The development of training course to promote learning activities skill based on the STEM Education concept for elementary school teachers

K Punsrigate Khonjaroen* and Sanit Srikoon

Curriculum and Instruction, School of Education, University of Phayao, Phayao 56000, Thailand

* Corresponding author’s e-mail address: ketsaraphan.kh@up.ac.th

Abstract. The objectives of this research are 1) to develop the training course to promote learning activities skill based on the STEM education concept for elementary school teacher 2) to evaluation of training course effectiveness from teacher’s understanding about learning activities with STEM education and teacher’s skill on learning activity management with STEM education, including of student’s skill on scientific process skills and the ability to use technology. The research method consisted of 4 steps. The step 1 was the developing framework of problems and needs in training course on learning activities with STEM education. Step 2 was the development of the draft training course and quality evaluation of training course. Step 3 was the evaluation of training course effectiveness. Step 4 was the training course improvement and development. The results of the research are as follows: the training course to promote learning activities skill based on the STEM education concept for elementary school teacher consisted of 1) principles 2) objectives 3) learning content 4) the 6 steps training activities were planning, acting, exchange of learning, idea reflection, evaluation and data feedback 5) required materials 6) training assessment. The training course effectiveness was found that the training course had an effectiveness on 1) the teacher’s understanding about learning activities with STEM education after passed the training course was higher than before attend training 2) a teacher’s skill on learning activity management with STEM education was at a high level 3) the students had skills on scientific process higher than defined criteria and 4) the students had a good ability to use technology.

1. Introduction

Learning activities management based on the STEM education are the kind of education activities with knowledge integrated of 4 subjects are Science, Technology, Engineering and Mathematics. A target of STEM education learning is solving a problem in the present life and future occupations. So, the STEM education learning is important for the students to promote them to develop an analytical thinking skill, solving skill, scientific process skill, technology skill, engineering skill and mathematics skill, which are the base of their future occupations. The STEM education learning help to develop the student skill in 21st century and cause of the educational vision change for education administration such as a creativity of solving problems including to develop a communication skill in term of using technology to collected an extensive knowledge and social skill of students. These effects to the students’ vision on education supports students to develop their ideas for solving problem in everyday life. This vision would provide students’ opportunities to find a good occupation as key workforce for developing economy and country development in the future [5], [8], [9], [10].
From these reasons the researcher is therefore interested to develop the training course to promote learning activities skill based on the STEM education concept for elementary school teacher in the main idea of empowerment and professional learning community and to study the student’s skill in term of scientific process skills and the ability to use technology of them.

2. Objective of the study

2.1. To develop the training course to promote learning activities skill based on the STEM education concept for elementary school teacher.

2.2. To evaluation of training course effectiveness from

   2.2.1. Teacher’s understanding and skill
          1) An understanding about learning activities with STEM education
          2) A skill on learning activity management with STEM education

   2.2.2. Student skills.
          1) A scientific process skill
          2) The ability to use technology

3. Scope of study

3.1. Samples

The samples of this research consisted of 1) Grade 6 teachers of Anuban Chiangrai School divided to 3 leaning area; 3 samples from the science leaning area, 3 samples from the mathematics leaning area, and 3 samples from the occupations and technology leaning area who was a volunteer to attend training course 2) 50 of Grade 6 students who was selected by specific random sampling method.

3.2. Variables

Dependent Variable is the training course to promote learning activities skill based on the STEM education concept. Dependent Variables are the training course effectiveness.

   3.2.1 Teacher’s understanding and skill
          1) An understanding about learning activities with STEM education
          2) A skill on learning activity management with STEM education

   3.2.2. Student skills.
          1) A scientific process skill
          2) The ability to use technology

3.3. Scope of research content

It’s consisted of 4 unit; unit 1 STEM education indicators analysis, unit 2 STEM education activities design, unit 3 STEM education activities management, and unit 4 Measurement and evaluation based on STEM education concept.

4. Research methodology

This research is the research and development method consisted of 4 steps are as follows:

   Step 1 Basic information study (R1) consisted of 2 parts as follows:
          1) Interview the school administrator, the Grade 6 teacher and education supervisor about the state, problems and needs in training course on learning activities with STEM education.
          2) Literature review about training course on learning activities with STEM education concept and the STEM education learning activities evaluation.

   Step 2 the development of the draft training course and quality evaluation of training course (D1) in this step the researcher was created the draft training course and make a quality evaluation of training course by focus group discussion method with 5 of expert personals; 2 of STEM education expert personals, 1 of curriculum expert personal, and 2 of learning activities management and measurement
and evaluation based on STEM education expert personals. The draft training course was quality evaluation by used a content analysis method.

### Step 3 evaluation of training course effectiveness (R2)

Period 1 pilot study was to use the training course trail with the 3 teachers who was not a sample. Period 2 sample study was to use the training course with 9 samples of Grade 6 teacher divided to 3 leaning areas; 3 samples from the science leaning area, 3 samples from the mathematics leaning area, and 3 samples from the occupations and technology leaning area. Period 3 the period of project activities learning based was the project activities teaching with the 50 of Grade 6 students who was selected by specific random sampling method.

### Step 4 training course improvement and development (D2)

In this step the researcher was improved and developed the complete training course according to sample suggestions.

The instruments used in this step consisted of

1. The instruments for teacher were as follows:
   1.1. The teacher’s understanding about learning activities with STEM education test was 30 items of a multiple-choice exam 4 options with IOC ranged between 0.80 – 1.00, the item difficulty ranged between 0.20 – 0.80, and the item discrimination more than 0.2. The reliability test by Kuder-Richardson KR-20 was 0.72.
   1.2. The assessment form for learning activity management skills based on STEM education concept had 34 items with IOC ranged between 0.80 – 1.00 and the reliability test by Cronbach's alpha coefficient was 0.92.
   1.3. The interview form towards the training course had 8 items with IOC was 1.00 and the reliability test by Cronbach's alpha coefficient was 0.71.
2. The instruments for student were as follows:
   2.1. The assessment form for scientific process skills had 5 items with IOC was 1.00, and the reliability test by Pearson Product Moment Correlation was 0.81.
   2.2. The assessment form for student’s ability to use technology had 4 items with IOC was 1.00, and the reliability test by Pearson Product Moment Correlation was 0.86.

### 5. Results

1. Basic data results were as follows:

   1.1. The state, problems and needs in training course on learning activities with STEM education found that 1) The 3 groups of teachers had no basic understanding about STEM education and the STEM education learning activities management. 2) The teachers are taught in scope of the content of the school curriculum. 3) School had a policy focusing on tutoring for O-net test. 4) The teacher had never been attending in the STEM education learning activities management training, they had attended in integrated course and local course training but lacked of practical knowledge. According to the teacher needs found that they need to attend the training course as follows 1) The STEM education learning activities management. 2) Teaching skills and techniques for the STEM education learning activities. 3) The measurement and evaluation based on STEM education concept. 4) A learning management plan writing. The researcher focuses on the STEM education learning activities management because the teachers are lack of knowledge and skill of STEM education learning activities management and have not teaching experience in their classroom.

   1.2. Literature review about training course on learning activities with STEM education concept were as follows:
   1) STEM education was an integration learning concept from USA. These was integrated of 4 subjects are Science, Technology, Engineering and Mathematics. STEM education in Thailand was integrated from the science leaning area, the mathematics leaning area, and the occupations and technology leaning area. A learning activity insert an engineering study process.
2) Integration learning management divided into 1. Insert integration, the teacher will insert skill and knowledge from other subjects to their learning activities. 2. Parallel integration was an integrated from many teachers together in one learning title.

3) Empowerment and Professional Learning Community concept

3.1) Empowerment concept

1) Empowerment means a process that an organization executive use to promote and develop their personnel decision and performance skills to focus on a perfect target of works.

2) Empowerment method; 1) Motivate teachers to be active in their work, 2) Develop teachers to have work commitment, 3) Promote an independent to make a decision on their works, 4) Create a good learning atmosphere and environment to promote teacher’s work, 5) Promote a teamwork and exchange of learning for the teachers and 6) Give a feedback to the performance of teachers.

3.2) Professional Learning Community concept.

Professional Learning Community means a grouping of professional person to develop a capacity and quality of learners by collaborative learning process, experience learning process and mutual exchange of learning.

2. Results of develop of draft training course and quality checking.

2.1 A draft training course development.

2.1.1 The principles consisted of 6 principles were as follows:

1) This training course was based on the STEM education concept.
2) This training course is a course that focuses on trainees.
3) This training course focuses on teamwork and have a target to develop teachers and students.
4) This training course focuses on content and performance integration.
5) This training course focuses on solving problems in real situations.
6) This training course focuses on exchange of learning and data feedback.

2.1.2 An objective of this training course was as follows:

1) Have knowledge and understanding about learning management based on the STEM education concept.
2) Have skills in learning management based on the STEM education concept.

2.1.3 Content of learning consisted of 4 units as follows:

1) Indicators analysis based on the STEM education concept.
2) Learning activities creation based on the STEM education concept.
3) Learning management based on the STEM education concept.
4) Measurement and evaluation based on the STEM education concept.

2.1.4 Training course activities consisted of 6 steps were as follows:

1) Planning step was the step that teacher attend training to planned and performance cooperation with others. This step was selected a teacher from 3 groups; 3 teachers of the science leaning area, 3 teachers of the mathematics leaning area, and 3 teachers of the occupations and technology leaning area. Each group would decide the chairman, vice president and secretary of group.

2) Acting step: In his step the teachers must be practice an activity in a learning unit.

3) Exchange of learning step was the step that the teachers in each group made an exchange of learning and teamwork working with the school administration, head of learning strand, and education supervisor to be a professional learning community.

4) Idea reflection step was the step that the teachers would record their knowledge from a practice activity.

5) Evaluation step was the step that the researcher and the teachers would together evaluation a practice activities of a group members.

6) Data feedback step was the step that the researcher given a data feedback to each trainees group.

2.1.5 Course evaluation.

1) Teacher knowledge and skills as follows:
1.1) Knowledge and understanding about learning management based on the STEM education concept.
1.2) Skills in learning management based on the STEM education concept.
2. Student skills as follows:
   2.1) Skills on scientific process.
   2.2) Ability to use technology.

2.2 Training course quality evaluation.
The training course to promote learning activities skill based on the STEM education concept had an effectiveness as follows:
1. The results compare score in the teacher’s knowledge and understanding about learning management based on the STEM education concept posttest was higher than pretest with a statistically significant difference of .01.
2. The average score of learning activities skill based on the STEM education concept was at a high level (x = 4.34 / S.D. = .51). When considering each aspect found that the ability to learning management focuses on learners had a mean score at a highest level. (x = 4.50 / S.D. = .55) However, the ability of learner analysis was state at a lowest mean score (x = 4.17 / S.D. = .50).
3. The student’s skills on scientific process was higher than defined criteria (70 percent of the full score).
4. The students had a good ability to use technology.

6. Discussion
6.1 This research had gotten the training course to promote learning activities skill based on the STEM education concept for elementary school teacher consisted of 1) principles 2) objectives 3) learning content 4) the 6 steps training activities were planning, acting, exchange of learning, idea reflection, evaluation and data feedback 5) required materials 6) training assessment.[4] The training course had an effectiveness accept can be appropriately used in elementary school because the processes of development of the training course had a systematically developed in 4 steps were 1) basic information study 2) the development of the draft training course and quality evaluation of training course 3) evaluation of training course effectiveness 4) training course improvement and development. Which is consistent with the Taba’s model of curriculum development concept [7]; the curriculum development should be 1) analyze the needs of learners and society 2) set the purpose 3) select the content 4) collect the data 5) select a learning method 6) learning activity management and 7) evaluation. In addition, the researcher was handed out the learning manual for the samples made the teachers who attended the training course can be passed a practice activity. [6]

6.2 The training course had an effectiveness follow defined criteria.
1) The results compare score in the teacher’s knowledge and understanding about learning management based on the STEM education concept posttest was higher than pretest with a statistically significant difference of .01 because a learning activity can promote the teachers who was a sample participated in planning, acting, exchange of learning, idea reflection, evaluation and give data feedback. Leading to the corrective action guidelines and can be used in their classroom.
2) The average score of learning activities skill based on the STEM education concept was at a high level because 1) the training activities focuses on the performance of 6 steps training activities consisted of 1.1) planning 1.2) acting 1.3) exchange of learning 1.4) idea reflection 1.5) evaluation and 1.6) data feedback 2) the teachers who attended the training course can participate in demonstrative of learning activities based on the STEM education concept 3) the teachers received the empowerment from their administration by participated in independent thinking and decision making. Which is consistent with the empowerment concept [2] that can be promoted and developed the independent personnel thinking and decision making. The teachers can be supported to the students by collaborative learning process, experience learning process and mutual exchange of learning to
focuses on the target of learner’s development, support the teacher’s knowledge, and the method of learning can help the teachers to create an effectiveness learning activities management, improve and develop their work. In addition, this result is consistent with the research results of Charoenrat [1] the research found that the science projects learning could be supported the scientific process of the students to solved the problems which a content of their interested.

3) The students had a good ability to use technology because of 1) learning activities in training course was promoted the teachers to practice in 6 steps were real acting, teamwork working, exchange of learning, make an idea reflection, and data feedback giving. In addition, the school administration, education supervisor, another teacher, and researcher were supported them by coaching technique make the teachers increased their knowledge and understanding about learning management based on the STEM education concept. 2) the school administrations were interested and supported the teachers to use computer for learning activities management in the classroom. 3) the teachers focus on project learning activities and give a facilitate and recommendations for their student. This result is consistent with a learning concept of Khaemanee [3]; the study based on project learning is promote the learners to identify problems which their interest, working with teamwork method, searching for problems solving, and self-learning.

6. Research Recommendations
As a result of the data gathered in this research, the recommendations were as follows:

6.1. Recommendations to use the data gathered
1. For effectiveness of training course the teacher should be:
   1.1) In deep study the data content in the science learning area, the mathematics learning area, and the occupations and technology learning area of the basic education core curriculum B.E 2560.
   1.2) Study the STEM education concept and the measurement and evaluation according to the STEM education concept.
2. The cooperation of the school administration, teacher, education supervisor, academic personnel to make a professional learning community, working as teamwork, to exchange learning, idea reflection, and give data feedback are the most important variables to be successful in learning activities management based on STEM education concept.
3. Should have reinforcement into learning activities management based on STEM education concept such as rewards or give praise for an active or enthusiastic student.

6.2. Recommendations for further research
1. Should investigating with the research and develop method for learning activities based on STEM education model for the teacher in primary school and secondary school.
2. Should develop the training course with STEM education concept integrate in another learning area.

7. Acknowledge
This work was supported by the Unit of Excellence in Research Methodology of Innovations and Learning Sciences based-on Educational Neurosciences Research Fund, University of Phayao, Thailand.

References
[1] Charoenrat, C (2012) Strengthening Science technology Art and Mathematics with the STEAM Model. Retrieved 1 March 2019, from http://www.educathai.com/workshop_download handout_download.php?id = 60 & page = 4
[2] Khachornsilp, P (2016) Development of learning process Science, technology and innovation through programs STEM. Retrieved 1 March 2019, from www.deansci.com/en/downloads/stem.pdf
[3] Khammanee, T (2012) Teaching styles and various options. Bangkok: Chulalongkorn University.
[4] Knight, J (2009) Coaching: Approaches and Perspectives. Corwin Press A Sage Company.
Mehalik, M. M., Doppelt, Y. & Schunn, C. D. (2005). Addressing performance of a design-based,
systems approach for teaching science in eighth grade, *National Association of Research in Science
Teaching (NARST)*, Dallas, TX.

[5] Ozel, S (2013) Who, when, and where. In R.M. Capraro, M. M. Capraro & J. Morgan (Eds.),
*STEM Project-based learning: An integrated science technology engineering and Mathematics
(STEM) approach* (pp. 41-46). Rotterdam, Netherlands: Sense.

[6] Rece H & Paige G (2013) Curriculum Development Course at a Glance Planning For STEM.
Sample Curriculum – Posted: February 15, 2013.

[7] Taba, H (1962). *Curriculum Development: Theory and practice*. New York: Harcourt Brace
Jovanovich.

[8] Chomphuphra P, Chaipidech P, and Yuenyong C 2019. Trends and Research Issues of STEM
Education: A Review of Academic Publications from 2007 to 2017. *Journal of Physics:
Conference Series*, 1340 (1), 012069

[9] Sutaphan S and Yuenyong C 2019 STEM Education Teaching approach: Inquiry from the Context
Based. *Journal of Physics: Conference Series* 1340 012003

[10] Yuenyong, C. (2019). Lesson learned of building up community of practice for STEM education
in Thailand. *AIP Conference Proceedings*. 2081, 020002-1 – 020002-6.