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Reflective Coaching for the Development of Pedagogical Content Knowledge of Biology Teachers in Thailand

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Abstract

This research aims to determine the effects of reflective coaching on developing pedagogical content knowledge (PCK) of biology teachers regarding cell biology. The research used qualitative research conducted with four participants to gain deeper insights into the topic rather than the broad consensus. The instruments used in the research consisted of teaching observation records, reflective coaching record forms, and Pedagogical Content Knowledge (PCK) tests. In addition, PCK questionnaires and interviews were subjected to content analysis with analytic induction were used to for data triangulation. The research results have commonly patterned that the level of PCK changed after reflective coaching but did not change every element of PCK. The participants still had limited knowledge of teaching methods in cell biology content. Differences were observed in each element of PCK, including information helping to support that science teacher professional development that should focus on promoting PCK. In summary, the participants could develop PCK in cell biology content with different reflection algorithms and methods as the experience and prior knowledge of individual case studies are different. The need for self-development in each element of PCK also differs. This may require various methods, such as self-reflection of the problem, self-assessment, and learning notes. Knowledge from this study can be applied in solving problems of individual teachers and benefit the teaching profession's development .

Keywords: professional development, pedagogical content knowledge, reflective coaching

Introduction

Education involves teachers helping students achieve learning results. Teachers can pursue knowledge with their students. Science teaching and learning must be aligned with the student context. The differences between the people have various factors that teachers need to be aware of to be used in their teaching (Nuangchalerm, 2015). In addition, learning outcomes should be assessed appropriately according to the curriculum standards. Although teachers can be very knowledgeable in science content and know about organizing the learning process, using various teaching methods, problems still happen in implementing a learning process appropriate for the content according to the curriculum standards (IPTST, 2012) because

teachers may not be able to align the teaching methods with the content. Thus, teachers can utilize the Pedagogical Content Knowledge (PCK) in integrating content knowledge and teaching methods that lead to action and presentation of a topic to be understood by students of different abilities (Shulman, 1986). PCK also serves as a conceptual framework to produce a curriculum, featured through teaching experience (Gess - Newsome & Lederman, 2002).

In this regard, developing the science teaching profession in Thailand involves training in-service teacher extensively to understand the curriculum. Teaching activity techniques should emphasize students to take action according to the educational reform guidelines (Office of the National Education Commission, 2003), including types of training and workshop by experts needing to be designed with activities for teachers to follow. However, some evidence showed that the training format is insufficient in its duration and can be costly, and sometimes does not guarantee long-term success. Also, the training topics do not meet the needs of the teacher. At the same time, the training does not link to the actual teaching practice, thus unable to help teachers continuously (Chartisathian, 2014). The appropriate way to help science teachers in classroom problem solving is by developing the teacher's knowledge and encouraging science teachers to exchange knowledge experience among teachers (Office of Research and Educational Development, 2016). Accordingly, developing trainings that meet teachers' needs while linking them to the actual teaching practice will enhance the teachers' experience and peer teacher's interaction and overcoming children's learning problems on a group or individual basis. A system is needed to guide inexperienced science teachers, using a network to establish coordination and cooperation as the desired culture. Many trainings are not successful because in-service teachers have different experiences. Coaching is then useful in responding to the problems of teachers who have different needs.

Coaching involves peer coaching, intellectual coaching, and reflective coaching (Beach & Reinhartz, 2000). Reflective coaching can help individuals consider their ability to seek help and support. It is to assist individuals in applying knowledge to work and to develop their abilities. Teachers with experience in the classroom should use reflective coaching to review the ideas from their work. It leads to a greater awareness of their limitations and investigating ways to improve themselves (Denton &Hasbrouck, 2009). Scholarly research revealed that reflection is an effective means for coaching, improving teachers' understanding, and visualizing the use and practice (Kovacs & Corrie, 2017). Applying the reflection method in the teaching profession enables teachers to develop new skills and derive new perspectives and paradigms, becoming a learned person self. Sharing knowledge, using the reflection as a regular practice helps the persons understand better both in terms of beliefs about teaching and learning and knowledge about teaching and learning approaches (Ladachart, 2018). All these techniques can be used to develop the PCK of the teachers themselves.

PCK is the problem of science teachers in Thailand. Teachers cannot integrate content knowledge and teaching knowledge. Reflective coaching can help teachers improve their PCK by themselves. Considering the importance of PCK and the growing needs of reflective coaching contributed to the development of teachers, the researcher is interested in studying PCK and developing the potential use of reflective coaching as a guideline for the professional development of biology teachers.

Literature Review

Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge is the integration of knowledge in the subject matter of learning and knowledge of teaching strategies of teachers in organizing learning activities for students to understand the subject matter. The teachers can modify the format of the content to use in organizing activities for students to learn correctly. PCK is used to teach mathematics, science, physics, chemistry, and biology. Shulman (1986) presents the concept of PCK as an element of a knowledge-based approach for teaching and learning. Shulman's concept of PCK include: 1) knowledge of specific content and teaching strategies; and 2) understanding of learning problems and students' concepts in specific content. Grossman (1990) focused on the value of content knowledge in curriculum development and organized the composition of a teachers' knowledge-based approach using three important components combined with being PCK consisting of specific knowledge in subjects, general knowledge about teaching, and contexts such as teachers and school. Magnusson et al. (1999) presented the elements of the PCK in science that included 1) orientation of teaching science; 2) the knowledge of students' understanding of science ;3) the knowledge of science curricula; 4) the knowledge of assessment; and 5) the knowledge of instructional strategies. From the above elements, beliefs in science teaching may affect the teaching and learning of teachers. Veal and MaKinster (1999) has divided PCK into three levels; namely, 1) subject-specific, 2) domain-specific, and 3) topic-specific whereby in each level would be in a specific, descending order; however, knowledgeable teachers needed to adapt PCK methods to be suitable for their students and their contexts.

Reflective Coaching

Dewey (1933 cited in Rodgers, 2002) stated that reflection and reflective practice are thought to be considered in a particular way using the concept of reflection and the careful rationality thinking and consideration for the knowledge-based approach. Reflective coaching leads to a process moving learners from one experience to another with a deeper understanding. It involves a systematic way of thinking that needs to occur in the community through interaction with others, which values one's own and others' growth. Schon (1983) extended Dewey's reflection on the concept of reflection as used in practice, i.e., the knowledge of the action involves looking at the reflection as a concept that believes that all human beings can accomplish anything based on inherent knowledge. Passmore (2011) explained reflection and reflection practice. Therefore, it could be concluded that reflection practice supports the development of coaching knowledge and is considered important for self-management. The concepts of reflection and reflective practice mentioned above can be applied in the form of reflective coaching. This type of coaching can be summarized as described below to guide individuals and reflect on their abilities. Reflective coaching can be an alternative to the professional development of science teachers, improve the knowledge of science teachers because of the basics of being a scientific method with reflective thinking and reasoning.

Applying the above concepts of reflection in reflective coaching guides the person to reflect on one's abilities to assist individuals in applying knowledge to their work and developing their abilities. Guiding reflection is not teaching new concepts and applied as

appropriate can be considered reflective coaching as a new way of supervisory innovation recognized by scholars. The continuous development of teachers' focus involves using questions to encourage thinking. The supervisor plays an advocacy role in helping the supervisor to deal with work problems by focusing on the student's participation through activities.

Definitions of Terms in this research

Pedagogical Content Knowledge means knowledge that arises from the integration of knowledge in the subject matter of biology courses related to cell biology and the knowledge of teaching strategies of the teachers in the biology course used in organizing the learning activities for the students to understand the contents of the biology course related to cell biology. The biology course teachers can modify the format of the content to be used in organizing activities for students to learn correctly. This research used PCK according to the conceptual framework of Magnusson et al. (1999) and Veal and Makinster (1999), there are five elements of PCK as follows:

1. Teaching orientation: science teachers' knowledge of orientations to teaching science. Relates to the teacher's beliefs in the biology course regarding cell biology. Teaching styles of biology teachers such as didactic, active direct, guided inquiry, and open inquiry.
2. Students' understanding of scientific concepts: science teachers' knowledge of students' thinking about science. The knowledge of biology teachers involves understanding the biology of students to teachers analyze students about misconceptions and concepts that students have access to the content of cell biology to develop teachers' teaching and learning management.
3. Teaching strategies: science teachers' knowledge of instructional strategies in science is the knowledge of the biology teachers with regard to teaching and learning. Corresponding to the teaching of science and teaching styles for each topic of cell biology content. Focus on teaching in the form of scientific inquiry.
4. Curriculum: science teachers' knowledge of science curriculum is the knowledge of the biology teachers about the course containing knowledge of goals and objectives for students on the topic subject to cell biology and knowledge of programs, courses, and teaching materials relevant to teaching on specific topics including cell structure and function, cell transport, cell division, and cellular respiration.
5. Evaluation: science teachers' knowledge regarding the assessment of students' science learning is the knowledge of biology teachers about the evaluation of the scientific learning of the student's knowledge of biology teacher in the measurement and evaluation of learning of students regarding cell biology. Focus on studying authentic assessments, formative, and summative assessments.

Research Methodology

The purpose of this qualitative research is to describe the phenomenological impact of reflective coaching based on participants' collective insights that emphasized the development

of biology teachers' PCK related to cell biology content. The research design for this study is descriptive and interpretive the participants were analyzed through a qualitative method. PCK tests, interviews, classroom observation, and video recordings of classes were used to collect qualitative data.

Data were collected by PCK test-taking, observing and interviewing over one month period. PCK data gathering method consisted of observation, interview, video recording of teaching the class, and associating material such as learning management plan.

Data Collection

The researched used the following the steps to collect the data.

1. Collected the basic information of each the participants such as age, sex, education, teaching experience, and teaching material.

2. Made an appointment with the participants to confer and exchange ideas regarding science teaching, the content of cell biology and reflective coaching them and PCK-testing such as teaching orientation, student's understanding of scientific concepts, teaching strategies, curriculum and evaluation.

3. Conducted a meeting with the participants to discuss about self-reflection, carried out reflective coaching session, consisting of the following step.

Step 1: Reflection on one's problems. Reflection on their problem to reconsider their problems, then the author observed the participants class, teaching and class' atmosphere and video record the observation using unstructured observation form after each class. The author conducts an individual semi-structured interview with each the participants regarding PCK in cell biology lasting 30 minutes and records the interview.

Step 2: Reflection from the point of view of the participants through the self-reflective coaching process. Then, the author showed the participants the records of their teaching to reflect on the problem during their classes. Then, they self-evaluated their performance, the author transcribed teaching videos and interviewed for more data based on the point of view of the participants for additional reconsideration.

Step 3: Self-assessments. Self-evaluation process. The participants reflected on their action and the author supervised each the participants using the record form, focusing on finding efficient answers by themselves. Then the participants self-evaluated and recorded their learning.

Step 4: Reflection on learning notes. The participants recorded their newly found knowledge to track the progress of reflective coaching. The participants recorded their learning following the results of their self-reflection. The participants recorded the knowledge they gained from reflecting on their present teaching, finding out their weaknesses, and improving their PCK. They tracked their reflection associated with PCK, and then summarized their individual reflective coaching results.

4. The participants took the PCK assessment test and interviewed by the researcher about PCK to estimate and check their PCK progress.

Data Analysis

The researcher conducted content analysis using analytic induction and data using the

following process .

1. Analyzed the content of reflection of the participants with data from PCK assessment test, PCK questionnaires, PCK interview form, Reflective coaching record form, Teaching observation form, and transcription of audio record of interviews and the participants' own reflection.

2. Developed a criteria to analyze and evaluate PCK data by dividing PCK into levels according to the observation of the participants teaching, interview and reflective coaching. Then the researcher compared the pre and post-reflection knowledge into high level (H), Moderate level (M) and low level (L) on each composition is presented on Table 1.

Table 1

The level of knowledge in each element of PCK

Pedagogical Content Knowledge	level of Pedagogical Content Knowledge	Behaviors demonstrated knowledge level
Teaching orientation	High knowledge (H)	Biology teachers are teaching with open inquiry and guided inquiry.
	Moderate knowledge (M)	Biology teachers are teaching with active direct.
	Low knowledge (L)	Biology teachers are teaching with didactic.
Students' understanding of scientific concepts	High knowledge (H)	Biology teachers to focus on students' prior knowledge can analyze the misconceptions of the students and the students who have difficulty in accessing the content of cell biology and can be used to develop the teaching and learning of biology teachers.
	Moderate knowledge (M)	Biology teachers to focus on students' prior knowledge can analyze the misconceptions of the students and the students who have difficulty in accessing the content of cell biology but does not lead to the development of teaching and learning management.
	Low knowledge (L)	Biology teacher does the focus is on students' prior knowledge can not be analyzed on misconceptions of students and concepts that students have access to the content in cell biology.

Table 1 (continued)

The level of knowledge in each element of PCK

Teaching strategies	High knowledge (H)	Biology teachers have organized teaching and learning focused on scientific inquiry and student-centered emphasis all topics of cell biology content.
	Moderate knowledge (M)	Biology teachers have organized teaching and learning focused on scientific inquiry and student-centered emphasis on certain topics in cell biology content.
	Low knowledge (L)	Biology teachers do not offer a scientific inquiry based teaching and focus on teachers.
Curriculum	High knowledge (H)	Biology teachers can tailor the curriculum to the context of the student and can use relevant teaching materials on a particular topic is appropriate.
	Moderate knowledge (M)	Biology teachers can also modify the curriculum in line with the context of students in some content.
	Low knowledge (L)	Biology teacher teaches according to the textbook. The use of the curriculum cannot be tailored to the context of the student.
Evaluation	High knowledge (H)	Biology teachers measure learning outcome. Focus on authentic assessments, formative, and summative assessments.
	Moderate knowledge (M)	Biology teachers measure learning outcome. Focus on formative and summative assessments.
	Low knowledge (L)	Biology teachers measure learning outcome. Focus on summative assessments only.

3. Recorded the data of each reflective coaching process from observation and interviews were examined PCK using the analysis table of PCK of the participants.

4. Interpreted the PCK of the participants on each category and summarized the PCK of the participants using analytic induction focus on understanding interaction of PCK.

5. Triangulation was performed using data triangulation that included data and method triangulation, by taking the PCK assessment test, PCK questionnaire, PCK interviewing form and study document about learning management plan, transcribed video recording of teaching observation and audio records of interviews. After the researcher examined the PCK of the participants, multiple investigator triangulation was brought to the researcher'ss advisor to verify the accuracy and validity of the content analysis and interpreted the PCK of the participants.

Results

The results of the reflective coaching for participants of four subjects, including Suda, Wipa, Pimjai, and Nucha, is presented on Table 2.

Table 2

Results of Reflective coaching to the development of the PCK of the participants.

Results information	Teaching orientation			Students' understanding of scientific concepts			Teaching strategies			Curriculum			Evaluation		
Level	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
Suda															
Before coaching			/		/				/			/			/
Reflection on one's problems		/		/				/				/		/	
Reflection on one's perspective	/			/			/				/		/		
Self-assessment	/			/			/				/		/		
Reflection on learning notes	/			/			/				/		/		
Conclusion	High			High			High			Moderate			High		
Wipa															
Before coaching			/		/				/		/			/	
Reflection on one's problems		/			/			/			/			/	
Reflection on one's perspective		/			/			/		/				/	
Self-assessment		/			/			/		/			/		
Reflection on learning notes	/				/		/			/			/		
Conclusion	Moderate			Moderate			Moderate			High			Moderate		
Pimjai															
Before coaching			/		/				/			/			/
Reflection on one's problems			/		/				/			/		/	
Reflection on one's perspective		/			/				/			/	/		
Self-assessment		/			/			/				/	/		
Reflection on learning notes		/			/			/				/	/		
Conclusion	Moderate			Moderate			Low			Low			High		
Nucha															
Before coaching			/		/				/			/			/
Reflection on one's problems			/		/			/				/			/
Reflection on one's perspective		/		/				/			/		/		
Self-assessment	/			/				/			/		/		
Reflection on learning notes	/			/			/				/		/		
Conclusion	High			High			Moderate			Moderate			High		

H = high level: M = Moderate knowledge: L = lower level

The findings from Table 2 are described below.

1. SUDA has an open mind to change found that the self-assessment coaching helped her to target and understand the situation concerning the teaching of cell biology content. Coaching was aimed to best expand knowledge regarding oneself. Able to make her see the

problems in teaching and learning and to develop a knowledge content integration method that was very quick and she learned how to upgrade enriched content such as teaching orientation. As a result, the students improved their understanding of scientific concepts and the assessment of learning outcomes.

2. WIPA did not change much concerning PCK in cell biology content, possibly due to the context, such as workloads other than teaching work. As a result, she experienced a change in PCK at a Moderate level. Coaching with Wipa, unlike other case subjects, involved coaching to create new techniques, such as storytelling because she is a teacher with a lot of teaching experience. She graduated directly in education coaching to understand the problem of her teaching and learning management. Self-assessments based on their practice made them more aware of the teaching of cell biology content. As a result, she changed PCK, especially the curriculum, more than any other case subject.

3. NUCHA had little experience but having a background in education and never having attended the training on learning in biology courses, found that coaching using self-assessment and written records reflects the idea, and this caused a problem in stimulating the learning needs and interests of their own to realize the benefits and the goal of teaching the content of cell biology. Also, because she had a misunderstanding of the subject matter related to cell biology. She was coached to locate more knowledge from new sources such as research-related article, and this added on her discovery of new knowledge related to cells on the Internet and in textbooks to nurture new knowledge or add information. As a result, she gained a deeper understanding of the subject matter and developed PCK by herself. Also, she achieved a high-level knowledge of teaching orientation, a better understanding of scientific concepts, and how to best evaluate student learning in science.

4. PIMJAI did not have a pedagogical basis, as a biology graduate, it was found that she was able to use her knowledge of the subject's content about cells to her students accurately. She demonstrated expertise in the subject matter rather than teaching strategies based on teaching experience and training in teaching biology; this allowed her to learn more about teaching biology and managing the learning process. Coaching with Pimjai involved reflective thinking and being able to bring out the greatest potential of oneself. She started with self-assessment, personality traits, and personal preferences and then used them to manage her teaching; this also included suggesting that she join a group of fellow teachers to exchange ideas and apply the scientific inquiry teaching method to manage cell biology content better.

Discussion

Reflective coaching results can help the participants reflect on what they are doing. Although the coaching process is the same , the methods of coaching should differ from person to person. Each person knows which methods of teaching cell biology content would be most suitable to make the participants' self-development more effective. The results of the research are discussed as follows.

The results of the reflective suggested on a case-by-case basis was used by the researcher to develop the participants. It consisted of a self–reflective using self–observation and self–assessment; this allowed for a detailed recording of learning activities. The elements of learning management in cell biology were completed using the four steps of the reflection

process, i.e., reflecting on one's problems, reflecting on one's perspective, self-assessment and reflecting on the learning notes.

Although the all the four participants' ability were developed, the PCK in the cell biology content was the same. However, not all the participants could understand and develop PCK regarding the cell biology content of the five elements to achieve a high level of knowledge. Therefore, it would be imperative that reflective coaching would be appropriate for subjects by guiding each one to address problems and obstacles related to each individual. The biological content of cells was consistent with the research conducted by the educator (Kuklick et al., 2015), reporting that reflection could cause a greater understanding of one's flaws than develop oneself with the support of peer teachers. One observation influenced reflective coaching, and case subjects differed for each person due to their different prior experiences and knowledge. Suda, Wipa, and Nucha, who were graduates from the Faculty of Education, could proceed directly with basic knowledge of teaching and learning management. This fact created changes in PCK concerning cell biology content rather than thinking at the end of science that focused on the subject matter more. These subjects showed that the individual could develop content knowledge, teaching oneself how to merge the contents of cell biology in the process of guiding a reflection of differences as described below.

Suda is an education graduate and obtained the basic knowledge of teaching and design of learning activities and trained in biology teaching. She also has more than ten years of teaching experience and she could readily transform the teaching and learning of the cell biology content and cooperate well with the researcher. Being teacher-centered was seen as a hindrance to students' learning, so the organization of activities was changed to involve students. In the reflective coaching phase, she rethought the students' problems related to cell biology content by reflecting on the self-assessment. It led to the further development of the PCK in cell biology content; this may have been due to visualizing one's teaching from the video. Therefore, she found problems arising with their teaching and recognized the importance and need to resolve problems to clarify them. For Suda, this meant the introduction and promotion of self-transformation.

Wipa is a teacher with more than ten years of teaching experience. Reflective coaching may not have greatly altered the development of her PCK; this may have been caused by the context that affected personal development. She left a message on her learning note "…I want less work other than teaching. It could be made more systematic…" (from the learning note; 17 February 2019). She understood the process of teaching might have been due to direct education. She may have remembered the pictures of the teachers who had taught her during her university years. However, when she was introduced to organized teaching and learning to allow more students to practice independently, she found that she could change the PCK in the curriculum to create a higher level of knowledge. The coaching made Wipa understand her problems by reflecting on her self-assessment through dialog and being encouraged to develop herself more; this made it possible for her to learn and redesign teaching by herself.

Nucha had less teaching experience than other the participants, which made her worry about managing teaching and learning. After coaching, she found that a change of the PCK, and teaching strategies from the past that were mainly taught as lectures. Then she reflected on herself and adjusted her teaching style using technology in organizing activities in which students could learn by themselves. Having experienced PCK, Nucha's teaching methods were

soon more developed. In addition, she used technology in teaching and evaluated student learning outcomes. She found that the self-evaluation and written records reflection could change her PCK regarding cell biology. She said "…when creating the event. Then I could use it to make the children enjoy learning. I was able to bring technology to be used in teaching. I thought that active teaching-learning was difficult ... but when I understood teaching and learning could be a form of scientific inquiry then my teaching became more student-centered" (learning notes; 17 February 2020).

Pimjai is a teacher who did not graduate with an education degree; this made her spend more time reviewing information about science and learning how to teach it. Writing a learning note, it allowed her to reflect on her teaching the cell biology content. The reflection on leaning note provided knowledge on how to evaluate the learning outcome and changed her teaching method. As for Pimjai, the learning reflection resulted in changes to her teaching of cell biology. Adopting technology in her teaching helped students to achieve learning outcomes. In addition, reflecting on her experiences more than reflecting on her problems allowed her to review her thoughts and knowledge about the events that happened in teaching. Also, writing a learning note is like recording events and problems that occurred, which allowed her to recognize their problems and mistakes in teaching cell biology content. It also made her more aware of her strengths that strengthened her teaching of the cell biology content.

The findings from research indicated that self-reflection while practicing teaching from the video and then self-evaluating are suitable for teachers with teaching experience such as Suda and Wipa, who had more than ten years of teaching experience in biology and have completed teaching training. They viewed themselves in action and then reviewed the problems that arose from what they have taught and these can lead to self-change. Instructors often fail to develop their full potential and improve their teaching-learning process (Lloyd & Modlin, 2012). Building a relationship between experiential learning and knowledge transfer can enable instructors to gain more effective expertise to improve their teaching quality (Wong & Nicotera, 2003; Hart, 2011). Self-reflection allows teachers to develop more experience that meets the diverse needs and long-term interests of teachers (Huston & Weaver, 2008). As a result, the four case subjects were able to develop themselves and upgrade their level of knowledge of PCK regarding the biology content. All four case subjects were able to develop themselves effectively and develop PCK through reflecting and practicing. Considering carefully the teaching-learning process, using mindfulness and concentration enabled the subjects to review and reflect on their actions (Johns, 2000) expressed in both speech and writing. Gaining understanding and learning from experience, using reason could lead to self-improvement and greater work efficiency.

Also, the research suggested that reflective coaching in the form of recording learning resulted in the case subjects improving their content knowledge through self-taught learning and transformation of content knowledge; this could be seen in the case of Pimjai, who did not directly graduate from teaching, and in the case of Nucha, who had little teaching experience. Writing the learning notes could also improve the level of PCK of the case subjects by themselves, both in the subject content and the teaching strategies. The reflections helped the participants understand themselves better before making decisions and use the knowledge that they had to make more informed decisions. By obtaining a more comprehensive perspective, it could be concluded that the learning notes created a learning process for better self-

improvement. Writing the learning notes added clarity to one's knowledge and actions, and the writing process helped subjects think about what they had encountered as they practiced. It could be said that it involved reflection and a deep level of thinking that could further stimulate learning (Brockback & McGill, 2007). It could also make the case subjects learn by doing by themselves. Developing the ability to apply the knowledge that arose in their teaching situations enabled them to apply specific knowledge gained to their operations. It also served as a method wherein case subjects gained more knowledge by themselves. The Subjects realized a greater understanding of teaching goals because they learned from real experiences from practice and solved problems in working by themselves.

Conclusion

This research can serve as a case study model in the development of PCK regarding instruction in cell biology with the content and how it reflects how thinking differs; this is because the experience and prior knowledge of individual participants differ. The need for self-improvement in each element of PCK and individual teaching methods is different, requiring various approaches such as self-reflection of problems, self-assessment and learning notes. Thus, this information supports that reflective coaching should consider a variety of learning methods and the needs of teachers (Kuklick et al., 2015) which could be used to improve teacher effectiveness (Desimone & Pak, 2017: Zhang et al., 2017). Additionally, this research demonstrates the usefulness of reflective coaching for the professional development of teachers. This should be encouraged, and subjects should be motivated to reflect on the learning process (Ladachart & Ladachart, 2017) and enable teachers to ponder more deeply. The teacher should think of ways to strengthen their PCK awareness and performance of their duties to believe that everyone has prior knowledge and great self-potential. It would also serve as a form of teacher training. Teachers can be supported by allowing them to apply knowledge to their classroom instruction. This process does not have to a fixed pattern, but rather engage the freedom of the teacher. It would allow teachers to think and solve problems by themselves, unlike other teacher training that uses a series of activities created by the trainers to follow and develop teachers in different fields of knowledge.

However, regarding the reflection direction, the researcher believes that in coaching, factors such as different learning styles should be considered for each individual. Because each person has an interest and the readiness to act on different perceptions, then analyzing the different case subjects will lead to varied problem solving and greater needs identified by the teachers. It would be extremely important to consider selecting the most appropriate coaching strategies for each individual. The knowledge would form the basis for interpreting and creating meaningful learning (Gallili, 1993) and knowledge from everyday life experiences (Allen, 2014). Further, case subjects may not know that what they do is an element of PCK, so having a deep understanding of reflective coaching would be important to develop PCK and self-teaching methods of instructors.

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