that creativity skills that influence form Open-idea-problem-solving Science laboratory in method more than traditional Science laboratory method [8].

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Appendix

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