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การพัฒนาหลักสูตรการสืบเสาะหาความรู้เชิงแนะนำโดยใช้ความเข้าใจก่อนเรียนเป็นฐาน เพื่อเสริมสร้างความเข้าใจเรื่องการสืบเสาะหาความรู้ การนำไปใช้ในชั้นเรียน และแก่นความคิดรวบยอดที่มีต่อการสอนของนิสิตครูวิทยาศาสตร์

The Development of ESRU-guided inquiry-based Curriculum for Enhancing Pre-service Science Teachers' Understanding Inquiry, Practicing Inquiry and Core Teaching Conceptions.

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บทคัดย่อ

งานวิจัยนี้ศึกษาผลของการใช้หลักสูตรการสืบเสาะหาความรู้เชิงแนะนำโดยใช้ความเข้าใจก่อนเรียนเป็นฐาน เพื่อเสริมสร้างความเข้าใจเรื่องการสืบเสาะหาความรู้ การนำไปใช้ในชั้นเรียนและแก่นความคิดรวบยอดที่มีต่อการสอนของนิสิตครูวิทยาศาสตร์ หลักสูตรประกอบด้วย 1)การตรวจสอบความเข้าใจก่อนเรียนเพื่อใช้เป็นข้อมูลพื้นฐาน 2)กิจกรรมการเรียนรู้แบบสืบเสาะหาความรู้เชิงแนะนำ 3)การเขียนสะท้อนความคิดของแก่นความคิดรวบยอดเกี่ยวกับการสอน ทดลองหลักสูตรโดยนิสิตครูวิทยาศาสตร์อาสาเข้าร่วมจำนวน 23 คน ใช้การเก็บข้อมูลก่อนและหลังการใช้หลักสูตร เพื่อประเมินความเปลี่ยนแปลงของความเข้าใจเรื่องการสืบเสาะหาความรู้ ความสามารถในการนำไปใช้ และแก่นความคิดรวบยอดเกี่ยวกับการสอน

ผลการวิเคราะห์ข้อมูล พบว่า ภายหลังจากเรียนรู้ด้วยหลักสูตร ผู้เข้ารับการอบรมเข้าใจกระบวนการสืบเสาะหาความรู้ว่าเป็นกระบวนการค้นหาความรู้ที่นักวิทยาศาสตร์ใช้ในการทำงาน ในส่วนของการออกแบบการจัดการเรียนรู้แบบสืบเสาะหาความรู้ ผู้เข้ารับการทดลองใช้โครงสร้างของห้าคุณลักษณะสำคัญของการสืบเสาะหาความรู้แทนการใช้โครงสร้าง 5E เพียงอย่างเดียว ในส่วนของแก่นความคิดรวบยอดที่มีต่อการสอนผู้เข้ารับการทดลองเข้าใจว่าผู้เรียนมีศักยภาพในการเรียนรู้ที่ไร้ขีดจำกัด การค้นพบนี้บ่งชี้ว่าเมื่อนิสิตครูวิทยาศาสตร์เข้าใจการสืบเสาะหาความรู้ว่า เป็นกระบวนการที่นักวิทยาศาสตร์ใช้ในการศึกษาค้นคว้าความรู้ใหม่ ๆ ส่งผลให้นิสิตครูวิทยาศาสตร์มองเห็นผู้เรียนว่ามีศักยภาพในการเรียนรู้และสามารถเรียนรู้ผ่านกระบวนการสืบเสาะหาความรู้ได้

คำสำคัญ: ความเข้าใจการสืบเสาหาความรู้ การปฏิบัติการสืบเสาะหาความรู้ แก่นความคิดรวบยอดเกี่ยวกับการสอน

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Abstract

This research studied the effects of the ESRU-guided inquiry-based curriculum on pre-service science teachers' understanding inquiry, practicing inquiry and core teaching conceptions. The curriculum consisted of 1) ESRU cycle, 2) guided inquiry-based learning experience about rice farming crisis, and 3) reflective writing about core teaching conceptions. There were twenty-three volunteer pre-service science teachers participated in the process of curriculum implementation. Research methodology was one group pretest- posttest design in order to track the changes in pre-service science teachers' understanding, practicing and core teaching inquiry toward science before and after the curriculum implementation.

The findings indicated that after the curriculum implementation, participants understand inquiry as the way scientists do science. For practicing inquiry after the implementation, participants used more structure of five features of inquiry beside 5E model. Finally, core teaching conceptions of the participants changed after the curriculum implementation, the participants understood that students have the expandable learning ability. The findings implied that when the pre-service science teachers understand inquiry as the process of that scientists use to construct new knowledge; therefore, they think of students as the expandable learning ability.

Keywords: understanding inquiry, practicing inquiry, core teaching conceptions

Introduction

According to the educational reform occurring around the world, the necessity and demand for the reform of education raised up, consequently, in Thailand, the National Education Act of B.E. 2542 (1999) was passed as the guiding principles for education reform (ORE, 2002). The goals of the National Education Act are to develop learners in four areas: morality, intellectual growth, quality of life, and competitive ability. Education institutions are burdened with the responsibility of managing learning development which emphasizes thinking processes, managing and confronting real situations, applying knowledge for solving problems. (Ministry of education, 2001) The change of learning activities from teacher centered to be students centered are required; therefore the teachers need to transform themselves from transferring knowledge to students to be facilitators. In science subject, the core curriculum emphasized the leaning science through inquiry as the main issue of educational reform(IPST, 2008).

As a key role of educational process, science teachers need to have a clear concept of inquiry, and then integrate it with the science body of knowledge to create the inquiry-based classroom curriculum. Considering the science educational standards, scientific inquiry teaching is a must strategy for teaching science based on the emphasis in all eight standards. Many efforts of implementation scientific inquiry, however; there are some misunderstandings in science teachers, even with the teachers who had experience with real scientific research (Crawford; et.al, 2005). Additionally, because of the strength of inquiry teaching and the need of science educational standard, the effort of giving information about inquiry teachings has begun right after educational reform. More understanding can be accomplished. Consequently, pre-service science teachers and in-service science teachers gain more understanding of inquiry.

Pre-service science teacher period is the peak time of teacher students to experience professional life. The experience that they learn will build up the core beliefs in science teaching (Christina & Yovita, 2007; Forbes & Davis, 2010). Also, professional development could be one of the choices to increase practicing skill for pre-service science teachers. Somehow, even teachers who understand scientific inquiry do not bring scientific inquiry into classroom practice (Brown & Melear, 2006). Lotter; Harwood & Bonner (2007) suggest that core teaching conceptions is the key to hold teachers' understanding of inquiry to classroom practicing inquiry. The teacher's conceptions of science, their students, effective teaching practices, and the purpose of education influenced the type and amount of inquiry instruction performed in the classroom. The researcher claimed that to be successful inquiry professional development must not only teach inquiry knowledge, but it must also assess and address teachers' core teaching conceptions.

According to all information above, helping pre-service science teachers to be more understanding and practice inquiry by bridging the gap of understanding and practicing inquiry is essential. The demand of the curriculum for pre-service science teachers to enhance understanding of inquiry, practicing inquiry and the core teaching conceptions that support inquiry should be provided.

Research objectives

The purpose of this study was to examine the pre-service science teachers' understanding of inquiry, practicing inquiry and core teachings conceptions before and after the curriculum implementation through the Frayer model, questionnaire, and lesson plan designing.

Research questions

Do pre-service science teachers' understanding and practicing of inquiry significantly increase after participating in ESRU-guided inquiry based curriculum?

What are teachers' core teaching conceptions that pre-service science teachers hold before and change after participating in ESRU-guided inquiry based curriculum?

Method

Research methodology

The design of this study is a mixed method, one group pre-test, post-test design, where the ESRU-guided inquiry-based curriculum is an independent variable and the outcome of pre-service science teachers on understanding inquiry, practicing inquiry and core teaching conceptions are dependent variables.

Curriculum setting

The ESRU-guided inquiry based curriculum was designed by consisting of three main parts.

1. ESRU engagement

The engagement part of the curriculum is the informal assessment model, ESRU model, which consisted of four steps as follow:

E is the teacher elicits the question

S is the students respond to the question

R is the teacher recognize the students' responses

U is the teacher use the recognized students' responses as a tool for learning activity

The researcher started the curriculum implementation by asking the participants about the concept of inquiry and recognized the answer in order to correct the misconceptions during the implementation.

2. Guided inquiry-based learning activity

The content of the learning activity is about rice farming crisis. The participants received the information about rice farming crisis. There were six units including water crisis, soil crisis, fertilizer crisis, pesticide crisis, organization crisis and microteaching of inquiry-based lesson plan. As a group, the participants had to create the projects to solve the problem through inquiry process.

3. Reflective writing about core teaching conceptions

The conflict stories about core teaching conceptions were provided to the participants in the last thirty minutes of each activities, then the participants wrote the reflective idea according to the stories they had read.

Time structure

The curriculum was implemented for a total of eighteen hours, divided into three days of six hours. Three hours for each unit, the structure of activities in three hours of each unit is as follows:

Guided inquiry-based lesson on rice farming crisis 2.30 hours

Reflective writing on core teaching conceptions 30 minutes

Participants

Participants in the curriculum implementation were 23 pre-service science teachers who were studying at the fourth year of a five-year of teacher preparation program. Participants were selected purposely from volunteered pre-service science teachers because the questionnaire and reflective writing part may not elicit the true information from the non-volunteer participants.

Data Collection

All instruments that were used in this research are as shown in table 1. The qualitative information was used to support the quantitative information to confirm the answers.

Table 1. All instruments used in this study.

Dependent variables	Instruments	
	Quantitative data	Qualitative data
1.Understanding inquiry	- Pre – post Frayer model	- Pre – post Frayer model
2. Practicing inquiry	- Pre – post inquiry scoring rubric for lesson plans - Project report form	- Observation forms of project presentation
3. Core teaching conceptions	- Pre – post questionnaires	- Pre – post questionnaires reflective writing

Data analysis

The collected data from the questionnaire about understanding of inquiry were coded into content-based or processes-based and reported as the percentage. The lesson plan task was scored using the inquiry rubric score for lesson plan. The dependent t-test was used to analyze the pre-test and post-test of lesson plan task score. The core teaching conceptions before and after the implementation were coded and report as the perecentage.

Research results

Understanding inquiry

Before the curriculum implementation, 83.58% of the participants responded to the Frayer model about the definition of inquiry as facts and knowledge which are content-based.

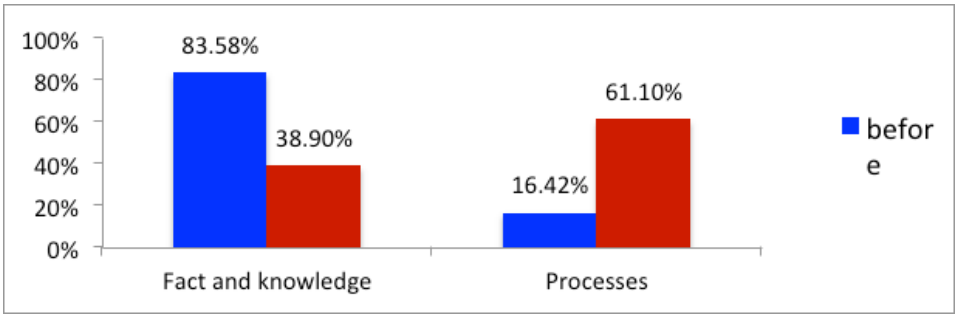


Figure 1. Pre-service science teachers' understanding inquiry before and after the implementation.

After the curriculum implementation, the answer has changed differently. A total of 44.68% of the participants changed their ideas of inquiry from content-based to be skill-based after the curriculum implementation.

Practicing inquiry

For 62.30 % of the participants designed the lesson plan about giving the experiment to the students, and the other four features of inquiry besides doing experiment were found in the very low percentage before the curriculum implementation.

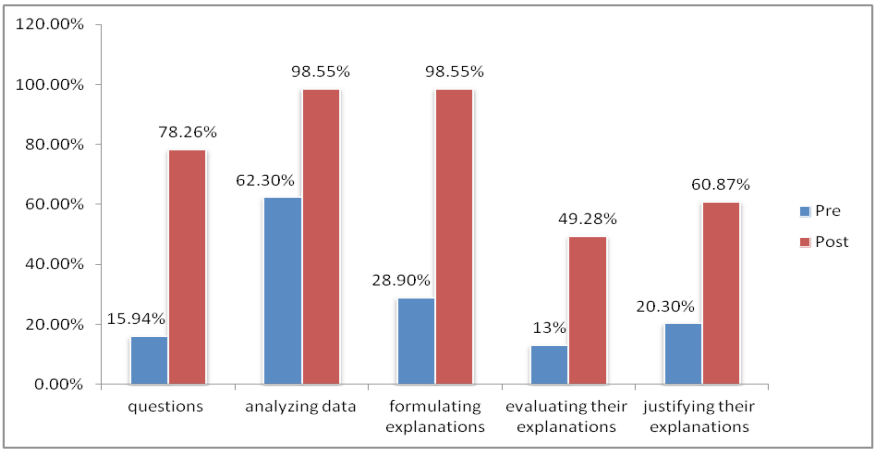


Figure2. Pre-service science teachers' practicing inquiry before and after the curriculum implementation

After the curriculum implementation, all five features of inquiry appeared more in the lesson plan of the participants. A total of 69.65% of the participants were aware of having students formulate explanations from evidences after participating in the professional development. The feature of engaging students to make scientific question rose up 56.92%. The feature of justifying data rose up 40.57% totally. The feature of engaging the findings with existing knowledge rose up totally 36.28% after the implementation, and the last feature, analyzing, rose up 36.25%.

Table 2: The t test score for dependent group of practicing inquiry.

Experimental group	N		S	ΣD	Σ	t
Pre implementation	23	4.22	3.49	-169	1495	-10.3869*
Post implementation	23	11.56	1.24			

t (.01, 23) = -2.500

The lesson plans were scored using the inquiry rubric score, the full score is fifteen. The t test score for dependent group of the inquiry-based lesson plans in table 2 showed that the inquiry-based lesson plans after the curriculum implementation significantly higher than the lesson plans before the implementation at level 0.01. This finding indicated that the curriculum implementation can improve the skills of designing inquiry-based lesson among participants.

Core teaching conceptions

The results of the response is shown in figure 3, before the curriculum implementation the strongest belief was about student ability of learning, which 91.30 % of the participants thought student might have the limitation of learning.

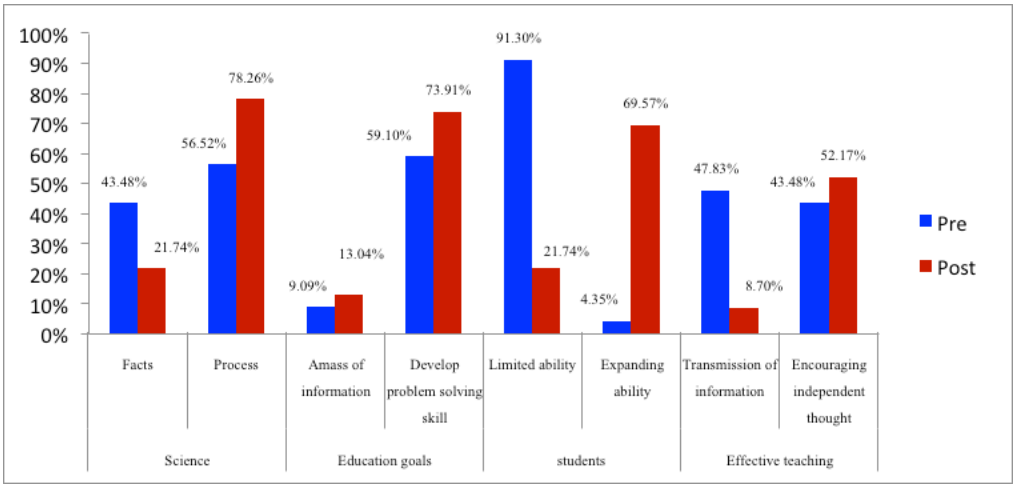


Figure 3 The percentage of pre-service science teachers' core teaching conceptions before and after curriculum implementation.

The results shown after the curriculum implementation; all core teaching conceptions that support inquiry rose up. The strongest belief about the limited learning ability of the students change by decreasing from 91.30 % to 21.74% and their belief of the expanding learning ability increased from 4.35% to 69.57 %.

Conclusion and discussion

The results of understanding of inquiry showed that the ESRU-guides inquiry-based curriculum can change the participants' understanding about inquiry from facts and knowledge based to be more process-based. In conclusion, before the implementation

participants did not understand the various types of inquiry; therefore, they could not make a clear definition to state their understanding of inquiry. This finding supports the work of Demir & Abell (2010) that the teachers held incomplete views of inquiry-based teaching. Moreover, the study of Crawford; et.al. (2005) shows that even the teachers with research experience failed to understand the diverse method of inquiry used by scientists. The incomplete view of participants understanding of inquiry before the curriculum implementation implied the same result as the work of Crawford.

The participants' lesson plans showed that pre-service science teachers will face the problems in practicing inquiry in the actual classroom. With the same result of the study by Demir & Abell (2010) which revealed that the teachers not just could not explicitly explain a clear understanding of inquiry-based teaching, but also they could not demonstrate inquiry-based teaching practices consistent with NRC (2000). Also Apedoe (2008) presented that undergraduate students could not do well in inquiry without supporting and guiding.

The core teaching conceptions as shown in the results showed that most of the participants hold the set of belief that does not support practicing inquiry before the curriculum implementation; however, after the curriculum implementation this belief changed from thinking of students as a limited learning ability to expandable learning ability. This will be the key factor of practicing more inquiry in the classroom with young students when the teachers think the students are ready. Lotter; Harwood & Bonner (2007) suggested for the successful inquiry professional development that the program must not only teach inquiry knowledge, but it must also assess and address teachers' core teaching conceptions, then find the way to adjust them properly into the set of core teaching conceptions that support inquiry.

Recommendations

The results from this study implied that pre-service science teachers need a clear understanding of inquiry which plays the important role to pre-service science teachers' core teaching conceptions. The proper time for practicing needs to be provided and the close attention by the experienced supporter is important for practicing inquiry. The core teaching conceptions of the pre-service science teachers need to be addressed and informed; therefore, the pre-service science teachers' core teaching conceptions could be more inquiry supported.

This study designed the guided inquiry-based, which is considered the middle level of inquiry. For further research, there should be studies on:

The survey of the obstacles during teaching experience should be studied to find the way to support pre-service science teachers.

The study of the relationship between school policy and the effects on decision making to chose the teaching method in science teachers should be examined.

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