The Development of Teacher Trainees' Science Instructional by Active Learning Competencies through Lesson Study

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The Osaka Conference on Education 2020
Official Conference Proceedings

Abstract
The research objective was to develop science instructional competencies by active learning of teacher trainees through lesson study. The methodology of practical action research was implemented in this study. The research was conducted in two phases in accordance with the four cycles of practical action research framework. The target participants were thirty fifth-year students, during their internship of teaching practicum, in the Department of General Science, the Faculty of Education, Phetchabun Rajabhat University in Thailand. The research instruments consisted observation form in regard to instruction and evaluation forms in regard to science instructional by active learning competencies. Analyze qualitative data through content analysis. And find the sum of the student teacher proactive science instructional competency scores then compare the score difference before and after the lesson study. The research findings revealed that the intern students during their teaching practicum demonstrated the potential in science instructional by active learning competencies in three aspects: the aspect of instructional design; the aspect of activities instructional; and the aspect of assessment and evaluation related to instructional. The positive developments were also observed in all aspects and indicators.

Keywords: Science Instructional by Active Learning, Lesson Study, Teacher Trainees

Introduction

The 21st century is an age of information and changes in both economic and social perspectives as well as education systems. Education systems still have many problems including educational disparities in educational opportunities and equality which is required to be adjusted in accordance with such changes. Teaching methods should be adaptable to the changing world, so it is necessary to constantly produce and develop teachers to support the changes. Student-oriented education creates students' characteristics consistent with the National Education Plan, the National Economic and Social Development Plan along with the course content or curriculum in the teaching profession should be modified to be up-to-date in accordance with dynamic global and Thai social contexts.

Science is a matter of learning about nature by using the process of observing, exploring, examining and experimenting with natural phenomena and organizing principles, concepts and theories. Therefore, teaching science aims to make students the most self-discovery. Teachers can execute instructions in a variety of ways such as project–based learning, inquiry–based learning, and problem–based learning. Each of the methods focuses on teaching learners to practice, which will increase knowledge and skills according to Simpson (1972) who states that practical skills can be developed with practices, and good and correct practices lead to expertise and persistence. Instruction can be executed in different ways including active learning that focuses on practical learning, and higher-order thinking highlighting on analysis, synthesis and evaluation which enables students to be not just listeners, but also active learners who are required to read, write, and ask questions to make discussion. The methods also take into account students' prior knowledge and needs as a priority. Science courses can be conduct by using those methods as stated by Chumnankit, B. (2006, pp.1-7) mentioning that science instructional by active learning is a teaching method in which students are demanded to find content to generate knowledge by speaking, writing, reading, reflecting or asking questions, which are valuable, exciting, fun, and challenging. Students can learn according to their own abilities and need can apply knowledge to daily life.

The Researcher is an instructor for a Bachelor of Education General Science Program, Faculty of Education, Phetchabun Rajabhat University, teaching in the course in which fifth-year teacher trainees are requisite to practice teaching in an educational institution for one year as a teacher trainee. The researcher as a teacher trainee's supervisor has found the problems. For instance, most teacher trainees use a lecture method, lack ability to conduct science learning that gives their learners profound knowledge and understanding of the concepts taught, cannot create learning activities that enable their learners to generate knowledge on their own through advanced thinking, and have inability to generate correct measurement and evaluation tools for science instructional.

Lesson study originated in Japan (Isoda, 2007; Saito, 2012). It has the characteristics of effective professional development: teachers are actively involved in both the process as the products, the focus is on content and specifically on teacher trainees learning this content, it takes place over a longer time span, and there is coherence between the activities (Garet et al., 2001, Penuel et al., 2007). In Lesson study, teachers in collaboration select a topic and plan and prepare a lesson (called a research

lesson), one teacher enacts the research lesson and the others observe the teacher trainees in class, and finally teachers discuss their observations (Lewis et al., 2006, Isoda et al., 2007, Stepanek et al., 2007). The implementation of the cycle consists of planning, seeing, and reflecting. This research is interested in applying concepts, principles and processes of lesson study to the development in science instructional competencies by active learning of teacher trainees in three areas: an instructional design, instructional activities, and assessment and evaluation related to instructional.

Methodology

This research aims to develop science instructional competencies by active learning of teacher trainees through lesson study. The target group is 30 teacher trainees who study fifth-year General Science Program, Faculty of Education Phetchabun Rajabhat University in Thailand. This research is a Practical Action Research of which process consists of two stages and four practical action research cycles. The one stage is before lesson study which comprises of two cycles. The first cycle is the study of analysis and synthesis of conceptual framework and processes of lesson study. The second cycle is the creation and enhancement of research tools. The other stage is during lesson study which also includes two cycles. The third cycle is an active science instructional practice through lesson study of teacher trainees. The fourth cycle is a science instructional by active learning through lesson study, while the researcher acts as a consultant and motivator who set issues and direct them to think, act, see, and reflect. Teacher trainees can develop their science instructional by active learning which can utilize in doing practices in a classroom, develop self-improvement, collect data for producing an appropriate lesson study process. To demonstrate the research processes, Table 1 is provided.

Practical Action Research cycle	Phase 1 before lesson study		Phase 2 during lesson study	
	Cycle 1: Study, analyze, synthesis, conceptual framework	Cycle 2: Build and develop research tools	Cycle 3: Practice science instructional by active learning through lesson study	Cycle 4: Practice science instructional by active learning through lesson study
Planning : P	The researcher - Studying basic information - Setting a conceptual framework - Planning research	The researcher - Determining the indicators of the science instructional by active learning of teacher trainees - Building and developing research tools	- setting the roles of the researcher and teacher trainees - The researcher made arrangements to create understanding with teacher trainees	- setting the roles of the researcher and teacher trainees
Acting : A	The researcher - synthesize information	The researcher participate in the orientation	- The researchers and teacher trainees	- The researcher and teacher trainees

Practical Action Research cycle	Phase 1 before lesson study		Phase 2 during lesson study	
	Cycle 1: Study, analyze, synthesis, conceptual framework	Cycle 2: Build and develop research tools	Cycle 3: Practice science instructional by active learning through lesson study	Cycle 4: Practice science instructional by active learning through lesson study
	related to the development of science instructional by active learning of teacher trainees through lesson study	class to study the contexts of science instructional by active learning	create mutual understanding - The researcher and teacher trainees collaboratively implement science instructional by active learning through lesson study (Lesson study) (Plan – See – Reflect)	collaboratively implement science instructional by active learning through lesson study (Lesson study) (Plan – See – Reflect)
Observing : O	The professionals examine the process of developing the science instructional by active learning through lesson study	The research - Synthesizing data from student attendance and an orientation class assessing the science instructional by active learning of teacher trainees	- Collecting teacher trainees' performance, the results on both teacher trainees and students - assessing the science instructional by active learning of teacher trainees after implementing lesson study for the first time	- Collecting teacher trainees' performance, the results on both teacher trainees and students - assessing the science instructional by active learning of teacher trainees after implementing lesson study for the second time
Reflecting: R	Reflecting, improving, and revising for the first time	Reflecting, improving, and revising for the second time	Reflecting, improving, and revising for the third time	- Reflecting, improving, and revising for the fourth time - Presenting research results

Table 1. Conducting research according to the Practical Action Research Cycle

Research instruments are instructional observation forms and science instructional by active learning evaluation forms. They have the characteristic of rubrics scoring and contains lists of behaviors based on three indicators which are eight lists of the

instructional design, six lists of the operations of instructional activities, and three lists of the measurement and evaluation of instructional. The total lists are 17 resulting in 51 as the full score. The research conducts by an assessment by the researcher collecting evidence data about science instructional by active learning of teacher trainees from various sources which are 1) instructional plans for teacher trainees 2) recording teaching in classrooms 3) observing instructional 4) reflecting on instructional results through lesson study to analyze and give scores corresponding to performance levels. The performance levels are divided into three – low, moderate, and high (An overall score fewer than 17 is low. between 18 and 34 is moderate, and between 35 - 51 is high). After that, the research compares the difference in scores between before and after lesson study together with levels of science instructional by active learning and conducts a qualitative-data analysis.

Research Findings

The results of analysis of the competency of science instructional by active learning between before and after studying the lesson study shows that all students and teachers had higher competency scores in science instructional by active learning at one level. That is to say, 24 students increased their scores from a low to medium level and 6 students improved from a medium to high level, as detailed in Table 2.

Teacher trainees no.	Before lesson study		After lesson study		Changes in the competency level of science instructional by active learning
	Total score	Interpret results	Total score	Interpret results	
Sci1	13	low	33	moderate	Increased
Sci2	12	low	29	moderate	Increased
Sci3	15	low	33	moderate	Increased
Sci4	27	moderate	46	High	Increased
Sci5	16	low	34	moderate	Increased
Sci6	14	low	33	moderate	Increased
Sci7	30	moderate	45	High	Increased
Sci8	13	low	29	moderate	Increased
Sci9	13	low	32	moderate	Increased
Sci10	12	low	30	moderate	Increased
Sci 11	32	moderate	46	High	Increased
Sci12	14	low	32	moderate	Increased
Sci13	12	low	32	moderate	Increased
Sci14	15	low	33	moderate	Increased
Sci15	32	moderate	48	High	Increased
Sci16	16	low	34	moderate	Increased
Sci17	13	low	33	moderate	Increased
Sci18	12	low	28	moderate	Increased
Sci19	15	low	32	moderate	Increased
Sci20	16	low	33	moderate	Increased
Sci21	30	moderate	46	High	Increased
Sci22	15	low	30	moderate	Increased
Sci23	13	low	29	moderate	Increased
Sci24	11	low	29	moderate	Increased

Teacher trainees no.	Before lesson study		After lesson study		Changes in the competency level of science instructional by active learning
	Total score	Interpret results	Total score	Interpret results	
Sci25	13	low	33	moderate	Increased
Sci26	31	moderate	48	High	Increased
Sci27	16	low	32	moderate	Increased
Sci28	14	low	31	moderate	Increased
Sci29	13	low	31	moderate	Increased
Sci30	13	low	29	moderate	Increased

Table 2. shows the results of the analysis of the science instructional by active learning performance of teacher trainees through lesson study of individual teacher trainees.

From studying the class and observing the instructional of teacher trainees, competencies in designing instructional were founded that the instructional plan of the teacher trainees has a comprehensive set of interrelated elements, learning activities are aligned with the indicators, objectives and content, and learning activities successfully promoted the thinking process of students. Likewise, competencies in organizing instructional activities shows that teacher trainees could use instructional methods to promote students to think, solve problems, and focus on the improvement of advanced thinking skills. The methods that were conducted include STEM instructional methods, problem-based learning methods. Self-practicing learning activities provided many different materials, equipment, media, technology and learning resources suitable for the content which enabled students to use the learning resources themselves. Apart from this, the competencies of the measurement and evaluation in instructional were found that the measurements and evaluations on the indicators/learning outcomes in terms of knowledge, skills and attributes were under real conditions

From the reflection of the instructional results through the lesson study of teacher trainees, it indicated that studying and seeing lesson study contributed teacher trainees to recognize actual operational conditions and to realize the consequences of applying the implement of science instructional by active learning. They also had the opportunity to discuss and share their knowledge gained from hands-on teaching experience and observation (teacher trainees no. 1, 6, 14, 17, 28). Reflections enables them to review which factors are useful or useless for instructional including what should be improved (teacher trainees no. 3, 5, 13, 15, 25, 29). Lesson study caused them to adjust their teaching behavior which gave rise to the changes in students. This made them discern the importance and gain confidence in lesson study, and demand to participate in the next class (teacher trainees no. 4, 7, 15, 26).

Conclusions and Discussions

The results of the research showed that all teacher trainees had higher competency scores in science instructional by active learning at one level after conducting lesson study. Since lesson study was a long-term continuous operating cycle, teacher trainees had the opportunity to use the study through repeated lessons. Studying and seeing lesson study in the teaching stage brough about teacher trainees to recognize actual operational conditions and to realize the consequences of applying the implement of

science instructional by active learning. They also had the opportunity to discuss and share their knowledge gained from hands-on teaching experience and observation. In the reflection stage, they could review which factors are useful or useless for learning management including what should be improved. This is aligned with Triwaranyu. C. (2013) who states that the most important stages in implementing lesson study are the stages of teaching and seeing and reflecting seeing that they encourage teachers to create perspectives, concepts, body of knowledge and understanding of instructional, and to solve teacher instructional problems according to students' learning.

Furthermore, lesson study enables teacher trainees who in the same grade to have a close relationship and collaboration, and to share and exchange knowledge related to work experience frequently. The study of Wasayangkull. P. (2014) found that lesson study is a cooperative operation of the classroom group as a professional learning community, PLC, in which teachers work together by sharing and exchanging their knowledge and experience along with educational resources, and teachers also promote a positive attitude towards working and a concept of teacher development with one another.

Acknowledgements

I would like to thank Faculty of Education, Phetchabun Rajabhat University, family for the endless support and love and thank you for providing me with the ability and perseverance that were needed to complete this work.

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