

# DEVELOPING EDUCATIONAL VIDEO TO IMPROVE THE USE OF SCIENTIFIC APPROACH IN COOPERATIVE LEARNING

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## Introduction

The Ministry of Education and Culture (MOEC) of Indonesia has strengthened the importance of scientific approach in education through the shift to the 2013 Curriculum as part of the education policy reforms in which aimed to increase the quality of education. To support scientific approach in the new curriculum, teachers have the responsibility to be proactive in planning the lesson and designing active learning experience which involves scientific method. Integration of scientific methods in science learning requires teachers to approach science teaching like a science in which practices and conclusions are based on the objective data rather than conventional lecture (Wieman, 2007; Wieman & Gilbert, 2015a; Wieman & Gilbert, 2015b). In other words, scientific approach to teaching sets out teachers to facilitate the students to generate, test, accept, or reject scientific statements and theories; therefore students actively construct their own knowledge. However, local teachers are not prepared to apply scientific approach in science education and are not able to train their students to use this approach. General aptitude of secondary teachers' subject knowledge in science was relatively low, with physics at 33 percent and biology at 48 percent, and followed by weak pedagogical practices (World Bank, 2010). Teachers also indicate the need of teaching using scientific approach but not knowing how to put their thoughts and ideas into practice (Leden, Hansson, Redfors, & Ideland, 2013).

As implied before, scientific approach engages the teacher and the students in learning activity which utilizes scientific method and science process skills. Scientific method is defined as inductive approach to arrive at theories or law by making testable hypotheses (Stinner, 2003). Scientific method also can be viewed as logical and orderly thinking involving gathering data, formulating, and testing hypotheses, and proposing theories which is then subjected to review and independent duplication to reduce the uncertainty



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**Abstract.** *This research developed educational video that showed a modeling of using scientific approach in cooperative learning. The purpose of this research was (1) to describe how pre-service teachers implement scientific approach in cooperative learning after carrying out a modeling session through this educational video, and (2) to describe the views of those pre-service teachers in response to the learning process. The study involved 11 pre-service teachers in Biology Education program, The State University of Surabaya, Indonesia. The pre-service teachers were then asked to conduct teaching simulations according to the video they had observed with different topics. The results showed that the educational video was effective in training pre-service teachers to implement scientific approach in cooperative learning. They also showed positive views towards the video. This research implies that modeling through educational video is able to promote scientific approach teaching to the pre-service teachers.*

**Key words:** *educational video, cooperative learning, scientific approach, teaching skills.*

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(McLelland, 2006). It cannot be separated from science process skills such as observing, classifying, measuring, using numbers, predicting, inferring, experimenting, interpreting data, and drawing conclusions (Kruea-In & Thongperm, 2014). Based on those perceptions, scientific approach generally consists of six key elements: (1) observing (to identify problem), (2) questioning (and posing hypotheses), (3) collecting data and information (conducting experiment), (4) analyzing data (associating), (5) concluding, (6) communicating result, and (7) creating (Ministry of Education and Culture of Indonesia, 2014). Observing, or the ability to use the five senses, is a fundamental skill to develop other systematic steps of scientific method. The simplest observation, called qualitative observation, only involves the sense to gather the data. Another type of observation which involves a number of quantities is called quantitative observation. This first step of observation aids the student to identify existing problems. Observation then leads to the question that needs to be answered, called questioning stage, that is why or how a phenomenon happens. Those scientific questions need to be answerable and lead to the formation of a hypothesis of the problem. This hypothesis formation depends on the careful research and literature review of the problem. To prove or disprove the hypothesis, there should be the process of experimentation in which collecting data and information can be conducted. Once the data and information have been gathered, it is time to analyze to ensure if there is no bias or inadequate effort which can lead to incorrect interpretation. In the analyzing stage, a student may apply quantitative or qualitative mathematical analysis (McLelland, 2006). Since scientific explanation should always be made in public, student should present or communicate the result or the discovery. In the creating stage, there should be scientific theory (or law) or suggestion created to solve the problem (Ministry of Education and Culture of Indonesia, 2014).

Scientific approach as an approach in teaching strategies should be incorporated into specific learning model which has systematic procedure (syntax) of teacher and students behaviors. Many scientific approach-oriented teaching models have been taught for teacher education both in pre-service phase and ongoing professional development through problem-based learning, inquiry-discovery learning, contextual learning, cooperative learning, or project-based learning, which then incorporated to the courses (Giere, 2001; Haefner, Friedrichsen, & Zembal-Saul, 2006; Moseley, Ramsey, & Ruff, 2004; Wan, Wong, & Zhan, 2013; Welsh, 2002; Wilke & Straits, 2005). At this point, MOEC of Indonesia also emphasizes the importance of cooperative learning model (teamwork-based learning model), that promoted social constructivism in learning activities, to be frequently applied within the implementation of the curriculum 2013 (Ministry of Education and Culture of Indonesia, 2012). Arends (2012) describes syntax of cooperative learning model which consists of six phases: (1) phase 1: clarify goals and establish set, in which teacher explains goals of the lesson and establishes learning set; (2) phase 2: present information, in which teacher presents information to the students either verbally or print/text; (3) phase 3: organize students into learning teams, in which teacher explains to the students how to form learning teams and helps teams to make efficient transition; (4) phase 4: assist teamwork and study, in which teacher helps learning teams as they do their work; (5) phase 5: test on the materials, in which teacher assesses students' knowledge of learning materials or groups present results of their work; (6) phase 6: provide recognition, in which teacher finds ways to recognize individual and group achievement. Each phase is build based on the social constructivism principle in which states that language and interactions with others take essential role in the construction of concepts. Hence, in cooperative learning model, the instruction should involve students to work together in small groups so that the students learn in collaboration with more capable peers rather than depend solely on the teacher as primary source of information (Prince & Felder, 2006). Zakaria and Iksan (2007) reported that cooperative learning model in mathematics and science education was effective to actively stimulate students to complete academic tasks due to its nature of collaborative shared-ideas.

Pedagogical skills are essential components in teacher preparation program and professional development to ensure teachers can conduct proper teaching and learning activities in the classroom. Even so, as schools and educational institutions in Indonesia were starting to implement the 2013 Curriculum, there are only limited numbers of pedagogy training focused on scientific approach teaching, particularly which is combined with collaborative learning, which is held by Teacher Training Institutes within universities (LPTK) in Postgraduate Course of Teacher Certification Program (PLPG). This indicates the need of educational video which can provide adequate modeling, also called video modeling, as well as opportunity of self-directed learning concerning scientific approach teaching. In line with this context, Slavin (2009) confirms that learning can be done by observing others which means that teachers can observe the video and learn how to teach in accordance to those observations. Whyte (2011) also indicates that video technology can help teachers to be more concerned with pedagogical principles and wide-



ranging teaching strategies. The use of video promises accessible modeling of instructional practices for teachers, making dissemination of information in the new curriculum more effective (Dieker et al., 2009).

Video modeling takes important role in teacher preparation and teacher professional development through an opportunity for teachers to collaboratively study their teaching practice without being physically present in the actual classroom (Borko, Koellner, Jacobs, & Seago, 2011). Video modeling has its underpinning in Bandura's Social Learning Theories which argues that human behavior is primarily learned by observing others and/or modeling others; thereby implying that modeling is a process by which a model (live, recorded, or imagined) demonstrates behavior that can be learned and/or imitated by the learners (Delano, 2007; LeBlanc et al., 2003). Video modeling integrates modeling and educational video as visual cues (Bellini & Akullian, 2007) then expects the teacher engages himself/herself in specific behavior which is planned to teach. 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, educational video helps audience to describe teaching steps or phases in more realistic and interesting ways than do verbal description. Educational 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). Regarding to the implementation with cooperative learning model, educational video fits into social constructivism 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, Yung, Cheng, Lam, & Hodson, 2006). Therefore, when pre-service teachers observe teaching through educational video, they learn how to develop and improve their teaching skills over time.

Based on constructivism theory, educational video which is followed up by microteaching or teaching simulations program also helps teachers to improve their ability to notice and interpret specific classroom events or problematic situations that may occur; thereby supporting educational video as connecting tool between authentic situation and their own existing knowledge (Brunvard, 2010). Here, educational video is used as a source model of practice to apply and test set of new pedagogical strategies in their own classroom. This 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). Furthermore, the educational video can be observed anytime and anywhere with the time and space needed (Sherin, Linsenmeier, & van Es, 2009); making subject materials are not classroom-based demonstration anymore. Video helps 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 also accelerates transition of pre-service teachers into in-service teachers and potentially develops teacher education program. In investigating the impact of the present educational video to the scientific approach teaching, this research was designed to address these research questions:

1. How would pre-service teachers apply scientific approach in cooperative learning model in response to the educational video?
2. What were pre-service teachers' views about the educational video?

## Methodology of Research

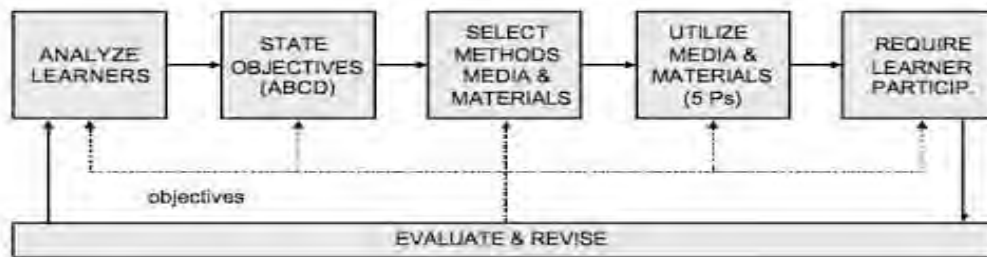
### *General Background of Research*

This research is limited to determine the impact of the developed video to the pre-service teacher's education in the Department of Biology of The State University of Surabaya involving scientific approach implementation integrated with cooperative learning. The video was developed to address teacher needs for modeling scientific approach in science classroom. Hence, there were only two parameters of teacher preparation observed in this research: teaching skills (representing pedagogical skills) and their views/responses toward the video (representing reflective behaviors). The research was conducted from January 2015 to October 2015 in the Department of Biology of The State University of Surabaya, East Java, Indonesia.



*Video Development Model*

This study uses the ASSURE video development model (Heinich, Molenda, Russell, & Smaldino, 2002). The ASSURE model was chosen since this model was simple, relatively easy to be applied in developing educational video, and modifiable. The components of the ASSURE model consist of: analyze learners, state objectives, select-modify-design media and materials, utilize media and materials, require learner participation, evaluate and revise (Figure 1). There is ABCD method to create the objectives: Audience (who learners are), Behavior (what performances are expected from the learners), Condition (the circumstance of behavior), and Degree (the degree of mastery of the learners). In the phase of utilizing media and materials, there is 5Ps method: Preview the materials, Prepare the materials, Prepare the environment, Prepare the learners, and Provide the learning experience. The educational video was developed along with the lesson plan and the script based on the ASSURE model.



**Figure 1: Adaptation of ASSURE model (Botturi, 2003).**

*Participants of Research*

Participants of this study were eleven (11) pre-service teachers in the Department of Biology, The State University of Surabaya, Indonesia, with the age range 19-20 years old. Although eleven pre-service biology teachers, but samples have represented all class, in terms of the ability of pre-service teachers understood pedagogical content knowledge (including essentials of cooperative learning, scientific method, and concept of biology). The pre-service teachers who spent two years of biology education program, but they had no teaching experience in actual classroom.

*Intervention*

At the first session, all of the pre-service teachers observed the educational video which demonstrated scientific approach in cooperative learning as they completed a worksheet to analyze the video content. Educational video was played twice. The worksheet consisted of several questions in which pre-service teachers were asked to discuss which scene depicted syntax of cooperative learning, which scientific approach steps appeared at each phase of cooperative learning model, what students' social skills demonstrated, and what strength and weakness of learning activity could be noticed. A supervisor explored their perceptions and understanding about how to teach any materials using scientific approach in cooperative learning model based on the worksheet 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 using scientific approach in one of the types of cooperative learning 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. These observers consisted of a lecturer and two independent pre-service teachers. Other five pre-service teachers (assigned as pre-service teacher number 7 to 11) performed in the second meeting. The observers evaluated each performance again and delivered some suggestions. This evaluation covered their teaching skills to apply scientific approach in cooperative learning model. 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.

#### *Data Collection and Analysis*

Teaching skills were assessed in the observation sheet using four point Likert scale rated from 1 to 4, where 1 = 'poor', scale 2 = 'fair', 3 = 'good', and 4 = 'very good'. These assessed teaching skills were including two criteria: (1) conducting cooperative learning model based on the syntax and (2) integrating scientific approach into the lesson or subject material. Full criteria of assessed teaching skills were listed in Table 1. Teaching skills score of each pre-service teacher were measured from average score from three observers. Data about pre-service teachers' view was collected using questionnaire covering questions whether the modeling through educational video could help them to identify and describe syntax of cooperative learning model and scientific approach steps. The questions were arranged in yes or no statement. These statements were listed in Table 2. In the end of the questionnaire, there was an open column saying "Which part of the video helped you the most to understand and apply scientific approach in the classroom and "Which part (s) of the video should be improved to understand and apply scientific approach in the classroom. The open columns give opportunity for the pre-service teachers to write their suggestion to improve video modeling quality in scientific approach teaching. Both of the pre-service teachers' teaching skills and response data were analyzed descriptively.

### **Results of Research**

#### *Educational Video*

Educational video that has been developed by the authors aims to provide adequate modeling of good scientific approach in science classroom with cooperative learning model. Design and development of the educational video was based on the ASSURE model. The total duration of these video clips was 4 x 45 minutes (edited to 25 minutes). The video was compatible to be played in DVD player, notebook, and mobile phone. By using any multimedia player, the video can be skipped into specific scenes by pressing the control buttons. Two independent experts 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 was taught by one of the authors on the subject of 'Acid Rain' to a class of 18-19 years old students (equal to secondary school, 10<sup>th</sup> 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, when the scientific approach principle was completed (including observation activity, posing research question and hypotheses, conducting experiment, analyzing data, and communicating data) in a lab session, cooperative learning was continued to the cooperative learning final stages in which model teacher gave a creative task (creating poster related to the preventive action of acid rain), announced best group as a recognition, and concluded the lesson. In addition, in the end of the video, there were also lecture notes explaining principle of scientific approach, and constructivism-view why scientific approach was important in education. Some specific scenes which depicted cooperative learning phases and scientific approach steps were also captioned.

#### *Teaching Skills of Pre-service Teachers to Apply Scientific Approach in Cooperative Learning after Modeling through Educational video*

Generally, pre-service teachers showed good teaching skills in most of the prerequisite criteria to conduct scientific approach teaching in cooperative learning model. After the educational video modeling, they conducted systematic and well-developed cooperative learning model (Table 1). However, performance of pre-service teach-





ers who assigned in the first meeting (assigned as pre-service teacher number 1 to 6) indicated initial inadequate skills in scientific approach teaching (Table 1). For instance, pre-service teacher number 4 organized students into several home groups to implement 'Environmental Pollution' jigsaw cooperative learning type. The home groups were divided into new groups to become experts who discussed different types of pollution. This type of learning activity did not apply to scientific approach since the students only discussed in their groups. It was clearly showed that pre-service teacher number 4 only focused on the syntax of cooperative learning model.

On the contrary, pre-service teachers demonstrated improved skills in teaching scientific 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 an 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 were 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 or associate, pose questions, and communicate the result. Thus, this pre-service teacher showed very good scientific approach teaching in cooperative learning model.

**Table 1. Teaching skills of pre-service teachers in response to the educational video with scientific approach a in cooperative learning.**

Performance aspect	Average score of performance	
	First meeting (pre-service number 1 to 6)	Second meeting (pre-service number 7 to 11)
<b>Ability to open the lesson</b>		
a. To motivate and deliver apperception (connection of subject content)	2.84	3.53
b. To clarify learning objective	3.39	3.67
<b>Mastering subject material</b>		
a. Topic was presented as it showed in lesson plan	3.39	3.93
b. Topic was clearly taught and explained	3.22	3.60
<b>Learning activities with cooperative learning model</b>		
a. Learning activities were appropriate with the phases of cooperative learning model:		
Phase 1: Clarify learning objectives and establish set/teaching resource	3.83	3.87
Phase 2: Present information	3.83	4.00
Phase 3: Organize students to learn	3.95	3.80
Phase 4: Assist teamwork and study	3.50	3.67
Phase 5: Evaluate	3.11	3.27
Phase 6: Provide reward (recognition)	2.89	2.33
b. Phases/syntaxes were conducted systematically	3.39	3.40
c. The subject material was appropriate to be taught with cooperative learning model	3.28	3.53
<b>Learning activities with scientific approach</b>		
a. Learning activities were focused on teaching scientific approach	2.83	3.73
b. Developing scientific approach, including:		
Observing	2.22	3.60
Pose question	2.22	3.47



Performance aspect	Average score of performance	
	First meeting (pre-service number 1 to 6)	Second meeting (pre-service number 7 to 11)
Collect data/conduct experiment	2.11	3.47
Analyze data (associate)	2.17	3.73
Communicate data	3.39	3.87
c. The applied scientific approach was appropriate to be used with current cooperative learning model	3.11	3.40
<b>Ability to end the lesson</b>		
a. To conclude the lesson	3.61	3.73
b. To inform the student about next learning topic in the next meeting	3.06	2.67
<b>Ability to utilize learning media (teaching aids)</b>		
a. The media was appropriate to be used in subject content	3.28	3.73
b. To perform adequate skills to utilize the learning media	3.28	3.73

*Pre-service Teachers' Views about the Modeling through Educational video*

Pre-service teachers showed positive response to the educational video which they had observed. Most of pre-service teachers stated that modeling through educational video helped them to identify and describe teacher behaviors at each phase of cooperative learning model (Table 2).

**Table 2. Pre-service teachers' view in response to the educational video with scientific approach in cooperative learning.**

Criteria	Percentage who answered 'yes' (%)
Content of the educational video was appropriate with concepts in subject content	100.00
Learning objectives in the educational video could be used as exemplary	100.00
Lab materials and instruments could be provided easily	91.67
<b>Learning activities could help to identify and describe phases of general cooperative learning</b>	
a. Learning activities could help to identify and describe phases of clarifying learning objective and establish set	91.67
b. Learning activities could help to identify and describe phase of presenting information	100.00
c. Learning activities could help to identify and describe phase of organizing student to learn	91.67
d. Learning activities could help to identify and describe phase of assisting teamwork and study	100.00
e. Learning activities could help to identify and describe phase of testing on subject material	83.33
f. Learning activities could help to identify and describe phase of providing reward (recognition)	91.67
<b>Learning activities could help to describe general scientific approach</b>	
a. Learning activities could help to identify and describe step of observing phenomena	83.33
b. Learning activities could help to identify and describe step of posing question	91.67
c. Learning activities could help to identify and describe step of conducting experiment	66.67
d. Learning activities could help to identify and describe step of analyzing data	83.33
e. Learning activities could help to identify and describe step of communicating data	100.00
f. Learning activities could help to identify and describe step of creating	91.67



They also found that video-analysis worksheet also helped them to figure out how to integrate scientific approach at each phase of cooperative learning. As one of them asserted:

*“Modeling through educational video was really helpful to figure out what really happened in the classroom between teacher and students during six phases of cooperative learning model. By identifying what scientific approach steps appeared at each phase using video-analysis worksheet, I also got clear comprehension about how to apply scientific approach in cooperative learning model.” (Pre-service teacher number 1)*

However, lowest response (66.67%) could be found in one of scientific approach steps where current learning activity in the educational video was not adequate enough to show the step of conducting experiment (Table 2). This was consistent with pre-service teacher comments as explained below.

*“The scientific approach teaching in the educational video was good, but it was hard for me to understand the details of the experiment which was conducted by the students. I did not know what happened in the students’ experiment so that they came up with the data shown in the table. I have to replay the video several times to catch the point how this scientific approach step (conduct experiment) could be applied on my own lesson. Perhaps, it would be better if the audience could see how they measure the growth of the plant in the different acidity.” (Pre-service teacher number 5)*

In line with this comment, as explained below, pre-service teacher also suggested that materials and methods, which were the essential parts of conducting experiment step, should be clearly explained to demonstrate what teacher did in fourth phase of cooperative learning model (assist teamwork and study) to strongly promote scientific approach to the students.

*“The materials and methods of the experiment were not shown directly. I barely notice the scene which the teachers assisted the learning teams to conduct the experiment with the green beans and different pH. I thought the educational video should shoot Phase 4 with the whole set of materials and lab instruments in which teacher helped the teams to measure the acidity using universal indicator or pH meter and then measure the length of germination.” (Pre-service teacher number 3)*

Besides, pre-service teachers also suggested interesting feature that there should be distinctive text or caption in the video which indicated holistic elements of scientific approach as explained below.

*“The caption should be attached in the video like ‘running text’, so that the video-user could understand the learning activity in shorter time. It would be easier to notice each phase of cooperative learning model with its integrated scientific approach steps during the scene as we observed the teacher’s behavior.” (Pre-service teacher number 11)*

## Discussion

The findings showed that educational video that had been developed was successfully able to improve scientific approach teaching to the tested pre-service teachers. Systematic video development using ASSURE model led to an educational video which could perform scientific approach modeling in cooperative learning model. Holistically, although this study was only preliminary evaluation to the present educational video, it could be inferred that the current educational video considerably promoted targeted-performance to the pre-service teachers. Exemplary case teaching in educational 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, Wong, Cheng, Hui, & Hodson, 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 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 educational video-based professional develop-





ment provides opportunities for teachers to develop good techniques or teaching strategies that are in line with learning objectives and education reform efforts. Findings of this study are also consistent with Chinna & Dada (2013) implying that educational 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 educational 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 enables 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 have been explained in teacher education program in most of educational institution, modeling through educational video elaborates analysis of practice (Star & Strickland, 2008); 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 educational video helps pre-service teachers to solve specific problems that may be noticed from actual classroom (Lin, 2005). Enriched classroom experiences drive pre-service teachers to possess multiple perspectives to handle problematic situation. Interestingly, this study also underlines the importance of stimulating pre-service teachers to describe and analyze teacher and students behavior at each step of scientific approach activities in the classroom to make them easily apply the same strategies in their own lesson. Specifically, in this study, pre-service teachers were asked to do video-analysis worksheet, to monitor their understanding about teaching using scientific approach in cooperative learning. Alsawaie and Alghazo (2010) also indicated that video lesson analysis improved pre-service teachers' ability to pay attention to noteworthy events during classroom interactions. Higher scores on the video analysis task were associated with better instructional quality (Kersting, Givvin, Thompson, Santagata, & Stigler, 2012). In addition to these, Fadde and Sullivan (2013) reported that pre-service teachers who wrote their own observations when observing video clips showed better classroom awareness.

Early evaluation of pre-service teachers' teaching skills revealed that developing scientific approach teaching through the present learning activities was relatively low (2.11 to 2.22 out of 4), except at the step of communicating data (Table 1). However, there was a shift between first meeting of performance and second meeting performance in teaching scientific approach. Most of the pre-service teachers who performed in the second meeting showed more adequate scientific approach teaching (3.47 to 3.87 out of 4) than pre-service teachers who performed in the first meeting. This increment might be resulted from the evaluation and suggestion given by the observers during the last stage of the first meeting. As it is seen in the their views or perceptions about the modeling (as commented by pre-service teacher number 5 and 7), other pre-service teachers become aware and reflective on their future teaching strategies by repeating and reanalyzing scenes in the educational 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 (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 educational video can inspire pre-service teachers to anticipate problem or failure by reconstructing possible tasks, instructions, and strategies. Similar study from Zhang, Zhou, Briggs, and Nunamaker (2006) also states that educational video can significantly increase learning performance upon the way it is used. The value of video modeling to improve scientific approach teaching may depend on many factors, including the facilitators (supervisors) and the pre-service teachers' reflective behaviors concerning the degree of their targeted performance. Facilitators play important role by supporting teachers in using video in meaningful ways for teacher learning and maintaining a focus on the video (van Es, Tunney, Goldsmith, & Seago, 2014).

In addition to the positive response concerning how to conduct cooperative learning model, pre-service teachers also found that the educational video was helpful in helping them to learn how to apply scientific approach in science teaching together with cooperative learning. This was in line with studies from Akerson, Abd-El-Khalick, and Lederman (2000) and Akerson, Morrison, and McDuffie (2006) that indicated positive views of scientific approach in science teaching perceived by the teachers who received reflective course in



nature of science. Kucuk (2008) also reported the same result that reflective approach, in this case through educational video which followed by teaching practice, improved pre-service teachers' views about implementation of scientific approach in science teaching. However, there was relatively low response in pre-service teachers' showing that educational video demonstrated learning activities which helped them to conduct experiment as part of scientific approach. This result was consistent with the earlier indication that most of pre-service teachers in the first meeting overcame difficulties to perform scientific approach teaching. 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 educational video, i.e. to conduct experiment. Therefore, like pre-service teacher number 11 suggests, 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 the text while listening and watching the educational video stimulates more accessible learning environment, thereby making the transfer of learning from one channel to the other is very easy (Bavaharji, Alavi, & Letchumanan, 2014). In the future study, keyword captions feature is expected to transmit content in educational video effectively so that pre-service teachers can be highly immersed in the target-performance. Video modeling should also emphasize materials and methods used in the experiment to clearly show how the conclusion or science concept made based on the objective data. As Mondada (2006) argues, choice of perspectives and spots to record actions, such as where to place the camera or how to set the angles and lenses, determines expectable patterns of events that can be observed by the learners or viewers. Two different sets of camera in video-recording may offer different relevant details of images. Herewith, video-recording details of materials and procedures of experiment play a key role in the successful modeling of scientific approach teaching. Prior to this recording, therefore, it is really important to develop the storyboard carefully, consisting of key information such as location of the cameras and positioning of the teachers and students in the shot (Dieker et al., 2009).

The findings of this study raise a number of recommendations in the utilization of educational video or video modeling in which aimed to improve scientific approach teaching. First, the implementation of educational video should be accompanied with video analysis task. Video analysis task helps the pre-service teachers to observe noteworthy classroom interactions, making the imitation process of scientific approach teaching in cooperative learning model can be monitored at each stage. Second, facilitators (supervisors) contribute significant role to adjust the focus of targeted-performance as it help teachers to reflect their teaching practice towards their earlier experience or other's experience. Facilitators foster reflective behaviors resulting from one's performance to another performance, stimulating pre-service teachers to enhance their scientific approach teaching capability and avoiding the bad teaching practice. Third, keyword captioning feature and meticulous storyboard development will transmit essential principle of targeted-performance in complete picture to the pre-service teachers. Keyword captioning during the video clips along with relevant perspectives delivers noticeable information concerning each detail of targeted-performance. The use of storyboards which depict how to stage each scene helps to ensure essential scientific approach component in cooperative learning if it is satisfactorily captured. This study also notices that the educational video itself is not the only factor that determines the increment of scientific approach teaching skills. For instance, in this study, the facilitators apparently showed important contributions in building pre-service teachers' reflection upon their pedagogical practices. Future study should implement modeling through educational video to a larger sample in different subject content to verify how teaching skills may develop in other situations or in actual science classroom. Indeed, findings of this present study strengthen that using educational video can deeply influence teaching skills in pre-service teachers when specific learning objective or target-performance is clearly modeled or strongly noticeable.

## Conclusions

The results show that the above mentioned educational video can improve the pre-service teachers' teaching skills of using scientific approach in cooperative learning. It also generates positive views about its implementation. Most of pre-service teacher stated that educational video helped them to identify and describe teacher behavior at each scientific approach phase in cooperative learning.



Based on the conclusion above, it is suggested that educational video should be completed with video-analysis worksheet to improve its effectiveness. Moreover, due to this study limitation related to the small number of participants, it is suggested that further research use a bigger number of participants.

The educational implication gained from this study is the other researchers who used to implement educational video should complete it with keyword captioning in teaching. It would also be interesting for further research to develop similar educational video but it should be improved with other essential teaching skills that contribute to teacher preparation program and ongoing professional development.

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