Pre-service science teachers should be graduated with sufficient subject matter knowledge and pedagogic knowledge to teach science to their students. Altogether, pedagogic content knowledge of teachers refers to a specific type of knowledge that teachers know about what to teach and how to teach. Educative mentoring is a way that helps pre-service teachers to develop pedagogic content knowledge (PCK). In this study, how mentoring process influences pre-service science teachers’ development of PCK. The study was designed as case study. Five pre-service science teachers participated in the study. Primary data source involved the use of Content Representations (CoRes) and transcripts of audio-recorded interviews with pre-service teachers (PSTs) during Cell Reproduction unit, specifically mitosis and meiosis contexts, video recordings and self-reflection papers. PSTs prepared CoRes and developed their CoRes with mentor’s online and face-to-face feedbacks. After mentoring process and revisions in original CoRes, PSTs practiced their CoRes in classrooms settings and their micro teaching sessions were video recorded. Results revealed that sufficient scaffolding in the development of CoRes influenced novice teachers’ PCK development. Moreover, results also revealed that while PSTs have sufficient content knowledge, they had difficulties in knowledge of curriculum (e.g., objectives about meiosis and mitosis and their relation to other dimensions reflected in the curriculum including science process skills, science, technology and society dimensions), knowledge of students’ understanding (e.g., students’ misconceptions, prior knowledge about meiosis and mitosis concepts), and knowledge of assessment (e.g., specific ways of ascertaining students’ specific misconceptions). Even they knew instructional strategies, however, they did not know how to synthesize instruction strategies with the curriculum objectives and choose specific strategies to teach specific content. This kind of educative mentoring helped PSTs to connect different PCK components in their CoRes and in their classroom teaching.

Keywords: pedagogical content knowledge, pre-service science teachers, educative mentoring

INTRODUCTION

Teaching science to the students require experience and the teacher preparation programs aim to provide opportunity to pre-service teachers (PSTs) in order to develop their teaching experience and preparing them for real classrooms settings. Educative mentoring plays a crucial role in teacher preparation programs (Abed & Abd-El Khalick, 2015, Barnett & Friedrichsen, 2015). While educative mentoring was reported to improved and develop their pedagogical knowledge and their understanding of science curriculum, this kind of feedback and guidance helped PSTs’ to improve their science teaching (Abed & Abd-El Khalick, 2015). Moreover, educative mentoring process supports PSTs’ development of pedagogical content knowledge (PCK) (Abed & Abd-El Khalick, 2015, Barnett & Friedrichsen, 2015). PCK consists of five domains as orientation to science teaching, knowledge of students’ understanding, knowledge of assessment and knowledge of instructional strategies (Magnusson, Krajcik & Borko, 1999). On the other hand, existing studies reported that novice teachers and pre-service teachers who were about to teach in real classrooms were lacked of sufficient in these PCK components (Loughran, Berry & Mulhall, 2012; Williams & Lockley, 2012). Existing studies about PSTs’ PCK components reported that PSTs lacked content knowledge (Bektas, 2015; Williams & Lockley, 2012), and pedagogical knowledge (Bektas, 2015).

In PCK instruction, researchers commonly used Content Representations (CoRes) and/or Professional-experience Repertoires (PaPers) to improve teachers’ and PSTs’ PCK (Aydın et al. 2013; Lehane & Bertram, 2015; Loughran et al. 2008; Hume & Berry, 2011). While Loughran et al. (2008) reported use of
CoRes and PaPers was a useful way to study PCK, Hume (2010) emphasized using CoRes as “lesson planning” tools enhanced PSTs’ awareness about PCK and understanding of PCK. In another study, Hume and Berry (2011) implied that using sufficient scaffolding and mentoring along with CoRes influenced the development of novice teachers’ PCK. Moreover, Barnett and Friedrichsen (2015) reported educative mentoring supported the development of PCK components including topic-specific knowledge of instructional strategies, students’ understanding of science, knowledge of assessment and knowledge of curriculum. While existing studies focused on different science contexts such as DNA/protein synthesis, evolution, chemical equilibrium (Aydin et al. 2013, 2015; Barnett & Friedrichsen, 2015), we know little about how educative mentoring supported PCK instruction influenced PSTs’ development of PCK in the context of meiosis and mitosis. Thus, this study explored how educative mentoring influenced PSTs’ development of PCK in the context of meiosis and mitosis.

METHOD

The study was designed as using qualitative case study approach. Case studies focus on a single unit which is also refers to bounded system. Specifically, interpretive multiple case study which involved collecting and analyzing data from several subjects (Merriam, 2009). The bounded system in this study is a science teaching method course. The course instructor’s mentoring process in developing pre-service science teachers’ PCK and their CoRes in Cell Reproduction unit (14 weeks phase) were the boundaries of the study. The course included PCK instruction (4 hours), introduction to CoRe, how to prepare Cores and preliminary exercises about constructing CoRes, PSTs’ CoRes, educative mentoring of course instructor, revisions, microteaching sessions (twice) and reflection papers (twice).

Study Group

The participants were junior pre-service science teachers who completed several courses about subject matter courses (e.g., general physics, chemistry and biology), general pedagogical courses (e.g., introduction to education, educational psychology, and teaching strategies) and subject-specific pedagogical courses (e.g., laboratory experiments in science education). All the PSTs voluntarily participated in the study.

Data Collection

In order to capture PSTs’ development of PCK in the context of meiosis and mitosis, multiple data sources were collected throughout the semester. Data sources included PSTs’ written forms of CoRes, course instructor’s online and face-to-face feedbacks, PSTs’ revisions in their CoRes, microteaching sessions (twice) and reflection papers written after each micro teaching session. CoRes are methodological tools that were developed by Loughran et al. (2008) in order to capture development of PCK. The CoRes mainly focus on the five component of Magnusson et al.’s (1999) PCK model. All the interviews with PSTs and their micro teaching sessions were recorded. After each microteaching session, PSTs revised their CoRes based on the feedbacks from their peers and the course instructor based on their real classroom performance.

FINDINGS

The aim of this study was to reveal how educative mentoring influenced PSTs’ development of PCK in the context of meiosis and mitosis. Close examination of first CoRes revealed that all the participants had difficulties in constructing a detailed CoRe about meiosis and mitosis. The first mismatch was found in PSTs’ determination of big ideas and their coherence with the objectives. The PSTs rarely were able to express their objectives in detail. For instance one PST, Daphne (Synonym) expressed “students learn to
daughter cells are formed at the end of mitosis”. It was not clear what Daphne meant by “learning” and it was not definite how she would understand whether their students “learn” or not. After the mentoring process, Daphne revised this objective. Another difficulty revealed was that PSTs were unable to connect their objectives with the domains of “Knowledge”, “Skills”, “Science-Technology-Society and Environment” and “Affective” domains that are found in the national science curriculum. At the end of the course, PSTs showed development in making connections among their big ideas, objectives and their coherence in the domains of the science curriculum. Another significant difficulty that the researcher noticed was that PSTs were unable to express why it was important to learn this concept. For instance, Susan indicated that “it is important to know the mitosis and the phases of mitosis”. Susan did not explain why it was important to learn the mitosis or phases of mitosis. After, mentoring, Susan revised this part as “As growth of cells, development of cells as well as repairs in the cells are results of mitosis, students should understand the mitosis and the phases of mitosis. Unless students understand the mechanism of mitosis, they were unable to understand how the cells are repaired and how our injuries are healed.” All the questions reflecting components of PCK along with PSTs’ responses will be presented in detail.

REFERENCES


