



UNDERSTANDING AND SATISFACTION TOWARDS STEM EDUCATION OF PRIMARY SCHOOL TEACHERS THROUGH PROFESSIONAL DEVELOPMENT PROGRAM

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ABSTRACT

The integration approach is not new to education, but it is very necessary for currently educating management. The study aims to explore the efficiency of STEM education for primary teachers through professional development. Participants were 200 primary school teachers who have been working for Roi Et Province, Thailand. STEM education manual guide for teacher, achievement test, and satisfaction questionnaire were used for research instruments. Experimental research, pre-test and posttest design were employed for data collection. The statistics used for data analysis were average, standard deviation, percentage and dependent t-test. Findings revealed that the efficiency of STEM education for primary school teachers reached criteria of 81.50/86.25. Primary teachers had understanding in STEM education by mean score of posttest was higher than pretest score at .01 level of statistical significantly differences. Also, they had satisfaction towards STEM Education at the highest level.

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INTRODUCTION

Teachers have an important role which is facilitator to help students meet their needs and learning success. Also, creating situations that allows students to face with problematic situations, challenge students to have higher-ordered thinking, and enable students to participate in classroom activities. Therefore, effective teachers need to have knowledge and understanding about learning management as well as specific contents. Teachers are key element to change new normal from reductionistic approach into holistic approach, due to natural setting can be explained by science and its interaction (Aslam et al., 2018). Teacher sometimes made their classroom by control-like environments, make science separate from real life situations, less described how science works in the social dimension.

The new modern lives had been discussing with new normal education, students can access and learn knowledge that around them. Knowledge is now booming and overloading to all students, but it depends on their abilities to collect, analyze, synthesize, and construct their knowledge into account. That seems to be easy for teacher to have lesson in different point view in content recitation. The process of learning should have emphasizing on necessary learning skills. Art of teaching through smart choice of classroom management in accordance with the interests of the learners and the context of the class (Kennedy, 2016; Setiawan & Sugiyanto, 2020). In addition, teachers should measure and engage students to have deep learning based on real life situations. Teaching science needs help students in understanding, science process skills, and attitudes towards learning. So that it can be measured and evaluated in accordance with the integration by the ways of teacher uses the method of inquiry-based learning in science teaching.

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Teachers are key role to help students understanding about science in daily live and problem solving in science, mathematics, and technology. Teacher in education is caused by the quality of education and also mathematics and technology as well as innovations engagement students to have positive attitudes (Nugroho et al., 2019). The integrating concept by allowing science, technology, engineering, and mathematics are engaged into science curriculum (Parmin et al., 2020). STEM education is a holistic approach to education that teachers and students can increase necessary learning skills (Du et al., 2019). An integrated STEM professional development program enable teachers to transform their practice and perceptions of STEM.

Understanding STEM education is important for teacher who can design and implement integrated approach into curriculum and instructional practices. As we know, STEM education is not new to education, but it can change the new school practices. In Thailand, IPST engage science and mathematics teachers design STEM classroom. According to Nuangchalerm (2018) investigates views of primary teachers in STEM education, teachers require to learn and implement STEM education as well as school contexts. The way to promote STEM education can be treated by employing professional development program that the educational policy about science instruction in Thailand need integrated learning as milestone due to new era of learning and nature of learners. Knowledge is now expanding through various kinds of methods and channels, but allocated time in school and curriculum are now limiting. These situations need holistic paradigm in education, teachers and students have to understand STEM education. Primary school teachers are early facilitator and engager students to meet science and other classroom activities.

From the above information reasons, the research concerned STEM education by the Institute for the Promotion of Teaching Science and Technology (IPST) and Ministry of Education (MoE) invited schools to have STEM education experiences, STEM activities, STEM curriculum, and STEM educators. That's why the study should have paying in attention on professional development program and STEM education should be promoted in school practices. Teachers have necessary learning tools engage students with lesson, teaching and learning strategies, psychological drives, and social interaction that helping students learn to be great (Polyiem et al., 2011; Kondakci et al., 2017). So that, the study

has initial goal to reach integration approach, especially teachers who are the change agents in school activities. Researchers aim to develop learning management, STEM education for primary teachers by focusing on learning management as a guideline.

Shernoff et al. (2017) studied needs of teachers and school leaders in promoting integrated instruction in STEM education. Research reported that teachers and school leaders are favored with STEM education, it is most helpful to them in way of curriculum and instructional practice. They should have well- prepared in integrated STEM education and other supporting to reach the requirement of integrated instruction. However, the implementation of STEM education in school need to be clearer and strengthen to the collaborative work (Bush et al., 2020; Zakariya, 2020; Permanasari et al., 2021). Teachers might want to have positive perception and attitudes toward integrated approaches especially STEM education in different learning contexts (Rose et al., 2017; Margot & Kettler, 2019; Daher & Shahbari, 2020; Kelly et al., 2020; Nguyen et al., 2020). So that, professional development is an important activity that engage teachers to understand and competence in STEM curriculum and instructional practices.

The purposes of this study is to explore the efficiency of STEM education for primary teachers through professional development in accordance with criteria 80/80, to compare the results of teacher development in learning management focusing on STEM education for primary school teachers between before and after professional development program, and to study satisfaction with learning activities that emphasize STEM education of primary school teachers with professional development program.

METHODS

The study employed pre-experiment research, one group pre-test and post-test design to study professional development in STEM education. The efficiency of professional development program is investigated that is, explaining the process and also the product of program. The understanding of teachers toward STEM education can be conducted by the following.

$$O_1 \quad X \quad O_2$$

(O_1 = pre-test, X = Professional development program in STEM education, O_2 = post-test)

The study invited 23,876 primary school teachers in the academic year 2019 from Roi Et Province, Thailand. The samples consisted of 200 primary school teachers who have been teaching in mathematics, science, career, occupation and technology learning area. They have responsibility to teach and engage students through integrate approaches. The volunteering sampling is conducted for collaborating STEM education. They are ready to participate in professional development program and report in what they have learn from program.

The tools for research conducting consisted of STEM education manual guide, achievement test, and satisfaction towards professional program. First, STEM education manual guide. Study of relevant research documents which STEM education reported, then creating a manual guide, learning management guide. Bring the manual created to 3 experts in order to check the accuracy of the content, format of the learning activity, content validity, and editing manual guide STEM education. Second, achievement test. Creating test about STEM education, 4 multiple-choice test with 40 items. Taking test to 3 experts to examine the content validity by using the criteria set by the expert opinion. Making a pilot study test with 30 primary teachers which has the value of difficulty between 0.20-0.80, discriminant power was between 0.20-1.00 and the reliability KR-20 was 0.80. Third, satisfaction questionnaire. Defining the guidelines and scope of the content in creating the satisfaction towards STEM education. Then, bring the questionnaire to 3 experts to check the accuracy of the content and improved to be more accurate.

Orientation the professional program to participants, the first semester of the academic year 2019, between 3 July 2019 and 31 August 2019, excluding the test time before and after

using the training package. Then, pre-test by testing before using the training set, 40 items for 1 hour, 200 primary school teachers and record the scores for analysis. Professional development program is conducted, manual guide for STEM education is used, participants pay their attention to program. Finally, the end of program, post test is employed for checking their understanding about STEM education, satisfaction questionnaire is investigated to rate their satisfaction level.

The process and product of development program can be calculated by E_1/E_2 . E_1 can explain in terms of process during implement program which find out from quizzes in each module. E_2 find out from the posttest score or summative assessment in terms of percentage. The researchers performed the analysis using the statistical package by using descriptive statistics. Mean (\bar{x}), standard deviation (S.D.), and dependent t-test for comparing teachers' understanding toward STEM education. Also the satisfaction can be compiled and interpreted by mean score and satisfaction level.

RESULTS AND DISCUSSION

The professional development program showed the accordance between process of STEM education and product of program ends. The finding indicated that the professional development can gain in both process (E_1) and product (E_2). Teachers can learn about STEM education through program as well as information in Table 1. They have learnt how to manage learning activities, learning assessment through STEM education, and also how to engage their students to meet integrated learning. However, the product score was higher than process that it would be testing effect within program intervention.

Table 1. Efficiency of Professional Development Program

Program	No. of Teachers	Average Full Score	\bar{X}	%
Process	100	10	8.15	81.50
Product	100	40	34.50	86.25

The efficiency of professional development program showed that teachers have score in both process of learning and product of learning in 81.50/86.25 which was higher than the 80/80 criteria. The effectiveness of learning activities using STEM educational management, for primary school teachers. They may have been trained or experienced in workshop of STEM education

and learning activities (Nuangchalerm, 2018). The program is widely implemented in Thailand for gaining knowledge and understanding about integrated learning (Pitiporntapin et al., 2018). Teachers can learn through their instructional practices, prior knowledge, professional setting by various methods of teacher development program.

The finding revealed that primary teachers have to know how to design their classroom activities to fit with nature of learning. The implementation of professional development program required teachers employed holistic view into their classroom. Science cannot separate from those other disciplines because it embedded into daily lives, working, learning, and social interaction (Parmin et al., 2019). Local science can be designed into modern science, also teachers might want to engage students with positive attitude towards science. Science can be decided that process of knowledge construction and innovate their thinking to sustainability (Listiana et al., 2019; Sagala et al., 2019). Program should have more variety of activities to collaborate teachers learn how to implement STEM education into their classroom, not only focusing on knowledge or understanding how STEM education works. The program should engage integration approaches into instructional practices as it could be based on school contexts (Purwaningsih et al., 2020; Widarti et al., 2020).

It can be discussed that primary teachers make science understandable through integrated learning as well as nature of science. Thus, science needs experiment, investigation, observation, and empirical experiences. They have process of learning activities through professional development program. Also, they can reach the score of product or posttest score after the professional

development program. The score is report higher than 80% in both process (E_1) and product (E_2), that is, they have understanding about nature of science and its integration with other disciplines (Prachagool & Nuangchalerm, 2019). Teachers have a basic foundation about nature of science to making linkage with STEM education. Understanding is the starting point to make a suitable way in education, they can implement STEM education as well as educational policy, goal of science education, and helping students to have positive thinking in science (Du et al., 2019). The study should be more developed in different background i.e., science process skills, scientific mind, STEM literacy and so on.

The comparison of the achievement test scores before and after professional development program as shown in Table 2. It is found that the achievement test score, before and after the STEM education in professional development program showed statistical significantly differences. Mean score of posttest was higher than pretest, it was showing the relevancy to efficiency of professional program. Teachers gained their understanding STEM education through the professional development program due to they have learn more lesson and take time to study what, why and how to deal with STEM education. That is not only lecture or direct instruction, but the program allowed teachers design and implement their lessons with peers.

Table 2. Compare the Differences Between Scores from Test Results Before and After Using STEM Learning Management

Test	No. of Teachers	\bar{X}	S.D.	<i>t</i>
Pre-test	200	23.88	3.12	
Post-test	200	34.50	1.36	46.65**

** $p < 0.01$

The post test score is higher than pre-test scores, that is may be empirical with the design of research. Teachers can gain their knowledge and understanding through various kind methods of professional development. However, they may be comprehended in what they known, prior knowledge, previous experiences, and STEM education activities. The program can motivate teachers to accept STEM education and also associate their professional experiences between instructional practices by integrated approach (Nedelson et al., 2013; Rinke et al., 2016). In addition, primary school teachers can integrate other disciplines into classroom due to nature of teaching and learning. They have to know and understand not only specific subject, but also deep and broad subjects in primary school level.

Primary school teachers can gain their score after expose program because they perceive and reflect in how STEM education should be implemented. The program allowed showed that mean score in the process of professional program help teachers understand STEM curriculum, STEM learning activities, STEM learning assessment (Stieff & Uttal, 2015). Finding indicated that teachers learn much about STEM education through various kinds of method and process. Also, the holistic approach is not new to education, but teachers have to sustain and keep integrated learning into their classroom by suitable and reliable approaches (Radloff & Guzey, 2016). Teachers may have prior knowledge in the way to design their classroom by designing lesson

plan. IPST and online course in new normal learning. Teachers can make self-study and take some useful knowledge which they want to know. An analysis of the satisfaction of elementary school teachers towards STEM education activities is shown in Table 3. Primary school teachers have satisfaction towards professional development

program in at highest level. In addition, it was found that the highest score in each item was, the time spent in carrying out the activities is sufficient and appropriate, activities allowed participants involving instructional practices, and activities can make participants learn in happily.

Table 3. Primary School Teachers' Satisfaction with STEM Educational Activities

	Item	\bar{X}	S.D.	Level of Satisfaction
1	Sequence of learning activities and contents are suitable for participants	4.61	0.45	Highest
2	Contents and activities are useful and clearly defined	4.60	0.47	Highest
3	Various activities are excited and very interested	4.64	0.47	Highest
4	Activities is clear and easy to make it understandable	4.60	0.48	Highest
5	Activity is comprehensive and consistent with previous teaching and learning activities	4.59	0.53	Highest
6	Activities and time are sufficiently and appropriately	4.68	0.41	Highest
7	Activities is in accordance with practices	4.63	0.53	Highest
8	Activities can be implied into school practices	4.62	0.57	Highest
9	Activities allowed participants involving instructional practices	4.67	0.45	Highest
10	Activities can make participants learn in happily	4.65	0.53	Highest
	Mean score	4.63	0.48	Highest

Findings in this study indicated that primary school teachers have satisfaction with professional development program in STEM education and also gain their positive perceptions regarding STEM learning activities. The participants express personal needs for resources and learning materials to help them during integrated STEM-based instruction, that is make science, technology, engineering, and mathematics meet in suitable methods (Du et al., 2019). When considering each item, it was found that the highest mean is the time spent in carrying out the activities is sufficient and appropriate, followed by all students participating in the activities. Learning activities enable learners to have knowledge and happily learn respectively. It enables teachers to understand how it connect among disciplines and school contexts with consideration of multiple disciplines (Dan & Gary, 2018). Furthermore, to implement STEM education in primary schools, an attention has been paid to teachers'

professional development as effective way to help teachers play their role in holistic teaching. Integrated approach is important for the changing world and new normal education. Thibaut et al. (2018) proposed that integration of STEM education, which blend science, technology, engineering and mathematics to aim at improve students gain their learning abilities and interest in STEM disciplines. Teachers have to involve and engage students in teaching an integrated STEM education, administrator provides sufficient opportunities for sharing experiences, teachers participate in professional development, and teachers should have positive perception with integrated teaching (Altan & Ercan, 2016; Al Salami et al., 2017; Houchens et al., 2017). That is, teachers express their satisfaction towards professional development program at the highest level. It can be discussed that professional development program engage teachers with STEM education based on effective program.

CONCLUSION

The efficiency of professional development reached criteria in 81.50/86.25. Teachers have 81.50% of process learning through professional program and 86.25% of product by calculating the posttest score. That is, teachers have gained their knowledge STEM education. Teachers have understanding towards STEM education by showing the posttest score higher than pretest score at .01 level of statistical significantly differences. Also, they have satisfaction level towards STEM education in at the highest level. All of these findings can be concluded that teachers can develop their understanding and process to deal with STEM education through professional development program as well. However, STEM education concerns curriculum, instructional practices, and learning assessment. The study should be continuously studied in professional development, engaging teachers about STEM learning management, and need more research collaborations that focusing on integrated science learning process.

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