Instructional Strategies of Teachers in Small-sized Schools to Develop Students' Science Competencies through Professional Learning Community

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Abstract
The present study aimed to develop the strategy for instructional of teachers in small-sized schools. The objectives of this study were to enhance learners' scientific competencies through a professional learning community and to synthesize teachers' strategy regarding instructional. The practical action research methodology was implemented as the framework of this study. The scope of this research was within schools under the Bureau of Educational Area for the primary level in Phetchabun Province. The pilot study was conducted at four schools located in the research area. The participants comprised four school directors, eight science teachers, and ten students. In the research operational phrase, two schools in the research area were selected. The participants included two school directors, six science teachers, and thirty students. The research instruments consisted of an in-depth questionnaire, an observation form of teachers' instructional and an observation form of students' learning performance and content analysis.This research study found that 1) there were improvements of teachers from small-sized schools in their instructional to develop students' scientific competencies in terms of the language aspect, activity engagement, and social participation 2) the instructional strategies to develop students' scientific competencies consisted of three sets, including inquiry method strategy, stimulating thought strategy and situations in daily life strategy.

Keywords: Instructional Strategies, Scientific Competencies, Professional Learning Community

Introduction

Teachers are one of the most essential resources to the development of educational quality standards. According to the present and future education reform approach, teachers play a crucial part in equipping children and youth of the nation to attain the goal of being a learning person as stated by the National Education Act**.** National Year 1999 and the amendment (No. 2) 2002, which provides that "the Ministry of Education promote the improvement in quantity and quality of teachers, faculties and educational personnel, suitable for the noblest profession"

Scientific Literacy is the ability to identify and evaluate arguments in daily lives based on the scientific concepts and processes whether the arguments are acceptable or not. Scientific Literacy is important to life in the 21st century as it enables people to understand social issues that science is involved in, so that great science-based decisions are achieved.

The components of the assessment of scientific knowledge include 1) the context of science 2) scientific knowledge 3) attitude and 4) scientific competencies which are divided into three competencies: explaining phenomena scientifically, assessing and designing the process of scientific knowledge acquisition, and interpreting data and testimony in science (OECD, 2016). According to the results of the PISA scientific assessment, it found that the scientific literacy of Thai students between PISA 2000 and PISA 2015 was still below the OECD average of 501 points (National PISA Operations Center, Institute for the Promotion of Teaching Science and Technology, 2016). It suggests that science teachers are required to adjust their teaching methods, especially teachers in small-sized schools which are an educational institution with fewer than 120 students.

As reported by the Office of the Basic Education Commission, small-sized schools with fewer than 120 children accounted for 15,000 or 50 percent of the total number of schools in 2017. Their major problems arose from a shortage of specialized teachers and an insufficiency of the number of teachers to fill classrooms, which caused the problem of teaching management including an insufficiency of time to prepare well-planned lessons since some time were needed to allocate to other school works. Consequently, most teachers focused on lectures and used less innovative teaching materials, lacked interactions with colleagues who taught in the same courses. Similarly, they also had no training time that allowed students to find and build their own knowledge from a variety of sources. These made teaching contents and practices irrelevant to real-life activities (Office of the Education Council, 2008).

Having considered the issues related to teacher development and instruction in the 21st century, it is found that the crucial concept in teacher development is to create a professional learning community emphasizing on teacher learning. It acts as a change agent to share teaching experiences gained from both inside and outside the classroom and to foster collaborative learning among teachers as a means for them to take part in change processes (DuFour, R., DuFour, R., Eaker, R. & Many, T., 2006; Khammanee T., 2014; Panich V., 2012).

Methodology

This research aims to develop instructional strategies of teachers in small-sized schools to acquire scientific competencies of students through a professional learning community and to synthesize a teacher's instructional strategies. The scope of the study is schools under the Office of the Primary Educational Service Area in Phetchabun province. The study is conducted by using the practical action research.

Prior to entering the practical action research cycle, the principles of building a professional learning community is used to find a group of teachers who have the common intentions and goals to develop their own practice and to create a common practice agreement. There are four schools in the research scope. The research participants comprise of four school administrators, eight science teachers and ten students. At this stage, the researcher performs 3 main steps: 1) raising mutual awareness which is the need for collaborative efforts to improve students' learning, 2) surveying current situation to explore instructional practices for improving scientific competencies of co-research teachers and characteristics of the school's professional learning community, and 3) choosing a instructional approach that can be developed together among the participants in this research. The research instruments are in-depth interviews, observations about manners of teachers' instructional and student learning, and workshop training manual.

The phase of the practical action research cycle which includes two schools as the research scope, and two school administrators, six science teachers and thirty students as research participants. To achieve the aim of scientific competencies advancement, there are four primary steps which are 1) planning: teachers reflect on their thoughts about the link between their own learning and students' learning for scientific competency development based on their experience and perception. It is important to apply knowledge acquired from the workshop to obtain a meaning and approach of instructional, to brainstorm about instructional to build a solid understanding, and to compile practice methods by applying a comprehensive understanding of instructional into planning guidelines and activities, 2) acting: teachers organize learning in real situations and do various activities together, 3) observing: the researcher and teacher participants take the role of an observer of the teacher's instructional and activities to revamp it, and 4) reflecting: teacher participants reflect on their own learning and student participants reflect on teachers' instructional to evaluate the teacher's instructional results and to lead to planning in the next phrase by using two research instruments; reflective models according to the operational research cycle, and behavior observation learning forms to improve teacher scientific competency and student learning behavior.

Following to the new cooperatively revised plan, teachers repeatedly perform the cycle until the end of the research process. The research participants play roles at every stage of the research in each cycle regardless of the fact that researchers adhere to the idea of either Kemmis & McTaggart (Kemmis & McTaggart, 1988) which states that operational research requires changes in three areas, languages, activities and social relations. The changes are not able to be done separately. Criteria for completing the research process are: 1) teachers have significant changes in instructional behavior and have ability in instructional to develop students' science competencies in accordance with school contexts, 2) teachers agree that the

instructional process is satisfied, and 3) students adjust their learning behavior according to a common goal. Achieving all, it therefore considers the end of the research process.

At the end of the practical action research, the researcher withdraws from the area and allow the participants to continue the cycle of the research. During the time the researcher is in the area, the researcher turns themselves into an assistant who provide help and guidance for teachers' needs, and also synthesize information.

Research Findings

After the end of the reflection of the second cycle, the researcher and the participants including administrators and teachers discussed the changes in the behavioral learning of teachers in small-sized schools to develop scientific competencies of the students to evaluate whether the research objective was achieved or not. The mutual agreements were that 1) teachers underwent a behavioral change in instructional to develop scientific competencies in languages, activities and social relationships at both the individual and group level, and also enable to instructional in accordance with the context of a small-sized school, 2) teachers were satisfied with the implement of the instructional process, and 3) students experienced changes in learning behavior, scientific competencies and learning happiness which contribute to better academic achievement. Furthermore, learning behavior of teachers in small-sized school to improve learner's scientific competency enabled teachers to improve in thought-provoking skills by asking questions, communication skills, instructional skills, and a perspective of students' learning together with pride in their own abilities. With regards to the changes in the schools, it found that two professional learning communities were established which are an informal community of teachers and a community of teachers that they can have meetings regularly. The participants therefore agreed that the research objective was achieved. To visualize the changes, the researcher summarized the changes in instructional behavior of teachers in small-sized schools to improve students' scientific competencies in language, activity, and social relationships that take place throughout the research process in each cycle and the effects on students shown as in Table 1.

Research cycle	Changes in learning behavior of teachers in small-sized schools to develop student scientific competencies.	Outcomes on students
A period before entering the research cycle	**1. Languages** 1.1 teaching according to a manual or a finished textbook 1.2 studying the indicators in a curriculum and study a content understandably 1.3 inquiring for teachers in learning management 1.4 evaluating students' learning outcomes at the end of the semester **2. Activities** 2.1 preparing before organizing learning - studying the indicators in the course - preparing a instructional plan from a manual or a ready-made textbook. 2.2 learning activities to develop the scientific competency of students - assigning students to work in groups - emphasizing on the joint learning summary 2.3 using quizzes to evaluate students **3. Social relations** 3.1 relationships that support teachers' instructional practices - role relationships - interdependent relationships 3.2 relationships that reflect the characteristics of a professional learning community - informal exchanging information - pursuing the common goals	**Learning behavior** 1. lacking the interest in learning 2. lacking enthusiasm for studying 3. lacking effort in learning **Scientific competency** 1. lacking understanding of the nature of science. 2. being unable to identify a problem that can be scientifically verified. 3. being unable to identify the source of the problem. 4. being unable to interpret the evidence of testimony
The phase of action in the operational research cycle	**1. Language changes** 1.1 understanding of scientific competencies - students can identify problems that can be scientifically examined by themselves. - students can create a body of knowledge by themselves. - using discussions and expressing opinion - applying scientific knowledge to create explanations 1.2 Understanding instructional to develop scientific competencies	**Learning behavior** 1. having eager to study 2. good preparing to present their own works or pieces 3. developing teamwork skills 4. acquiring problem solving skills **Scientific competency** 1. Showing a greater understanding of the nature of science 2. Being able to

Research cycle	Changes in learning behavior of teachers in small-sized schools to develop student scientific competencies.	Outcomes on students
	- understanding teaching process by means of scientific inquiry - understanding the role of teachers in instructional for developing scientific competencies - organizing self-inspection activities for students to investigate - organizing discussion and sharing-opinion activities - highlighting on the process of searching for and acquiring knowledge 1.3 Feelings to instructional to develop scientific competencies - gaining satisfaction with learning management 1.4 Languages used in instructional - Focusing on understanding the role of students in learning. - Asking open-ended questions - expressing relationship Closeness with Students - Guiding learning for students **2. Activity changes** 2.1 Preparing to teach - learning the indicators of the Science Competency Link course in detail - Designing a instructional for students to explore and examine themselves. 2.2 Learning activities to develop the scientific competency of learners - Using daily-life situations to encourage students to think and design their learning to build their own knowledge. - Using thought-provoking questions - Arranging activities for students to identify issues and present their ideas - Arranging activities for students to connect scientific knowledge with real life 2.3 Evaluate learning outcomes - making authentic assessment - Evaluating workpieces **3. Social relation changes** **3.1 Relationships that affect the practice of teachers learning**	identify problems that can be scientifically verified by themselves 3. Evaluating and designing the process of scientific knowledge acquisition on their own 4. Interpreting the meaning from the testimony. **Learning happiness** 1. Having more fun and happiness with studying 2. Having more interactive conversations between teachers and students

Research cycle	Changes in learning behavior of teachers in small-sized schools to develop student scientific competencies.	Outcomes on students
	1) Relationship between the administrators and the teachers - the administrators observed teacher's teaching. - the administrators inquired about the development of teacher competencies in the science of learning. - the administrators inquired about problems and obstacles in the work. - the administrators and teachers had a more casual relationship 2) Relationship between the participants and the researcher - the participants and the researcher had a more casual relationship - the participants consulted the researcher one-on-one in informal ways **3.2 Relationships that reflect the characteristics of a professional learning community.** 1) the informal community - discussing about instructional practices to develop learners' scientific competencies. - Listening to the problem and helping solve it - Sharing experiences and knowledge about learning with other teachers 2) the community of teachers that they can have meetings regularly. - consulting about writing a learning management plan. - arranging an appointment for presenting the instructional plan to exchange ideas. - observing teaching one another 3) Communities of teachers between both schools - exchanging ideas through both LINE and Facebook groups. - discussing about instructional and general matters - Using words that show friendliness rather than comparison or competition. 4) Supporting the learning community - The researcher inquired about the	

Research cycle	Changes in learning behavior of teachers in small-sized schools to develop student scientific competencies.	Outcomes on students
	teacher instructional through Line groups. - Reducing the unnecessary workload of co-research teachers **4. Other changes** - Having a good perspective on students' learning - Feeling proud of ability development	

Table 1. summarizes the changes in instructional behavior of teachers in small-sized schools to develop learner's scientific competencies and outcomes on students.

According to the data synthesis of the changes in instructional behavior of teachers in small-sized schools to develop scientific competencies of students in the two schools, the researcher proposes three instructional strategies of teachers to develop students' scientific competencies; 1) questing for knowledge strategies: teachers must study the details of the indicators in the science competency link course, design a instructional that focuses on students to search, survey, and validate knowledge by themselves by using everyday situation to encourage students to think and design activities, and arrange activities that allow students to identify issues, to connect scientific knowledge with real life, and to present their ideas, 2) thought-provoking strategies: teachers must use questions to stimulate students' interest. This helps strengthen their thinking ability by practicing thinking for answers and reasoning and educating themselves, and 3) daily-life-situation strategies: teachers must create situations related to daily life at individual, local, national and global levels.

Conclusions and Discussions

The research found the changes in teachers' instructional behavior to develop the original learner's scientific competency towards learning management suitable for the school contexts. The changes took place in three main areas, languages, activities and social relations. Moreover, professional Learning Communities were set up inside the schools. According to the results of the data synthesis, the researcher proposed three instructional strategies of teachers to develop students' scientific competencies which were questing for knowledge strategies, thought-provoking strategies, and daily-life-situation strategies. The professional learning communities are operated under the participation of the school administrators, the teachers, the students and the researcher including those involved in teachers' instructional. This offered opportunities for school administrators and teachers to perceive what happens in current practices at the individual and group level. This also brought about more rational and sustainable problem solving or practice improvement in agreement with the concept of Sergiovanni (Sergiovanni, 1994) which mentions that a professional learning community is a place for "interactions" to reduce the "isolation" of school teachers to improve student performance or school's academic works. Hence, a professional learning community to develop instructional is one of the methods that stimulates teachers to change, and is essential for learning in the 21st century (Darling-Hammond; et al. 1999: 93; Leiberman, 2000: 225).

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