

Teacher Tensions When Adopting a New Approach to Teaching about Photosynthesis

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This study examined a Thai biology teacher's creative tensions when she was challenged to adopt a new teaching approach to photosynthesis with her class. The teacher was purposively selected on her need of professional growth. Data from observations and interviews documented the tensions. The data indicated that the biology teacher experienced tensions with regard to her own conceptual knowledge, in initiating teacher-student discussion and in challenging students' class participation. The teacher's prior professional experience and the researcher's additional reflection may have helped the teacher to solve these pedagogical problems.

Key words: Teacher tension; Professional development; Teaching approach

Introduction

A teacher's professional development involves professional knowledge and placing oneself in the position of a learner. Specifically, this development may involve knowledge about curriculum, instruction and assessment, as well as about epistemology, methodologies and natural phenomena (Bell, 1998; Bell & Gilbert, 1996; Russell & Martin, 2007). Bryan and Abell (1999) additionally considered that the "...knowing...can not be learnt from coursework alone. The construction of professional knowledge requires experience...in identifying problems of practice, in approaching those problems and implementing solutions, and in making sense of the outcomes of their actions (pp.121-122)".

However, difficulties in teacher professional development are often found after teachers are challenged to change their teaching practices based on a new educational reform. The teachers poorly understand when implementing a new curriculum, and they experience tension in changing their teaching approach (Hewson, 2007; Kijkuakul, 2006). Anderson (2000) argued that rethinking and reflecting on the teaching practices by the teacher themselves and by teacher educators might overcome the difficulties.

Extensive international reviews of teacher professional development in science, for example Russell and Martin (2007), and Hewson (2007), contain relatively few references to Asian studies. The present study was initiated in the context of a major curriculum reform in Thailand. One of the outcomes of the National Education Act of 1999 was that teacher professional development was re-conceptualised and the biology teachers (like all teachers in Thailand) found themselves facing a new vision of a learner-centered approach to biology curriculum change. The teachers were being challenged to adopt social constructivist-based learning activities namely, collaborative learning and group participation,

and authentic learning and assessment to their class (Institute for the Promotion of Teaching Science and Technology, 2002).

However, exploration of classroom situations reported poor adoption of new pedagogies. For example, in one classroom of a public high school studied by Kijkuakul (2006), there was only one teacher for forty-four students, no teacher assistance, no computer, very few learning resources, and the school did not pay the teachers well to develop teaching media and materials. Subsequently, the teacher was found to hesitate about preparing own conceptual knowledge and scientific instruments for teaching based on the new pedagogies, in particular experiment and group discussion.

This main interest in this study was to explore teachers' thoughts and practices when adopting a new teaching approach as a way of illustrating the challenge. The study also aimed to elicit what difficulties were obstructing the adoption, and also the solutions for the difficulties that might be identified.

Methodology

Context of the Study

This was a case study of a collaborative action research project (Kijkuakul, 2006), based on an interpretive methodology (Erickson, 1986; Cohen, Manion & Morrison, 2000). In the collaborative action research project, the researchers and three volunteering biology teachers developed a new teaching approach about photosynthesis. Firstly, five principles of the new teaching approach had been developed by the researchers (Kijkuakul, 2006). These five principles expected the teacher to focus on 1) correcting the students' prior misconceptions about plants before 2) enhancing their understanding of photosynthesis (Barker & Carr, 1989a; 1989b; 1989c). The students also should be enabled to 3) relate photosynthesis knowledge to conserve the environment (Carlsson,

2002; Ekborg, 2003). The teacher should 4) use historical narratives (Barker, 1997; Allchin, Anthony, Bristol, Dean, Hall, & Lieb, 1999) to integrate the nature of science (AAAS, 1989; IPST, 2002) in the teaching. Also, the teacher should 5) encourage the students to participate in the teaching by taking account of the students' culture and society in the Thai classroom (Buranakarn, 2003; Srivichit, 2004; ThaiWorldView, 2004) as sociocultural perspectives (Cobb, 1994; Packer & Goicoechea, 2000).

Secondly, the three volunteering biology teachers were informed about the five principles and a research-based report on their students' prior misconceptions about photosynthesis (Kijkuakul, 2006). Then they collaboratively developed a photosynthesis teaching unit based on the five principles with the researchers. The photosynthesis teaching unit comprised the course syllabus, list of concept proposition, concept map, lesson plans, and teaching media and materials.

As a result of the collaborative action research project, the three volunteering biology teachers gradually adopted the new teaching approach in the classroom in the photosynthesis teaching unit by themselves. The students' learning outcomes according to the five principles were reported in Kijkuakul (2006); the present paper focuses on the pedagogy by which the learning was facilitated.

Participants

In the collaborative action research project, the three biology teachers volunteered to implement the new teaching approach for their classes, but only one teacher, called Mrs. Engka (pseudonym), was purposively selected for the present study. Mrs. Engka was chosen because of her beliefs about learning and her perceived need for her own professional growth. Mrs. Engka and the researcher (first author) used to work together collaboratively before Mrs. Engka came to the action research project.

Mrs. Engka was a forty three year old teacher who taught seventh-grade science as well as eleventh-grade biology in a public high school. She believed that teaching by only lecturing could no longer develop student learning about biology. Personally she preferred studying natural phenomena and loved being a biology teacher: "...I love to study the natural world around me" she said. Also, she was interested in improving her teaching practices. She was making considerable attempts to engage with the new teaching approach, and was willing to discuss the teaching difficulties with the researcher.

This study focused on Mrs Engka's eleventh-grade teaching. There were forty-four students in the classroom. The students were approximately sixteen years old, and studied biology for three sixty-minute periods a week. None of the students attended biology classes in the private tuition centres. Before Mrs. Engka started implementing the new teaching approach, she administered a questionnaire to identify students' perceptions of learning biology in the classroom. The data showed that the students' attitudes towards learning biology varied considerably: 30/44 would like to learn biology for their everyday life, 10/44 would like to learn biology only for the examination, while four students did not like attending the biology classroom because they did not like reading the biology textbook.

Data Collection

The method of triangulation was used to collect qualitative data in this study. In order to understand the teacher's thought and practices, classroom implementation was observed persistently. The classroom observations were done on every Wednesday, for two months (November 2004 to December 2004). There were two sixty-minute teaching periods a day. The classroom observations allowed the interpretation of key elements of the data. The researcher was

an observer in the classroom, and also assumed the role of mentor, providing professional development opportunities for the teacher as a friend. The teaching and learning situations were recorded through field notes. These focused on student-teacher interactions during discussions, negotiations and classroom management. The learning culture in the classroom was also examined. Before and after each observation, the researcher had a conversation with the teacher and the students to build up good relationships and to encourage them.

A few of Mrs. Engka's students were also purposively interviewed to examine their opinions about the teaching practices and the learning activities after teaching period. A student who could finish and another student who could not complete the learning activities would be selected for the interview.

Informal interviews were additionally used to gather data from the teacher, Mrs. Engka. During the interviews, teaching difficulties were discussed. The teacher often also asked for the researcher's reflections. Suitable interview times were non-teaching periods, lunchtimes, or after school.

Data sources comprised tape recorded interviews with the teacher and with her students, extensive field notes of lessons and some videotaped lessons. The data were collected once a month, for four months (September 2004 to December 2004).

Data Analysis

Content analysis was used to interpret the observational data. Coding based on the researcher's interpretation and peer reviews of the teaching and learning situations was used to identify the teacher's thoughts and practices when the teacher adopted the new teaching approach.

Discourse analysis was used to interpret the interview data. Teacher interviews as a basis of the teaching reflection were

transcribed verbatim. The transcripts were revised by the researcher listening to the recordings. They were confirmed by peer reviews. Useful data from the transcripts were selected, quoted and acknowledged to support the findings of this study. The data provided enough opportunities for triangulation. In other words, the analysis was completed when the researcher found convincing evidences from both observation data and interview data.

Results and Discussions

The findings presented in this section were taken from qualitative data that focused on the teaching difficulties obstructing the adoption of the new teaching approach to this classroom, and on the solutions which Mrs. Engka used to solve the problems.

By taking into account the principles of the new teaching approach explained as a context for this study, the findings indicated that the teacher experienced tensions in developing her own conceptual knowledge to enhance the students' understanding of photosynthesis, in initiating teacher-student discussion, and in challenging the students to participate in class activities.

Tensions about the Teacher's Own Conceptual Knowledge

Mrs. Engka, the biology teacher, was worried about having inadequate chemistry knowledge of the photosynthesis process. Her own words conveyed a sense of tension while she was explaining to the class about oxidation-reduction in the electron transport system, the light-dependent phase of photosynthesis process: "...that pigment is thylakoid...giving and taking the electron. The reaction is called...um...I don't have strong content... (*voice expressed less confidence in explaining the following concepts*), but the oxidation and reduction then occurs...". Mrs. Engka then appeared to repeat this explanation until the students encouraged her by nodding.

During an interview she also raised concern about her conceptual knowledge: "I'm not comfortable with teaching things I'm not quite sure about...", Mrs.Engka said. Later, the following exchange occurred:

Researcher: What did you think about your teaching today?

Teacher: ...I'm not confident teaching about oxidation and reduction. It's a chemical concept!

Researcher: Um...I think you've done quite well.

Teacher: But I just repeat the words on the book. (*hesitation*)

Researcher: ...it's O.K. You don't need to be so serious. I used to do like this when I had less experience in teaching. Sometimes discussion about concepts with students helped me learn.

Teacher: Really? (*nods and pauses to think*)...I will attempt to ...for next lesson.

Mrs. Engka's appeared to continue to teach about oxidation-reduction until the students showed that they understood the concepts. Repeating words in the textbook was her rather tense strategy to overcome her perceived lack of confidence in the conceptual knowledge. Her teaching practice, that seemingly emphasized lecturing, was the converse of her stated beliefs about how students learn: "...the students learn when they talk to each other,...using children's language in discussion...and hands-on activities [support] the learning...".

Discussions between the teacher and the researcher may provide a good opportunity to encourage an interactive teaching practice by way of professional development (Anderson, 2000). In this case, Mrs. Engka was challenged to rethink how to teach science with more confidence in her own approach, being true to her views about learning.

In response to this dilemma, Mrs. Engka paid attention to developing and improving a strategy to promote teacher-student discussion. The situation is now presented.

Tensions about Initiating Teacher-Student Discussion

After Mrs. Engka had taught a lesson on the nature of science, using the past scientists' discovery of sugar to initiate a discussion on the light independent phase of photosynthesis process, she was upset by some students. She observed that "[the students] didn't think I'm teaching them about [the nature of science]. They needed me to give the answers straight away, not from the discussion." She also found that the number of students in her class did not facilitate group/class discussion. There were forty-four students in the class, and student tables were clustered to accommodate groups of four to seven students. The students were unfamiliar with direct discussion with the teacher. As often happens in Thailand They felt they were expected to show considerable respect for authority, especially the teacher (Srivichit, 2004). The relationship between the teacher and the students was typically formal, and the students rarely argue against the decisions made by the teacher (Triolo & Lewis, 1998).

Then, Mrs. Engka appeared to find a solution to the problem. A new way of initiating discussion for a real classroom situation was developed based on her informal friendly conversations with the students inside and outside the teaching period. The students were allowed to independently form groups, making a bit of noise in group discussion, and walking around the group desk for discussion. She commented that "I improved by initiating a strategy..., [because the students] had been unconvinced by classroom discussion...they were convinced by listening and taking notes rather than talking with me...they frequently asked me to give them a lecture as usual,...[but in spite of that]...my answer was 'the discussion would help you to learn better...' "

Additionally, Mrs. Engka appeared to use small group discussions in her forty-four student classroom. She challenged the students to make a decision or answer a question through small group discussion. The students would pair up with someone sitting near them, verbally sharing their answers and working together to create a final answer. She would randomly choose a few pairs to summarise answers.

The observations and interviews indicated that the students became more familiar with direct discussion with the teacher over time. They automatically began discussing with a friend and then proposed the ideas to the teacher by themselves. A student gave this evidence on the third week of December 2004: "...our group chose a representative to present the group ideas answering the teacher's questioning during the discussion. Students took turns to be the group representative. This allowed everyone a chance in the discussion." This evidence was the opposite to what the student thought on the second week of November 2004: "...I don't think there will be one who is brave enough to answer the question. You would feel a fool if you make some mistake in front of the class."

The success in developing a way of initiating the discussion may have brought Mrs. Engka to face a new problem of how to challenge the students to participate in the discussion.

Tensions about Challenging Students to Participate in Class Activities

Mrs. Engka additionally made a change to her teaching practice. She attempted to persuade the students to change their learning style from a rote learner to an active learner. As noted earlier, some students valued biology study particularly to assist them in passing examinations rather than learning about natural phenomena (Buranakarn, 2003). One student claimed that "...the [biology] study

needed too much memory.” Mrs. Engka also thought that some students passively learnt biology because she had initially strongly emphasised summative assessment. She said: “They would [only] prefer to participate in an activity connected to the examination...”.

To address the problem, Mrs.Engka decided to change her style of students’ learning assessment. “I would give a credit for students if they participated in the activity...and for those who showed responsibility in class work...or [who] improve on assignments”.

The data from observations and interviews showed that after this the students participated more often in the classroom activities and were more positive attitude towards the class study. They were willing to organise the group work to prepare learning materials and to manage group responsibility for class participation. This is evidenced from interviews with the students, for example:

Researcher: What else would you like to say [about the teaching]?

Student: Initially I didn’t understand the content much. There was only doing an activity (*on the second week of November 2004*)...only later I could understand...

Researcher: Did you think this teaching differs from usual?

Student: Yes, I did.

Researcher: How was the difference?

Student: Um...I would like it if there was less homework such as worksheets and activities, but I knew this idea wasn’t good (*laugh*). The discussion activities (*on the third week of December 2004*) stimulated thinking..., caused us to cheerfully share our ideas, being enthusiastic, and convincingly participating...

Conclusions and Implications

When the teacher was challenged to improve teaching practices through adopting a new teaching approach in her classroom, she experienced tensions with regard to her own conceptual knowledge, in initiating teacher-student discussion and in challenging students to participate in class activities. However the collaboration between the teacher and researcher helped overcome the teacher tensions and encouraged more interactive teaching. The researcher's attempts to understand the teacher's dilemma between the learning belief and the teaching practice may have positively influence in developing the teacher's confidence in new ways about teaching based on principles of the new approach, and then to weave the resulting insights into the teacher's practice. The findings of this study have implications for the professional development of teachers, showing that supportive discussion with a mentor can enhance the adoption of new ways of teaching that engage the learner more enthusiastically and successfully with their subject.

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