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TEACHING SKILLS AND VIEWS OF PRE-SERVICE BIOLOGY TEACHERS ON RESPONSE TO THE INSTRUCTIONAL VIDEO WITH SCIENTIFIC APPROACH IN COOPERATIVE LEARNING

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Abstract: Essential teaching skills of pre-service teachers, including scientific approach teaching in which become primary goal in science education, are often developed through modeling. This study utilized an instructional video in biology that showed scientific approach teaching in cooperative learning model. The purpose of this study was (1) to describe the teaching skills of pre-service biology teachers after a modeling session which used the instructional video using scientific approach in cooperative learning, and (2) to describe the views of those pre-service teachers in response to the learning process involving the instructional video. The study involved 11 pre-service teachers in Biology Education program, The State University of Surabaya, Indonesia. The pre-service teachers were asked to conduct teaching simulations according to the video they had observed with different biology topics. Results showed that the instructional video was effective in training pre-service teachers to implement scientific approach in their own cooperative learning. In addition, the pre-service teachers showed positive responses towards the video modeling. Educational implication of this study implies that the instructional video is able to train teaching skills of pre-service teachers.

Keywords: *teaching skills, instructional video, scientific approach*

1 INTRODUCTION

In Indonesia, scientific approach and its connection to an understanding of nature of science knowledge and scientific inquiry are widely implemented in learning process within Curricula 2013. For a subject material to be considered as scientifically approach-based, its learning activity requires involvement of scientific methods such as observing (to identify problem), questioning (and posing hypotheses), collecting data and information, analyzing data, concluding, and communicating result. Hence, nowadays, pre-service science teachers should prepare themselves to apply scientific approach teaching in any science contents and train their students to use scientific approach in learning science. Many scientific approach-oriented learning models have been taught to pre-service science teachers in educational institutions through problem-based learning, inquiry-discovery learning, contextual learning, or project-based learning, which then incorporated to the courses (Giere, 2001; Haefner et al., 2006; Moseley et al., 2004; Wan et al., 2013; Welsh, 2002; Wilke & Straits, 2005). In subject matter knowledge, a lot of biological science textbooks have been using scientific approach platform in holistic or partial topics (Campanile et al., 2015); thereby helping pre-service teachers to understand how scientists and researchers investigate theory and concepts into the modern applied biology. Instructional video, however, is rarely used for developing teaching skills in which associate with scientific approach activity.

Visualization of phenomena through several techniques, for instance demonstration, simulations, models, and video, aids development of understanding and concepts by attaching mental images or visual association (Escalada & Zollman, 1997). In particular, instructional video helps audience to describe teaching steps or phases in more realistic and interesting ways than do verbal description. Instructional video also improves quality of teaching and learning activity, builds interests and system thinking, and constructs concrete knowledge (Agommuoh & Nzewi, 2003). Video is also reported to potentially improve drive to learn, memorize, and conduct specified teaching skills (Gaudin & Chaliès, 2015).

Teaching skills are essential components to be built in pre-service teachers to conduct teaching and learning activities in general classroom. In line with this context, Slavin (2009) confirms that learning can be done by observing others which means that pre-service teachers observes the video about how scientific approach should be taught. This video can be viewed anytime and anywhere; making subject materials are not classroom-based demonstration anymore. Video helps pre-service teachers to learn what really happens in class, correct teaching practice, and reflect themselves in perceiving good teacher (Sherin & van Es, 2005; Wong et al., 2006). This indicates that video accelerates transition of pre-service teachers into in-service teachers and potentially develops teacher education program. This study was designed to address these research questions: (a) How would pre-service teachers

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perform their teaching skills involving scientific approach in cooperative learning in general biology classroom on response to the instructional video modeling? (b) What were pre-service teachers' views about the instructional video with scientific approach in cooperative learning that had been developed?

2 THEORETICAL FRAMEWORK

2.1 Instructional Video in Professional Development of Pre-service Teachers

There are two main purposes of viewing instructional video to pre-service teachers in terms which perspective professional development built on. The first purpose is building knowledge on 'how to interpret and reflect on classroom practices' which is designed from 'developmentalist' perspective, while the second purpose is to construct of 'what to do' in classroom which is designed from 'normative' perspective (Blomberg et al., 2013). In 'developmentalist' perspective, instructional video provides conception of 'good' and 'bad' teaching practice to challenge pre-service teachers in developing new personal understanding about teaching and learning (Wong et al., 2006). When pre-service teachers watch instructional video, they are not only simply a 'viewer' but also an observer who can reflect on their own beliefs and practices (Coffey, 2014; Newhouse, 2007; Masats & Dooly, 2011). Therefore, pre-service teachers can critically analyze and evaluate teaching actions of model teacher then consider how they will act to handle the similar condition. Moreover, based on constructivism theory, instructional video which is followed up by microteaching or teaching simulations program also helps pre-service teachers to improve their ability to notice and interpret specific classroom events or problematic situations that may occur; thereby supporting instructional video as connecting tool between authentic situation and their own existing knowledge (Brunvard, 2010). In other context, instructional video demonstrates best practice of teaching actions which build knowledge about 'what to do' in classroom (Yung et al., 2007). Here, instructional video is used as a source model of practice to apply and test set of new pedagogical strategies in their own classroom. Video modeling enables pre-service teachers and in-service teachers to prepare themselves to diversify their instruction in variety of classroom circumstances; thereby developing inquiry toward their own learning and teaching practice (Cochran-Smith, 2003).

2.3 Instructional Video and Scientific Approach in Science Education from Constructivist Perspective

Scientific approach teaching means that teacher integrate scientific methods and knowledge into subject-matter content so that learning activity is focused on the cognitive and evaluative process of science (Develaki, 2012). In other words, teachers facilitate students to generate, test, accept, or reject scientific statements and theories; therefore students construct their own science concepts. Scientific approach teaching is designed from constructivism theories in which explain that learning is not viewed as merely a transfer of knowledge from teachers to student, but as a process in which the learner constructs his own knowledge (Duit & Treagust, 1998). To support learning in scientific approach ways, pre-service teachers should visualize and reflect to exemplary cases about best teaching practice with scientific approach in content-specific situation–through the instructional video. As pre-service teachers watch instructional video, they identify relevant classroom events and decide to create their own instructions based on those interpretations (Sherin & van Es, 2005; Gaudin & Chauliès, 2015). Instructional video also fits into constructivist approach in pre-service teacher education, in which students and teachers are: (1) stimulated to communicate their conception about teaching and learning, (2) encouraged to explore their ideas to check their response to various problematic conditions, (3) presented alternative views beyond their own experiences, (4) supported in developing their ideas to accommodate complexity of science classrooms (Wong et al,. 2006).

3 MATERIALS AND METHODS

3.1 Participants

Participants of this study were eleven (11) pre-service teachers in the Department of Biology, The State University of Surabaya, Indonesia. These pre-service teachers understood pedagogical content knowledge (including essentials of cooperative learning and scientific methods) but they had no teaching experience in actual biology classroom.

3.2 Instructional Video

The purpose of this video was providing adequate modeling of good scientific approach teaching in biology classroom with cooperative learning model. The total duration of this video clips was 4 x 45 minutes (edited to 25 minutes). Two independent biology educators were asked to validate the video in order to ensure all of prerequisite teaching skills and scientific approach indicators had been completely covered. Lesson in the video taught by one of the authors on the subject

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of 'Acid Rain' to a class of 18-19 years old students (equal to secondary school, 10th grade). The aim of this lesson was to provide opportunity to students to construct their own knowledge about the effect of acid rain on living organisms and its surrounding ecosystems through scientific approach. The lesson demonstrated scientific approach in which integrated to cooperative learning and computer-assisted learning media (as teaching aids). Cooperative learning initial phases were followed up by laboratory session in which students conducted experiment using provided materials. Even though there was no detail procedure of the experiment, it could be inferred that the experiment investigated the influence of various level of acidity (pH) with pH range 2, 4, and 6 to green bean germination. Teacher made this activity in scientific method format and cooperative learning setting to make teacher keep interacting with the students. After all of the scientific approach principle completed (including observation activity, posing research question and hypotheses, collecting data and conducting experiment, analyzing data, and communicating data) in lab session, cooperative learning was continued to the cooperative learning final stages in which model teacher gave creative task (creating poster related to the preventive action of acid rain), announced best group as a recognition, and concluded the lesson. In addition, there was opening and concluding remarks in the present instructional video explaining cooperative learning syntaxes, principle of scientific approach, and constructivism-view why scientific approach was important in science education. Some specific scenes which depicted cooperative learning phases and scientific approach steps were also captioned.

3.3 Procedures

At the first session, all of the pre-service teachers viewed the same instructional video which demonstrated scientific approach in biology classroom using cooperative learning model as they completed a worksheet to analyze the video content. A supervisor explore their perceptions and understanding about how to teach any materials in biology classroom using scientific approach in cooperative learning model based on the worksheet video analysis. The supervisor replayed the video at specific scenes when pre-service teachers answered the worksheet incorrectly. These pre-service teachers were then asked to teach other topics based on the video modeling in the next two meetings. They were told that they only had 30 minutes to perform and the order of the performance was randomly assigned. In the first meeting, after six pre-service teachers (assigned as pre-service teacher number 1 to 6) performed, three observers evaluated each performance and shared advice to encourage others to teach better in the next meeting. Other five pre-service teachers (assigned as pre-service teacher number 7 to 11) performed in the second meeting. Three observers evaluated each performance again and delivered some suggestions. This evaluation covered their general teaching skills and scientific approach teaching in biology. At the end of the session, the pre-service teachers were given opportunity to fill in a questionnaire about the video modeling and whole learning process.

3.4 Data Collection and Analysis

Teaching skills were assessed using Likert-scaled observation sheet in scale one to four in which one (1) for descriptor 'poor', two (2) for 'fair', three (3) for 'good', and four (4) for 'very good'. These assessed teaching skills were including several criteria, i.e. opening lesson, subject material mastering, conducting teaching syntax of cooperative learning model, conducting scientific approach in lesson by teaching scientific skills, ability to use learning media, and closing the lesson. Data about pre-service teachers' view about video modeling and whole learning process was collected using questionnaire covering video display, content, and language. These aspects of the video were observed in yes or no (closed) statement. There was also open column in the questionnaire to give opportunity for the pre-service teachers to write their suggestion to improve video modeling quality in scientific approach teaching. Both of pre-service teachers' teaching skills and response data were analyzed descriptively.

4 RESULTS

4.1 Teaching Skills of Pre-service Teachers after Video-based Modeling

Generally, pre-service teachers showed good teaching skills in most of prerequisite criteria. After the video modeling, they conducted systematic and well-developed cooperative learning (Figure 1a). However, performance of pre-service teachers who assigned in the first meeting (assigned as pre-service teacher number 1 to 6) indicated initial inadequate skills in scientific approach teaching (Figure 1b). For instance, pre-service teacher number 4 organized students into several home groups to implement 'Environmental Pollution' jigsaw cooperative learning technique. The home groups were divided into new groups to become expert who discussed different type of pollution. This type of learning activity did not apply scientific approach since the students only discussed in their groups. It was clearly showed that pre-service teacher number 4 only focused on cooperative learning phases.

On the contrary, biology pre-service teachers demonstrated improved skills in teaching scientific

ISSN: 2502-4124

approach (pre-service teacher number 7 to 11) after their peer performance had been evaluated by the observers. This improvement was shown by pre-service teacher number 9 who delivered topic about 'Bryophytes' using wet mount of mosses as observation object. Her class was organized into three groups in which each group observed one type of mosses (consisted of liverworts, hornworts, and mosses). Scientific approach of pre-service teacher number 9 was fairly good. Other improved scientific approach teaching skills was indicated from the performance of pre-service teacher number 11. As a model teacher, pre-service teacher number 11 guided his students to make their own respirometer using vial bottle and straw. In his designed scientific approach learning activity, the students used crickets, eosin (or other non-colorless liquid), and potassium hydroxide (KOH) crystal to conduct experiment in Respiratory System. During the class, the students were guided to observe phenomena, conduct experiment, analyze data (associate), pose questions, and deliver their arguments. Thus, this pre-service teacher showed very well teaching skills to train scientific methods to the students.

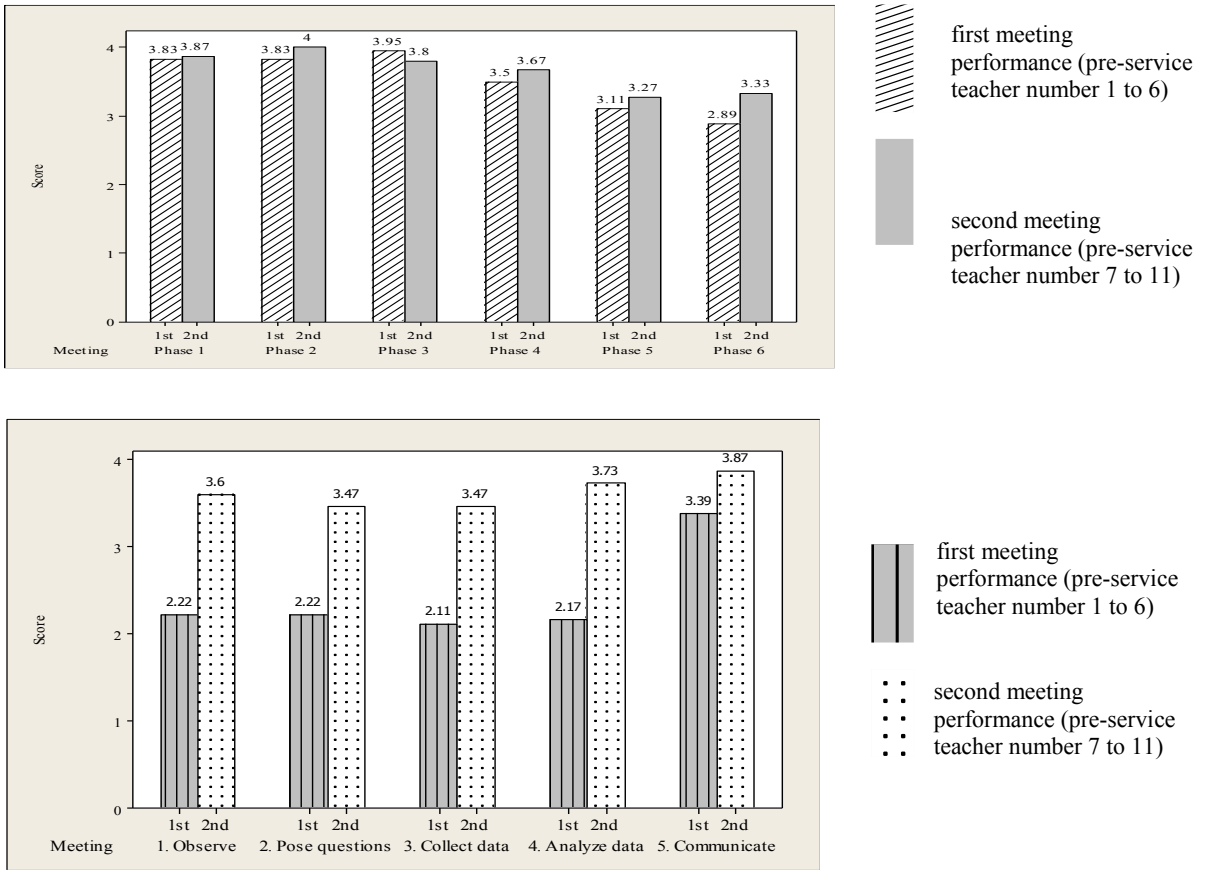

Figure 1. a) In response to the video modeling, pre-service teachers carried out cooperative learning properly. First meeting performance score was derived from average score of pre-service teacher number 1 to 6, while second meeting performance score was derived from average score of pre-service number 7 to 11. Each phase indicated cooperative learning syntaxes (phase 1: clarify goal and establish set; phase 2: present information; phase 3: organize students into groups; phase 4: assist teamwork and study; phase 5: test on the subject materials; phase 6: provide recognition); b) Pre-service teachers showed different trend of scientific approach teaching between first meeting and second meeting performance. Each bar represented average score of performance on each meeting. Paired bars showed components of scientific approach teaching.

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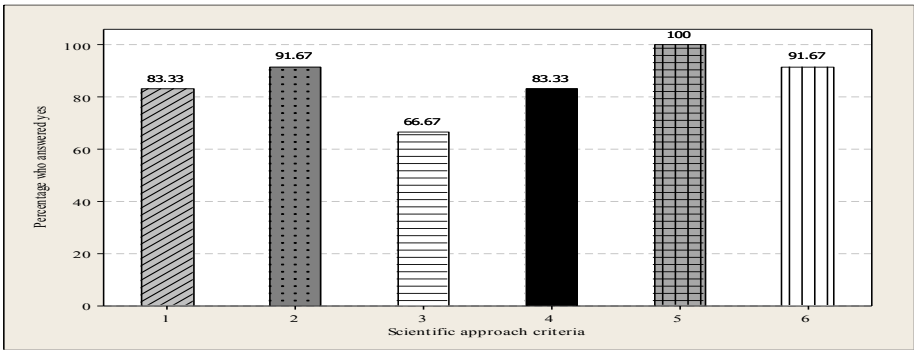

Figure 2. Pre-service teachers viewed that the instructional video could help them to identify and describe criteria of scientific approach teaching. Data were derived from percentage who answered yes in questionnaire. Each bar showed pre-service teachers' positive response regarding to the question whether the video help them to identify components of scientific approach teaching (step 1: observe phenomena; step 2: pose questions; step 3: collect data and conduct experiment; step 4: analyze data [associate]; step 5: communicate result and conclusion; step 6: create)

4.2 Pre-service Teachers' Views about the Instructional Video

Pre-service teachers showed positive response to the instructional video in which they had viewed. Pre-service teacher number 5 stated, "The video was really helpful. I got clear image about how to apply scientific approach in cooperative learning." However, poor response could be found in one of scientific approach criteria where current learning activity was not adequate enough to teach students how to collect data or conduct experiment (Figure 2). Although most of the content criteria of the video were well-constructed, pre-service teachers suggested that there should be distinctive text or caption in the video which indicated holistic elements of scientific approach. Pre-service teacher number 7 wrote, "The caption should be attached in the video like 'running text', so that the video-user could understand the learning activity in shorter time." Pre-service teacher number 9 also added that laboratory materials, instruments, and procedures should be showed in detail, while pre-service teacher number 1 suggested that background sounds should be more interesting.

5 DISCUSSION

Exemplary case teaching in instructional video has been reported applicable to prepare teachers to perform and practice teaching skills in situation-specific classroom that closely match with targeted-performance (Star & Strickland, 2008; Yung et al., 2007). Targeted-performance of the present study was teaching science with scientific approach, which means teachers incorporate essential components of scientific research through scientific methods and scientific thinking into their learning activities. This study demonstrates that instructional video, also called video modeling, has a role in developing scientific approach teaching to pre-service teachers, especially when the subject material was taught in cooperative learning setting. Similar to the result of this study, Sherin & van Es (2005) reported that instructional video-based professional development provides opportunities for teachers to develop good techniques or teaching strategies that are in line with learning objectives and science education reform efforts. Findings of this study is also consistent with Chinna & Dada (2013) implying that instructional video provides concrete learning through playback mechanism in which learners can replay, rewind, or fast-forward on specified scenes and motivates learners to take greater interest about what are they going to learn.

After watching the instructional video, as Wong et al (2006) has confirmed, good teaching skills performed by pre-service teachers can be generally categorized into: (a) relating the lesson to daily life and previous topic (during apperception), (b) explaining concepts clearly, (c) providing learning environment that enable the students to actively contribute in their activities and construct their own knowledge (in this case, by implementing scientific approach in cooperative learning), (d) incorporating scientific approach into learning activities, and (e) using appropriate learning media (teaching aids). Although all of these criteria has been explained in teacher education program in most of educational institution, instructional video 'translates' theory and research-based knowledge into 'real-world' action in classroom (Carter, 1993); thus, pre-service teachers perceive alternative classroom-based teaching strategies and critically evaluate their own ideas to teach particular topics. Furthermore, learning to teach from instructional video helps pre-service teachers to solve specific problem that may be noticed from actual classroom (Kisa, 2013; Lin,

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2005). Enriched classroom experiences drive pre-service teachers to possess multiple perspectives to handle problematic situation.

Evaluation of pre-service teachers' teaching skills revealed that developing scientific approach through the present learning activities was relatively low. However, there was a shift between first wave of performance and second wave performance in teaching scientific approach criteria. Most of pre-service teachers who performed in second meeting showed more adequate scientific approach teaching than pre-service teachers who performed in first meeting. This increment might be resulted from the evaluation and suggestion given by the observers during the last stage of first meeting. Other pre-service teachers might become aware and reflective on their future teaching strategies by repeating and reanalyzing scenes in the instructional video where scientific approach was strengthened. This result supports earlier study in which reports that learning from others, either through live action or video, stimulates teachers to reflect quality of their own teaching practice and promote reformulation of good and bad teaching concepts (Harrington, 1995; McCullagh, 2012; Wong et al., 2006). Reflective behavior and learning based on others experience broadens opportunity for pre-service teachers to explore and improve their teaching skills. In other words, viewing, imitating, and discussing instructional video can inspire pre-service teachers to anticipate problem or failure by reconstructing possible tasks, instructions, and strategies.

In addition to the positive response of the display, subject-matter content, and language, pre-service teachers also found that the instructional video was helpful in helping them to learn how to apply scientific approach in biology classroom together with cooperative learning. Their suggestion only related to technical aspects of the video such as captioned scenes, alternative background sounds, and how to stage the play into smoother one. However, there was relatively low response in pre-service teachers' showing that instructional video demonstrated learning activities which helped them to identify collecting data or conducting experiment as part of scientific approach. This result was consistent with the earlier indication that most of pre-service teachers in first meeting overcame difficulties to perform scientific approach teaching skills. At this point, the pre-service teachers might perform inadequate scientific approach in their teaching skills due to poor ability to notice one of the essential elements of scientific approach teaching in the instructional video, i.e. to collect data and conduct experiment. Therefore, like pre-service teachers suggest, it is important that all of important scenes which represent crucial teaching skills, especially when model teacher engages students in scientific approach-based activities, are optimized with keyword captioning. Reading text while listening and watching the instructional video stimulates more accessible learning environment, thereby making the transfer of learning from one channel to the other very easy (Bavaharji, 2014; Guillory, 1998). In the future study, keyword captions feature is expected to transmit content in instructional video effectively so that pre-service teachers can be highly immersed in the target-performance.

This study had some limitations in which small size of participants were involved and the results were only derived from single instructional video. We cannot generalize how teaching skills develops in other situations unless future study can build. Indeed, findings of this present study strengthen that using instructional video can deeply influence teaching skills in pre-service teachers when specific learning objective or target-performance is clearly modeled or strongly noticeable.

6 CONCLUSION AND IMPLICATION

Instructional video with scientific approach content in cooperative learning model has developed teaching skills and generated positive views in pre-service teachers. Video modeling together with worksheet of video-analysis to improve its effectiveness. Educational implication that can be implied from this study is to use the present instructional video, featured with keyword captioning, to train specific teaching skills of pre-service teachers. It would be also interesting for future researchers to develop another instructional video to train other essential teaching skills or other important targeted-performance in science education that contribute to pre-service teachers' professional development.

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