

THE EFFECT OF USING MULTIMEDIA CASES ON PROSPECTIVE TEACHERS SELF-EFFICACY BELIEF

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The study explores how the use of multimedia cases affects the science teaching self-efficacy of prospective teachers in one university in Kenya. Chemistry and physics prospective teachers (N = 42) explored questioning and lesson introduction strategies using multimedia cases filmed in Kenyan classrooms. The changes in their self-efficacy was analyzed by looking at the difference in their scores in a pre-test and a post-test on a popular science teaching efficacy beliefs instrument developed by Enochs and Riggs, (1990). The results show that the use of multimedia cases created a cognitive dissonance that led to a decrease in the personal science teaching efficacy (PSTE) and no significant change on the science teaching outcome expectancy (STOE). These findings point to the effectiveness of multimedia cases in challenging the beliefs of prospective teachers during the methods courses.

Keywords: Self-efficacy, Multimedia Cases, Prospective Teachers, Sub-Saharan Teacher Education Programs

Background

The year 2015 marks the expiration of the timeline set for achieving Education For All (EFA), the Millennium Development Goals (MDG) and the onset of fresh agendas for development and education (Winthrop, Anderson & Cruzalegui, 2014). According to Winthrop et al., many educational stakeholders have called for a reformulation of the spirit of EFA agenda from merely access, to access *plus* learning. This fresh approach places more emphasis on the teacher's actions in class. Many studies have established that the teacher is the most influential factor in students' learning (Boonen, van Damme, & Onghena, 2014; Bressoux & Bianco, 2004; Darling-Hammond, 2006), and educators are looking to teacher education programs to improve the quality of learning.

Africa, with 54 countries, is the second largest continent and second most populous after Asia (World Atlas, 2014). The population of the region is rapidly growing at a rate of 2.4%, and in 2010, 43% of the population was under the age of 15 (UNESCO, 2010). This rapid growth places an enormous strain on resources, both financial and human that has negated the efforts aimed at uplifting the quality of education in the region (Mohamedbhai, 2008). Despite the acknowledgement of the central role of education in uplifting the individual and societal standards (Akindutire & Ekundayo, 2012), the inevitable large class sizes have been apportioned the largest piece of the blame for the deterioration in the quality of graduates, especially in teacher education programs within SSA (Indoshi, 2003; Kafu, 2011).

Kenya for example has experienced an unprecedented demand for higher education including in teacher education programs. In higher education, there were 570 undergraduate students and three graduate students in Kenya's only university at independence in 1963. By 2000, there were 50,000 undergraduate students and 5,000 graduate students enrolled in six universities (Gudo, Olel & Oanda, 2011). In 2014, about 325,000 students were enrolled in over 40 universities (see Figure 1). In 2014 alone, enrollment at the universities rose by about 35%.

The first teacher education program in Kenya began in 1964 at the University of Nairobi's constituent college called Kenyatta College (Kafu, 2011). The first professional teaching degree (Bachelors of Education) in Kenya was offered starting in 1970. To date, there are 22 public universities, 17 chartered universities, 12 universities with Letters of

Interim Authority (LIA), and two registered private universities. In all these, there are over 40 approved academic programs that train teachers and offer a bachelors certification (Commission of University Education (CUE), 2014).

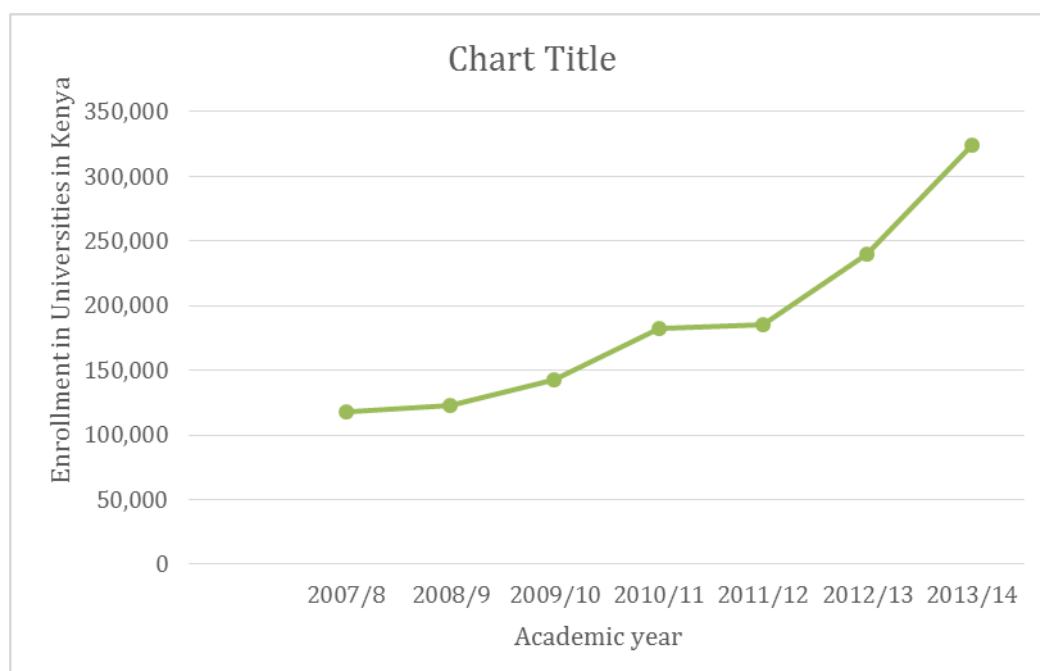


Figure 1: Enrollment in Kenyan Universities between 2007/8 and 2013/14 (Kenya Bureau of Statistics, 2014)

Though there are guidelines for the requirements for each degrees offered in the university, there is no regulatory professional body that monitors the standards of teachers graduating from the teacher education programs. This has implications for the quality of teaching, the nature of teacher education curricula, as well as the present image of the teaching profession in the country (Kafu, 2011). Kafu further noted that the status of facilities and resources used in these programs is not adequate for the skill levels desired of the graduating teachers. Beginning teachers in Kenya experience challenges fitting into the classroom, and they mainly blame this on their teacher preparation program (Indoshi, 2003).

Studies that focus on teacher education attribute the low quality of teachers graduating from these programs to the predominantly lecture-based instructional practices, examination oriented teaching culture, obsession with paper qualifications (Hardman et al. 2012), a very theoretical curriculum, and the inadequate supervision of practical field practice by the teacher educators (Akyeampong, Lussier, Pryor & Westbrook, 2013). It seems therefore, that pedagogical skills are studied for examinations and not for application. This has the effect of creating a large gap between theory taught in methods courses and actual classroom practice.

Challenge of Assessing Prospective Teacher's Cognition

Shulman (1986) isolated a particular type of knowledge - pedagogical content knowledge - that teachers need to have for them to effectively teach domain specific content to their learners in ways that are appropriate to the students' level. According to Shulman, pedagogical content knowledge (PCK) is knowledge, "which goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching" (p. 9). The main focus of teacher education programs is therefore to support prospective teachers in

developing this knowledge that, alongside the knowledge of content, teachers need to have to be effective in their practice.

The notion of pedagogical content knowledge has undergone a significant re-evaluation. For example, Grossman (1990), linked PCK to the specific context of the learners; Magnusson, Krajcik, and Borko, (1999) argued that besides the context, PCK incorporates the dynamic process through which the subject, context and assessment of learning interact during classroom teaching; while Davis (2004) added that PCK evolves during the day-to-day experiences developed during interaction with the learners. Perhaps even more significant is the argument by Park and Oliver (2008), that PCK is developed through reflective practices, which also shape teachers' beliefs about teaching and learning. In teacher education programs that lack integrated field experiences, such as the case for teacher education programs in SSA, it becomes challenging to determine what kind of cognition, other than examination grades, would be most suitable to reflect effectiveness of prospective teachers.

While the teacher training programs focus on acquisition of this specialized knowledge, some scholars have argued that teachers' knowledge is "perspective-bound and belief-generated" (Tillema, 1995, p. 292) and what is more vital is the belief change that is likely to alter the perspectives and orientations of prospective teachers. Kagan (1992) described such beliefs as "tacit, often unconsciously held assumptions about students, classrooms, and the academic material to be taught" (p. 65). Beliefs encompass both attitudes and subjective norms. This makes it difficult to disentangle teachers' cognitive knowledge from teachers' individual preferences and opinions on how things need to be (Ewijk & van der Werf, 2012). This implies that teachers can gain new knowledge in their methods classes, but still remain greatly influenced by their beliefs, especially when deciding whether they accept the new knowledge and apply it.

Bandura (1977) stated that beliefs are the best indicators of the decisions that individuals make in everyday life, better than knowledge and motivation. He argued that knowledge alone could not account for the behaviors that are observed in human beings. Teacher education scholars have placed teachers' belief system at the center of understanding teachers' actions in their classrooms (Nespor, 1987; Pajeras, 1992). More specifically, the study of teachers' self-efficacy beliefs has gained recognition as an outcome of teacher education (Bandura, 1986). Gibson and Dembo (1984) argued that there are important behavioral differences between teachers who have different levels of self-efficacy beliefs and therefore posited that the understanding of beliefs is critical to teacher education programs. Other studies on teachers' beliefs and teachers' knowledge concur with the assertion that teachers' beliefs are stronger predictors of behavior than teachers' knowledge (Ewijk & van der Werf, 2012; Kagan, 1992).

Beliefs that teachers hold are formed even before they embark on their teacher training. Shilling-Traina and Stylianides (2013) gave examples of teachers' beliefs that are prevalent in teacher trainees and that influence the behavior of teachers, irrespective of the knowledge they have about student learning. When prospective teachers believe that the efforts of students are not very important in their success, they will not use students centered approaches but rather stick to teacher centered approaches. Another example is when prospective teachers believe that teaching well depends on making school work interesting, they will reject as irrelevant parts of their methods course that focus on teaching students to use metacognitive strategies. The most prevalent belief about teaching involves the use of the traditional lecturing approach as a primary vehicle for communicating a teacher's enthusiasm for subject matter. Such beliefs may lead prospective teachers to react negatively to ideas for cooperative learning.

Prospective teachers bring with them to teacher education these beliefs about the nature of teaching and learning. These beliefs then interact with the content and pedagogy of their teacher education courses to influence what and how they learn (Anderson & Bird, 1995). The beliefs that teachers bring to teacher education programs are quite resistant to change. Ewijk

and van der Werf (2012) argued that it is only when teacher beliefs are proven unsatisfactory when challenged that the individuals will be motivated to change them. The main mechanism for change in beliefs is the creation of cognitive conflict – a cognitive dissonance that challenges the emotional quality of the held beliefs and provides new information that can be integrated into the individual's belief system to either modify existing beliefs, replace held beliefs with new ones, or develop alternative parallel beliefs (Shilling-Traina & Stylianides, 2013).

Nespor (1987) argued that beliefs draw their strength from previous episodes and events that illuminate the current events, more than from cognitive knowledge. This view complicates the endeavors of teaching pedagogical content knowledge using lecture and examination methods, such as the ones prevalent in large classes within SSA. Such classes provide few opportunities for analyzing new teaching episodes and reflecting on them. However, the promise of determining appropriate beliefs about teaching lies in a subset of beliefs about an individual's self-judgment of their own abilities to execute behaviors that have desirable outcomes. Bandura (1977) defined this subset of beliefs as self-efficacy – the belief that one has the power to produce an effect by completing a task or activity related to that competency. Self-efficacy encompasses two constructs that are independent of each other: personal teaching efficacy and outcome expectancy (Bleicher, 2004; Riggs & Enoch, 1990).

Changes in self-efficacy beliefs have been reported to originate from school-based experiences. For example Knoblauch and Hoy (2008) and Onen and Kaygisiz (2013) reported that the self-efficacy beliefs of science teachers increased after doing their first teaching practicum. The gain in self-efficacy beliefs was not so high when the prospective teachers went for their field placement in more challenging schools. Caprara, Barbaranelli, Steca and Malone (2006), attributed changes in self-efficacy to a higher level of job satisfaction among teachers and also to student achievement. Self-efficacy is also greatly influenced by contextual factors, such as the teaching resources available to the teachers, as well as interpersonal support available (Tanel, 2013; Tschannen-Moran & Hoy, 2007). These findings have a strong bearing on teacher training environments that have teachers with low morale, lacking adequate resources, and without well organized support mechanisms for prospective teachers' initial field practice.

Multimedia Cases

Research on the use of multimedia cases (MMCs) with prospective teachers has shown promising gains in equipping novices with skills to meet the demands of 21st century classrooms. Various studies have discussed how the use of cases has shaped the epistemological evolution of professional knowledge and skills as well as the beliefs of professionals. For example, MMCs have been reported to cause cognitive dissonance that is prerequisite for conceptual change and attitude modification (Fitzgerald, 2011; Koury et al., 2009; Pfister, White & Masingila, 2006), lead to acquisition of knowledge and skills (Malesela, 2009; Thomas & Reid, 2011), as well as scaffolding the debut classroom teaching (Fulei, 2010; Masingila & Doerr, 2002). Other studies reported an increased transfer of theory to practice (Bencze, 2009; Firtgerald, 2011; Masingila, Ochanji & Pfister, 2010).

Prospective teachers' initial teaching experience can be scaffolded through the use of MMCs (Fulei, 2010). Conducting initial teaching practice by injecting prospective teachers straight into schools where they experience teaching and learning contexts is comparable to teaching people how to swim by throwing them into the deep end of a swimming pool. The study by Fulei (2010) postulated that, in such a case, the prospective teachers, in order to survive, adapt to traditional perspectives and practices – mainly teaching the way they were themselves taught. Fulei suggested that prospective teachers could learn how to teach by first

observing practicing teachers through a MMC, a safe environment that will allow for observations, reflections and discussions of teaching practices.

One of the best ways to make the practice visible to novice teachers is through exposure to field experiences (Darling-Hammond, 2006). Limited resources may problematize collaboration with school classrooms as sites for investigation. But the representations and approximations of classroom practices can be brought into methods courses through videos recorded lessons. Such lessons can then be prepared as multimedia cases and used as sites for examining and reflecting on teaching practices. The challenge, therefore, is to provide empirical evidence that the use of multimedia cases would be a more effective way to stir the self-efficacy of prospective teachers.

Design of Study

Prospective teachers from Central University's physics and chemistry subject methods classes were invited to participate in the study and were asked to fill a pre-test questionnaire. The questionnaire was adopted from the Science Teaching Efficacy beliefs instrument developed by Riggs and Enoch (1990) and scores science teaching efficacy on a 5-point Likert scale that requires participants to respond if they strongly agree, agree, undecided, disagree or strongly disagree with 23 items. The respondents were then asked to attend a session that used multimedia cases to discuss one subtopic in their methods course and then complete a post-test of the same questionnaire.

The chemistry prospective teachers were taken through a 2-hour session discussing questioning strategies in classroom. They were shown four 3 to 5 - minutes video segments that were selected to highlight different questioning strategies that the veteran video teachers used in their classes. The video segments featured questions that progressed from low-order recall questions to complex questioning strategies that required the video case students to recognize patterns and extend their thinking to respond to a question that was beyond what the teacher had discussed.

The physics prospective teachers were taken through two sessions that focused on ways to conduct a good lesson introduction, and the other focused on conducting a teacher demonstration. The segments highlighted both exemplars of practice and not so good practices.

In both cases, the discussion was structured using the concept of Learning to Notice that emphasizes the ability of teachers to notice the rapidly changing and unpredictable interactions in classroom teaching. The Learning to Notice Framework (van Es & Sherin, 2002) has been used in structuring feedback from teachers in video lesson analysis. In this study the modified framework required that teachers watch a video segment and *describe* what they have seen. Describing involved identifying what is important or noteworthy about a classroom situation and making a "call out" (van Es & Sherin, 2002, p. 573). They then watched it again and *evaluated* the segment. This means they reach to their affective domain to make value judgments. Watching a second time also fills up the gaps in their initial description and its not uncommon for teachers to notice and describe in more details incidences that they did not notice in the first viewing. The final part of the framework requires teachers to *interpret* what they have noticed by connecting the classroom interactions to the broader principles of teaching and learning that they have learned from their methods courses.

The number of participants in the MMCs was unexpectedly larger than would be suitable for effective class discussion. For example, one physics session had approximately 120 students in attendance and another chemistry session had approximately 100 students. So, a worksheet was designed to have each students individually respond to the task of *describing*, *evaluating* and *interpreting* the video segments. The pre-test and post-test questionnaires were

matched, together with the worksheets. A total of 42 ($N=42$) matched and completed responses formed the data that was analyzed to answer the research question: What is the effect of using MMCs on prospective teachers self-efficacy beliefs?

Analysis of Self-efficacy Beliefs

The science teaching efficacy beliefs instrument (STEBI) measures two constructs: personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE). PSTE is a person's belief in his or her ability to teach science effectively and STOE is the belief that the persons teaching approach will have a positive effect on student learning outcomes. PSTE and STOE are independent of each other. Of the 23 items on the STEB instrument, 13 items measure PSTE and the other 10 items measure STOE.

To determine the changes in personal teaching efficacy for the prospective teachers, the responses were analyzed as follows: The responses from the negatively worded items were first recoded into positive statements. The highest positive response of "strongly agree" was assigned a value of 5 points, while the lowest response "strongly disagree" was awarded 1 point. These points were then tallied for each of the items that measure the two constructs separately. The sum of pre-test scores was then subtracted from the sum of the posttest scores for the chemistry and physics group of students. A paired t-test analysis of the changes on both constructs was then done. To get a clearer picture of the change across the participants a graph of the changes from pretest to posttest for constructs was drawn.

Results

Prospective teachers hold high, false-positive, personal teaching efficacy beliefs. They believe that they are able to teach very effectively but when they are exposed to the intricate classroom interactions through analysis of multimedia cases, their beliefs are challenged and they do not feel as confident about their personal ability to teach. Prospective teachers also believe that the way they would teach would yield high student outcomes. This belief is not significantly affected after watching MMCs during a methods course.

The maximum personal efficacy score that a participant can get on the 13-item PSTE questionnaire is 65. The average pre-test score for the physics and chemistry prospective teachers were 57.5 and 59.0 respectively. These scores are quite high and comparable well with scores in other studies. It means that the prospective teachers strongly agreed with items that asked them about their personal efficacy in teaching science. When they prospective teachers were taken through multimedia case studies, the scores decreased to 33.5 and 34.5 for the chemistry and physics prospective teachers. This implies that the MMCs had the effect of challenging the personal teaching efficacy beliefs, evidence of a cognitive dissonance, which proceeds belief modification.

A closer look at the pattern in the changes in PSTE scores revealed that all the participants without exception scored lower in the post-test than in the pretest. To make this clearer, a graph of the ascending scores on pretest (PSTE) and corresponding score on the post- test (PSTE_P) for each participant was created using an Excel spreadsheet (See Figure 2).

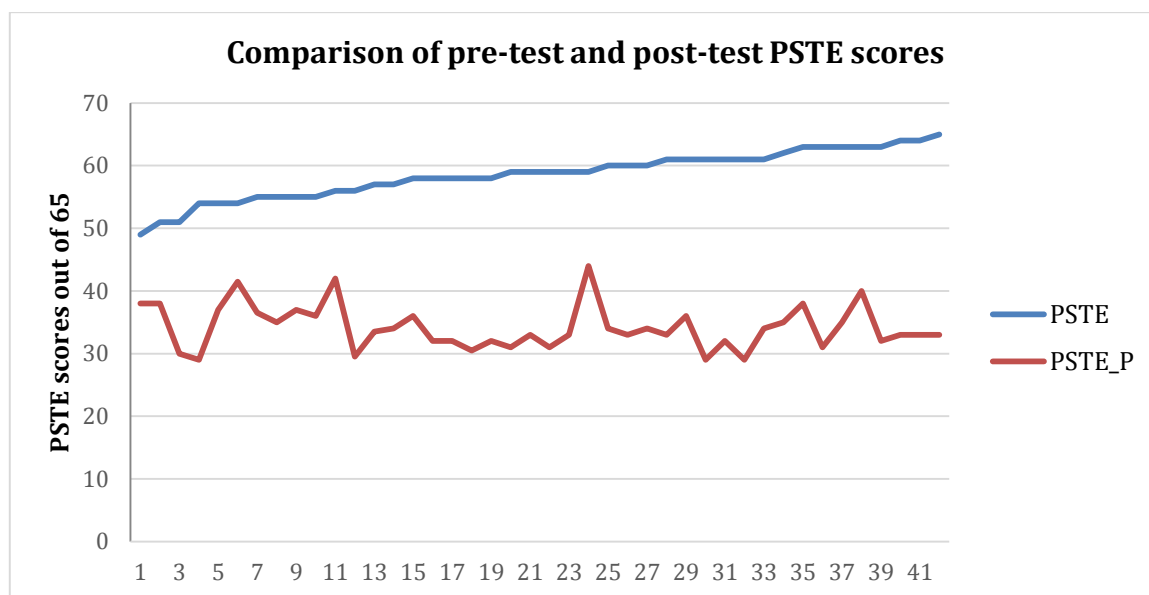


Figure 2: Comparison of PSTE Scores

An analysis of the science teaching outcome expectancy (STOE) was done by adding up the scores on the other 10-items on the science teaching efficacy instrument. These items measure the belief that what prospective teachers believe about teaching will have positive outcomes with the students. The results show that the teachers hold high outcome expectancy beliefs. These beliefs are unchallenged or altered by using multimedia cases in the methods courses. The mean outcome expectancy scores for the physics and chemistry prospective teachers at pre-test are 41.5 and 39.5 respectively out of a possible maximum score of 50. After the intervention the scores were 41.5 for physics group and 38.9 for the chemistry group.

The paired T-tests for both physics and chemistry groups shows that there is a statistically significant difference in the change in PSTE scores of prospective teachers who used MMCs in their methods course (N = 42, M = -24.39, SD = 5.71 p = .000). This means that the teacher’s personal beliefs that they are able to teach their subjects effectively decrease significantly when they use MMCs. The prospective teacher’s belief that the way they teach will have a positive effect on the students’ learning is not significantly affected by the use of MMCs in the methods courses (N = 42, M = -0.21, SD = 4.32, p = .750) (see Table 1). This means that using MMCs does not significantly change the way prospective teachers feel about the impact of their teaching strategies on students learning outcomes.

	Paired Differences					t	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
Pair 1 PSTE _(post) - PSTE _(pre)	-24.392	5.71	.88107	-26.17222	-22.61350	-27.685	.000
Pair 2 STOE _(post) - STOE _(pre)	-.214	4.32	.66742	-1.56217	1.13360	-.321	.750

Table 1: Paired t-tests for changes in scores for PSTE and STOE

Analysis of Prospective Teachers' Worksheets

To make more sense of these findings, a further analysis was done on the worksheets that the prospective teachers used during the multimedia case study lessons. The chemistry group was shown four questions that progressed from low-order poorly posed question (What is matter?), to high order question that required students in the video lesson to recognize patterns in writing chemical symbols and suggest what the chemical symbol for bromine would be. We will discuss the pattern that was consistent across most of the worksheets using one example of a video segment in the chemistry group.

In the first segment, the video teacher introduced the topic for the day as “constituents of matter” and then put up a slide that reads matter is a substance that occupies space and has mass. He then looked at it as if to read the slide, a gesture that intuitively directed student’s attention to what is written on the slide. He turned to the students and said, “we all have come across the word “matter,” can anyone tell us what is matter? Hands up?” At this point numerous hands went up and he then looked at the students for about 30 seconds, apparently trying to select and nominate one of them to give a response. He finally pointed to one student and said, “yes”. The student said that matter is anything that occupies space and has mass. The teacher said, “correct” and repeated the response, “matter is anything that occupies space and has what?” Then all students respond in chorus “mass.”

A survey of most of the worksheets shows that the descriptions written indicated that the prospective teachers noticed the teacher’s actions, the student’s reaction, as well as the classroom environment. For example, one prospective teacher wrote:

The teacher introduced the sub-topic “constituents of matter” very well and gave the various classifications of substances in real life. He then introduced the classification of matter in terms of chemistry. After that the teacher poses a question “what is matter” and the students raises up their hands where he nominates one student. (Overwritten on the initial description), The teacher also repeats the definition. The definition was already on the board (slide). There is biology on the board (referring to writing still on the board from the previous lesson). (Chemistry worksheet, 2015)

A number of the evaluative remarks ranked this question as average and good. The rationale given included the fact that being at the beginning of the lesson, the teacher needed to ask easy recall questions, establish students prior knowledge and the need to start from known to unknown. Evaluations on the worksheet that said the question was not good cited the low cognitive demand, the presence of a visible answer while the question is being posed, selecting students from the front desks, and the inaudible low volume of the student while responding.

During the plenary discussion prospective teachers attention was focused to the factual ways of knowing matter that the question and the responses may have missed to capture. The discussion centered on whether students looking at a bottle half-filled with water would be able to identify the bottle, the water inside as well as the air above the water surface as matter, based on their presumed knowledge of what matter is. This new focus led the prospective teachers to challenge the way students knew “matter”. One prospective teacher suggested, “the best way is to ask what is not matter” (Field observation notes, 2015). This implies that it would be better to think of anything other than a vacuum as matter as a way as a sure way of debunking a common student misconception that air does not occupy space. Before going to the next question, it appeared like the prospective teachers were in agreement that the way a question is posed determines the cognitive engagement of the students, and that poorly posed questions do not challenge student’s ways of understanding and leads to lower forms of learning (for example the rote memorization of a definition) at the expense of deeper conceptual understanding of chemistry.

Though the other video segments contained higher order questions, the evaluation and rationale given seemed to be more critical of the exact wording of the questions, the failure to consider alternative ways of seeking deeper understanding, the inadequate time allowed for thinking, the failure to extend students thinking from an incorrect response, and later in the final segments, the inability of the teacher to reach the students at the back of the class.

The physics lessons followed a similar pattern: the first clip was evaluated very positively but after a plenary critique of the teacher actions and overall effect on the learning objectives the subsequent clips were criticized for failing to elicit students prior conceptions, failing to anchor the lesson on students everyday knowledge, and setting or not setting an appropriate climate for the days lesson.

The opportunity to observe lessons, think about the teacher actions and critique with peers such actions in a non intimidating environment may have led most of the prospective teachers to reach the conclusion that teaching may not be as easy as they initially thought, hence the lower personal teaching efficacy scores at the post-test.

Discussion

Prospective teachers have perceptions of teaching and learning that are based on their schooling experiences and are hardly affected by the theoretical nature of methods courses that they take in their teacher education programs. Based on such experiences, prospective teachers hold high self-efficacy beliefs about teaching. They feel confident that they know how to teach, and that their way of knowing will yield good learning outcomes.

Using multimedia cases in such methods classes highlights the importance of teacher actions in advancing students learning. Knowledge and skills about teaching and learning are understood in a way that is practical and that creates a cognitive conflict that challenges the held beliefs leading to attitude and behavior modification (Shilling-Traina & Stylianides, 2013; Pfister, White & Masingila, 2006). For prospective teachers who have no field experience, and therefore have not had any chance to evaluate students' learning, the belief change may not affect how they feel about student's outcomes. The resulting cognitive dissonance serves as a reality check on the held beliefs.

Limitations for the Study

The intervention that was done with the participants was very brief, and it would be important to see if there would be an increase in self-efficacy after a sustained use of multimedia cases in the methods courses. The brevity of the intervention also limited the reinforcement of the learned concepts through mastery experiences, such as would be achieved by asking participants to model exemplar practices.

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