2017 Conference Proceedings

ICEL

Tokyo International Conference on Education and Learning

Global Academic-Industrial Cooperation Society

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Monitoring and evaluation of Teaching Efficiency of Science Pre-Service Teachers from Faculty of Education, Ramkhamhaeng University

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ABSTRACT

This research is intended to monitor and evaluate teaching efficiency in science pre-service teachers in eight aspects; relationship between teachers and students, ability of measurement and evaluation process, self-development, knowledge of the content subject, ability in managing instructional process , managing instructional climate, understanding of curriculum, and appropriate characteristics of good science teachers. Such monitoring and evaluation were conducted during the practicum by using questionnaires that were filled out by pre-service teachers two months and four months after the start of the semester. The subjects of the research included 21 science pre-service teachers (SciPT) who were registered in the Field Experience in the Teaching Profession I (TL 5001) at Ramkhamhaeng University during the second semester of 2016. The research consisted of a 5-point rating scale questionnaire with 80 items. The statistical analysis included mean, standard deviation, and t-test dependent. The analytical results showed that the mean scores of the three aspects: *knowledge of the subject, ability in managing instructional process, and understanding of curriculum,* were higher from student teachers who had four-month teaching experience compared to those who only had two-month teaching experience.

Keyword: science teaching efficiency, pre-service teach

Introduction

Teacher education degrees at Ramkhamhaeng University takes four years plus another year of pre-service teaching program, per the *Teachers' Council of Thailand*. The five-year teacher education program aims at increasing the standards of pre-service training by highlighting teaching experiences, classroom research, school curricular development, students' learning activities, school and community services, and other works. Under the supervision of the university and school mentors, student teachers take the same responsibilities as a teacher would in a classroom for the duration of two semesters. The program also provide seminars before, between, and after the pre-service program to support student teachers so that they can work effectively in school.

Teaching efficiency relates to several variables such as students' academic performance, students' satisfaction, types of educational board, gender, teachers' attitude, belief in teaching profession and others (Matilde Bini & Lucio Masserini, 2016; Chang-Fu Lin, Tsai-Ku Liao, Chin-Wen Liao, and Chia-Ling Shih, 2016; Elvis Munyaradzi Ganyaupfu, 2013; Kumpol Thananimith, 2007; Sangeeta Mishra, 2015)

The education reform in Thailand could be categorized into two phases. The first, from 1999 to 2008, a five year teacher education program and the Project for the Promotion of Science and Mathematics Talent Teacher (PSMT) were initiated in order to produce high quality teachers who have passion for the teaching profession. In addition, there are continuous efforts to develop and embolden teachers within the whole of the educational system. To increase incentive in the teaching profession, data provided by teachers are used to help further their professional development as educators. However, the Office of the Education Council (2009) reported that the first decade of the educational reform was not successful enough in terms of developing teachers. The second, was from 2009 to 2018. In this period, the goal of the educational reform was emphasized on developing the quality of new generation of teachers by creating a system that produce new teachers and enrich existing teachers.

Monitoring and evaluating the pre-service teaching program is essential in knowing whether the student teachers are effective in how they teach. This will provide information that can show successes, strengths, and weaknesses. Therefore, offering some guidelines on how to improve the program will help the student teachers increase their quality in teaching.

Such monitoring and evaluating method can be used to measure the efficiency of student teachers in teaching science. (November 2016 to March 2017). This will help with the continued effort in improving and developing student teachers' in their teaching abilities during second semester. (June 2017 to September 2017)

Purpose of study

This current study would monitor and evaluate teaching efficiency in eight areas; relationship between teachers and students, ability of measurement and evaluation process, self-development, knowledge of the subject content, ability in managing instructional process, managing instructional climate, understanding of curriculum, and appropriate characteristics of good science teachers of Science Pre-Service Teachers (SciPT).

Literature review

Teaching efficiency

Kumpol Thananimith (2017) made a factor analysis of teaching efficiency among science teachers in primary schools under the Office of Pattani Educational Service Areas. The cumulative variance was 67.922, indicating that the factor analysis of the teaching efficiency could be explained by the variance of variables consisting in the factor analysis. The eight factors are relationship between teachers and students, competency in measurement and evaluation, teacher development, teacher content knowledge, strategies in learning and teaching, management of classroom environment, teacher's ability and knowledge in curricula, and appropriate characteristics of science teachers. Kompol Thananimith's result was in congruent with the recommendation of Philip Gurney (2007). Philip Gurney stated that five factors influencing teaching efficiency were 1) teacher knowledge, enthusiasm, and responsibility for learning, 2) classroom activities that encourage learning, 3) assessment activities that encourage learning through experience, 4) feedback that establishes the learning process in classroom, and 5) effective interaction between teachers and students creating the environment of respect, encouragement, and stimulation of learning through experience. Moreover, Robert Coe, Cesare Aloisi, Steve Higgins, and Lee Elliot Major (2014) proposed that there are six factors contributing to effective teaching, namely pedagogical or content knowledge, quality of instruction, classroom climate, classroom management, and teacher beliefs in teaching profession.

The comparison among effective teaching factors is shown in Table 1. Teaching efficiency factors include teachers' ability to provide and facilitate appropriate experiences for students to learn. Teachers' behavior can also affect students' ability to successfully reach the learning objectives to help them reach learning objectives successfully as well.

Table 1 The synthesis of factors contributing to teaching efficiency from research and articles

Teaching efficiency	Research / articles		
	1	2	3
1. Relationship between teachers and students	✓	✓	✓
2. Ability of measurement and evaluation process	✓	✓	✓
3. Self-development	✓	✓	✓
4. Knowledge of the subject content	✓	✓	✓
5. Ability in managing instructional process	✓	✓	✓
6. Managing instructional climate	✓	✓	✓
7. Understanding of curriculum	✓	-	-
8. Teachers characteristics	✓	-	✓

Note: 1=Kumpol Thananimith (2007), 2=Philp Gurney (2007)**,** and
3 = Robert Coe, Cesare Aloisi, Steve Higgins and Lee Elliot Major (2014)

Monitoring and evaluation

The Organization for Economic Co-operation and Development (OECD, 2002) defined monitoring and evaluation as follows:

Monitoring highlights systematic and continuous collection of data from specific indicators in order to inform administrators and stakeholders about the progress of an implementing project. The monitoring will report whether the project's objectives are attained and whether the budget is properly used.

Evaluation is the systematized assessment of a carrying out or finished projects, work plans, policies, designs or implementation of work, as well as their effectiveness. The purpose of an evaluation is to analyze the correspondence of work and the actualization of objectives. The evaluation also provides data about efficiency, effectiveness, impacts, sustainability, and appraisal.

UNESCO (2016) referred to Monitoring and Evaluation (M&E) as the two distinct methods with similar processes mutually supporting each other. M&E is used to monitor the impact or progress of a program or a policy, according to the overall goals, objectives, and targets. M&E also reveals the consequence of an activity, a program or a policy in accordance with their efficiency and sustainability.

The purposeful use of M&E in education is to ensure educational accountability and quality for people of all levels. International Institute for Educational Planning (2007) stated that the quality of education involves different

dimensions, such as input (human, material, and financial), process (teaching-learning and effective management practices), and outputs or outcomes (the learning outcomes and quality of results).

In this study, monitoring teaching efficiency is implemented by performance monitoring with a focus on outputs. The emphasis of this type of monitoring is students' academic achievement through testing to investigate contributing elements of educational outcomes. This study will scrutinize the efficiency of the pre-service teaching program by collecting data from student teachers. The study will provide advantages, disadvantages, suggestions, and preventive measures. The evaluation will be made according to the study's objectives in order to improve the eight factors of teaching efficiency for the second semester.

Methods

Study sample

There were 31 pre-service teachers enrolled in Field Experience in the Teaching Profession I (TL 5001) at Ramkhamhaeng University. The total number of pre-service teachers providing complete data about teaching efficiency two times (2 months and 4 months from start date of the first semester) was 22. The number of pre-service teachers according to their majors were 13 in biology (61.9%), 7 in general science (28.5%), 1 in chemistry (4.8%), and 1 in physics (4.8%), respectively. Student teachers spent at least eight to twelve hours per week teaching.

Instrumentation

The questionnaire inquiring Teaching Effectiveness of Pre-service Teaching in Science (SciPT) was developed by Kumpol Thananimith (2017). It contains 80 items of rating scale items. The interpretation of the scales are as follows:

4.51 – 5.00 Teaching or competency is very good.
3.51 – 4.50 Teaching or competency is good.
2.51 – 3.00 Teaching or competency is moderate.
1.51 – 2.50 Teaching or competency is low.
1.00 – 1.50 Teaching or competency needs improvement.

The questionnaire was given to 26 Science Pre-Service Teachers (SciPE) who were enrolled in the Field Experience in the Teaching Profession I (TL 5001) at Ramkhamhaeng University during the first semester of 2016. To ascertain the validity of the instrument, a panel of experts on testing and evaluation examined all items of the questionnaire to determine content validity and language appropriateness. Concerning reliability, Cronbach's alpha correlation coefficient was also employed to explore the internal consistency of the questionnaire. The value of Cronbach's alpha was .98, indicating high reliability.

Table 2 The number of items and some of their examples in the questionnaire about teaching efficiency according to the eight aspects of evaluation.

Teaching Efficiency	Number of items	Examples of items
1.Relationship between teachers and students	20	- Offer students suggestions on how to behave according to certain moral principles - Allow students opportunities to freely ask questions and offer their opinions
2. Ability of measurement and evaluation process	12	- Have students be engaged in creating criteria and evaluate their own projects - Constantly monitor students' work and support students to fully develop their potential
3. Self-development	11	- Apply new technology in teaching - Use classroom research to improve teaching
4. Knowledge of content subject	10	- Be knowledgeable and skillful in using scientific equipment - Be able to clearly explain and interpret abstract ideas about scientific laws and theories
5. Ability in managing instructional process	10	- Create various learning activities and situation to meet students' interests, aptitude, and abilities - Integrate real life events in science instruction to help students perceive and understand scientific phenomena around them
6. Managing instructional climate	6	- Provide interesting atmosphere to assist students in learning effectively. - Arrange scientific substances and apparatus systematically
7. Understanding of curriculum	7	- Be competent in writing teaching manuals - Be able to analyze curriculum, content subjects, and instructional plans to improve teaching and learning
8. Appropriate characteristics of science teachers	4	- Have a good attitude as a science teacher and for the teaching profession

Research methodology

1) Data from the questionnaire about teaching efficiency was collected two times: 2 months and 4 months after the beginning of the first semester. Table 3 shows the schedule of data collection.

Table 3 The schedule of data collection

Time	Duration of Pre-service teaching program	Period of data collection
1	November – December 2016	First week of January 2017
2	January – February 2017	First week of March 2017

2) Interviews of pre-service teachers were made regarding teaching effectiveness.

Data analysis

The results of collected data from the questionnaire were analyzed by using mean, standard deviation, and t-test dependent.

Results

Levels of Teaching Efficiency

The results of teaching efficiency in eight aspects between the first and second data collection periods were compared. The increasing number of pre-service teachers showing teaching efficiency at levels of very good and good at the second period was as follow: 4 (19.0%) in relationship between teachers and students; 3 (14.3%) in ability of measurement and evaluation process; 3 (14.3%) in teachers' self-development; 5 (23.8%) in knowledge of the content subject; 5 (23.8%) in managing instructional climate; 6 (28.6%) in ability in managing instructional process; 2 (9.6%) in understanding curriculum; and 2 (9.6%) in appropriate science teachers' characteristics.

Table 4 Level of Teaching Efficiency

Teaching Efficiency	Time	Level of Teaching Efficiency (n=21)							
		Low		moderate		good		Very good	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
1.Relationship between teachers and students	1	-	-	5	23.8	10	47.6	6	28.6
	2	-	-	1	4.8	10	47.6	10	47.6
2.Ability of measurement and evaluation process	1	-	-	9	42.9	9	42.9	3	14.3
	2	-	-	6	28.6	12	57.1	3	14.3
3. Teachers' self-development	1	1	4.8	5	23.8	11	52.4	4	19
	2	-	-	3	14.3	15	71.4	3	14.3
4. Knowledge of the subject content	1	-	-	9	42.9	11	52.4	1	4.8
	2			4	19.0	15	71.4	2	9.6
5. Ability in managing instructional process	1	1	4.8	10	47.6	9	42.9	1	4.8
	2	-	-	5	23.8	13	61.9	3	14.3

Table 4 Level of Teaching Efficiency

Teaching Efficiency	Time	Level of Teaching Efficiency (n=21)							
		Low		moderate		good		Very good	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
6. Managing instructional climate	1	-	-	10	47.6	8	38.1	3	14.3
	2	-	-	5	23.8	16	76.2	-	-
7.Understanding of curriculum	1	1	4.8	4	19.0	15	71.4	1	4.8
	2	-	-	3	14.3	15	71.4	3	14.3
8. Appropriate science teachers characteristics	1	-	-	5	23.8	10	47.6	6	28.6
	2	-	-	3	14.3	13	61.9	5	23.8

The comparison of pre-service science teachers on teaching efficiency

The result illustrated that mean scores of student teachers who had been teaching between two and four months were significantly different at alpha .05. Student teachers teaching for four months had higher means than those with two-month teaching experience, on the three aspects: knowledge of a subject, ability in managing instructional process, and understanding of curriculum.

Table 5 The comparison of teaching efficiency of pre-service science teachers in two times: two months and four months after the beginning of the semester.

Teaching Efficiency(n=21)		Mean	S.D.	$\bar{D}$	$SD_{\bar{D}}$	t	P
1. Relationship between teachers and students	Time1	4.15	0.63	-.23	.69	-1.52	.14
	Time2	4.38	0.46				
2. Ability of measurement and evaluation process	Time1	3.77	0.60	-.17	.69	-1.11	.28
	Time2	3.94	0.61				
3. Self-development	Time1	3.83	0.65	-.20	.64	-1.46	.16
	Time2	4.03	0.51				
4. Knowledge of the subject content	Time1	3.69	0.40	-.27	.49	-2.51	.02
	Time2	3.96	0.47				
5. Ability in managing instructional process	Time1	3.55	0.45	-.36	.53	-3.09	.01
	Time2	3.91	0.50				
6. Managing instructional climate	Time1	3.83	0.57	-.05	.65	-.34	.74
	Time2	3.88	0.49				
7. Understanding of curriculum	Time1	3.73	0.51	-.31	.49	-2.86	.01
	Time2	4.03	0.51				
8. Appropriate science teachers characteristics	Time1	4.20	0.68	-.02	.70	-.16	.88
	Time2	4.23	0.56				

Interviews from science student teachers on teaching effectiveness

Although student teachers' instruction was more efficient after having experience in teaching for four months, most had concerns about subject knowledge. They realized they had a problem with classroom management and incapability of applying various teaching techniques. The interview results are described below:

"I think I had a pretty good attitude, I was clam and able to regulate my emotion. However, I was not confident in my knowledge of subject. I was not able to control the class well and I did not think I gave good instruction. Before teaching in school, I did not know and understand indicators and learning standards."

Pre-service teacher in general science

"I was unsure about my knowledge of the subject matter, so I watched a teaching demonstration on YouTube. I tried to find learning strategies to help the students memorize. I had a problem with managing the classroom and with introducing topics to help stimulate students' interests.

Pre-service teacher in biology

"I had a good relationship with the students. My students felt comfortable enough to openly have discussions and ask questions. To me, my knowledge of the subject matter was moderate, though I think I would be able to improve this with more hours to teach. I did not have many teaching pedagogies. I mostly, gave lectures to my students."

Pre-service teacher in chemistry

"I was able to speak eloquently when teaching. I used a certain tone of voice that help in getting the students' attraction. I would like to apply more learning activities for the students. Lastly, I was able to avoid any misconceptions by the students because I went over the lesson with my mentor before the beginning of class."

Pre-service teacher in physics

6. Discussion

The assessment of teaching efficiency showed that the aspect of managing instructional climate had the least change on means during two and four months of teaching, respectively ($Mean_{time1}$=3.83, $Mean_{time2}$=3.88). Mean scores on this aspect was also lowest in the second time of collecting data compared to other aspects. The problem with managing instuctional climate aspect called for an immediate plan of action to improve teaching efficiency from mentors and all related persons. Managing instructional climate is an important factor for successful teaching and learning. Having an effectively managed classroom can have a great impact on how students learn. (e.g., Opdenakker, Maulana & Brok, 2012; Smith, Baker, Hattie, & Bond, 2008; Teodorović, 2011).

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