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Engaging pre-service teachers to teach science contextually with scientific approach instructional video

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Abstract. Contextual teaching and learning (CTL) present new concepts in real experiences and situations, where students can find out the meaningful relationship between abstract ideas and practical applications. Implementation of CTL using scientific approach fosters teachers to find constructive ways of delivering and organizing science contents in science classroom settings. An instructional video for modelling by using a scientific approach in CTL was then developed. Questionnaires with open-ended questions were used to, asking whether modelling through instructional video could help them to teach science contextually with a scientific approach or not. Data for pre-service teachers' views were analyzed descriptively. The aims of this research are to engage pre-service teachers in learning how to teach CTL and to show how their responses to learning and how to teach CTL using the video. The study showed that ten pre-service teachers in science department were involved, all observed through videos that demonstrated a combined material of CTL and scientific approach and completed worksheets to analyze the video contents. The results show that pre-service teachers could learn to teach contextual teaching and make use of scientific approach in science classroom settings with the help of model in the video.

1. Introduction

Contextual teaching presents new concepts in real experiences and situations, where students can discover the meaningful relationship between abstract ideas and practical applications in the context of their usage. Scientific approach makes the way of the science taught was found through objective data rather than conventional lecture [1,2]. Hence, implementing contextual teaching together with scientific approach will foster teachers to find constructive ways of delivering and organizing science content. In this paper, we developed an instructional video to become the model which is an adequate example of contextual teaching integrated with a scientific approach. We proposed that the use of this



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instructional video is capable to engage pre-service teachers to learn how to teach science contextually as well as corroborate scientific approach along with learning material taught.

Contextual teaching is supported by cognitive psychology theory, stating that “cognition is contextually dependent and must be described in that context before the material is understood at all.” There are two complementary usages of word context [3]. First, context used to denote domain specificity which relates to the disciplinary knowledge that the learners wish to acquire, while the later used to denote signal task that contains true-to-life problems for the learners in the process of acquiring or applying the knowledge [4]. Contextual learning occurs when students process new information or knowledge in a way that it makes sense to them in their own frames or reference (their own memory, experience, and response) [5]. There are seven components of contextual teaching and learning: a) constructivism; b) modelling; c) questioning; d) learning community; e) inquiry; f) authentic assessment; and g) reflection. In constructivism, students build their own knowledge by testing ideas based on prior knowledge or experience, applying these ideas to a new situation, and integrating the new knowledge gained with pre-existing knowledge [6]. As a result, students are actively engaged in hands-on activities and encouraged to gain knowledge through exploration [7]. The inquiry has its origins in the practices of scientific inquiry, emphasizing students to pose questions, to gather and analyze data, and to construct problem-solving or conclusion based on evidence [6]. Modeling in contextual teaching can be performed by the teacher or even involving students to give example to other students relating to the material taught. Questioning aims to stimulate and foster students’ thinking skills; this can be conducted by encouraging students to ask questions and the questions must be answered by other students or simply asking the students about what they have not understood or they wanted to know. Learning community refers to increase the use of group work and to help low-achieving students to learn with the assistance of high-achieving students. Authentic assessment utilized tasks that are the real examples of extended criteria performances of actual learning goals [8]. This kind of assessment also used rubrics and other criteria checklists as standards to improve learning and teaching, providing multiple opportunities for students to learn and practice the desired outcomes as well as receiving feedback and reflection. The last component, reflection engages students and teachers to review, think, and evaluate their learning process and what they have just learned.

In science, contextual teaching can be conducted by illuminating theoretical practices and providing an opportunity for hands-on investigation. The contextual hands-on investigation should increase the degree of openness and confront students using raw phenomena with opened problems, answers, and methods [9]. Contextualized science should be taught like scientist’ science or open-ended research in which the task is simplified and students’ motivation and engagement are enhanced by the perception that their practical work is authentic. Essentially, contextual teaching in science should also present concepts in familiar contexts and tangible examples or experiences compared to abstract conceptual models [10].

Bandura’s Social Learning Theories used as the theoretical framework for using instructional video in pre-service teacher education. Instructional video integrates modelling and video as visual cues in the expectation that the teachers will engage themselves in specific behaviour which is planned to teach [11]. Video with classroom instruction also builds bridges between learning theory and teaching practice in the actual classroom. It helps the students to raise insightful ideas relating to good teaching practice [12]. The use of video in teacher education is likely to increase the ability to plan a lesson and observe authentic classroom sequences [13].

In investigating how the instructional video affects learning process of pre-service teachers in applying contextual teaching along with scientific approach, this study addressed these research questions:

- Could the instructional video engage pre-service teachers in learning how to teach CTL with the scientific approach?
- What were pre-service teachers' responses on how to teach CTL using instructional video?

2. Research methods

2.1. Participants

Participants of this study were ten (10) pre-service teachers in Department of Natural Sciences, Surabaya State University, Indonesia. These pre-service teachers had been taught about the general overview of contextual teaching and learning as well as scientific approach and had no experience to teach in the actual classroom. All participants' names used in this study were pseudonyms.

2.2. Classroom procedure

All participants observed the instructional video which demonstrated contextual teaching and learning combined with the scientific approach as they completed a worksheet to analyze the video content. During this activity, they were supervised by a lecturer (one of the authors). The worksheet asked pre-service teachers replayed the video on their own to discuss: (1) which scene showed characteristics of contextual teaching and learning, (2) which scientific approach steps appeared at each phase of it, (3) what social skills could be gained from learning activities and (4) what strengths and weaknesses of learning activity could be noticed.

2.3. Instructional video

Instructional video used in this study was developed to provide adequate modelling of contextual teaching and learning in the science classroom with a scientific approach. This instructional video was validated by three independent educational experts. A lesson in the video was taught by one of the authors on the subject of 'The Motion of Human Body' to a class of 13-14 years old students. The purpose of this lesson was to provide an opportunity to students to construct their own knowledge how simple machines work through contextual teaching and learning activities combined with a scientific approach. The instructional video was also featured with captions, showing which characteristic of contextual teaching was demonstrated at specific scenes and what element of scientific approach inserted along.

2.4. Data collection and analysis

We monitored how pre-service teachers planned their learning activities through their designed lesson plan and observed their teaching skills through microteaching using criteria and rubrics performances. Observers assessed pre-service teachers' teaching skills using a Likert scale: 1 = 'poor', scale 2 = 'fair', 3 = 'good', and 4 = 'advanced'. These teaching skills involve two criteria: (1) performing contextual teaching and learning and (2) integrating scientific approach into science topics. Score 3.0 or above indicates adequate teaching skills. Data for participants' responses were collected using questionnaires with open-ended questions, asking whether modelling through instructional video could help them to teach science contextually with a scientific approach. Data for pre-service teachers' views were analyzed descriptively.

3. Results and discussions

3.1. Could pre-service teachers teach contextually and scientifically with instructional video?

According to their average score (Table 1), pre-service teachers showed adequate skills in teaching science contextually and incorporated the learning activities to the scientific approach. We examined

their teaching performance based on essential characteristics of contextual teaching learning and scientific approach elements.

Table 1. Pre-service teachers' performance in conducting contextual teaching with scientific approach

Performance aspect	Average score
Teaching science contextually	
a. Learning activities were relevant with seven components of contextual teaching and learning:	3.4
b. Characteristics of contextual teaching and learning were conducted systematically	3.7
c. The material was relevant to be taught with contextual teaching and learning	3.5
Learning activities with scientific approach	
a. Learning activities were focused on teaching scientific approach	3.8
b. Developing scientific approach	3.7
c. The applied scientific approach was relevant to be used with contextual teaching and learning	3.6

In their consistency of well-contextualized teaching, pre-service science teacher number 5, 8, 7, 9 and number 6 correctly identified all of model teacher's behaviours representing characteristics of contextual teaching and scientific approach elements. As pre-service science teacher number 7 asserted:

"Model teacher started *constructivism* approach as she played a show of badminton match. Later, as part of *modelling*, she asked several students to demonstrate how a badminton player served. In this situation, students *observed* both of badminton show and live-show of serving and make them interested and *questioned* how badminton techniques related to the human locomotion, model teacher constructed the knowledge further by asking them to *make groups* (learning community) and *investigated* the problem (inquiry) through an open-ended worksheet and portfolios. After that, students *collected data* and *made the association* to their prior knowledge about the motion. The students then being asked to *communicate* their investigation in portfolios that became part of the assessment. Lastly, model teacher *reflected* on learning process with her students, reviewing how motion system could work in the human body and how this principle can be useful to score a serving point."

Interestingly, although some of the pre-service teachers, such as pre-service science teacher number 4, 10, 3 and number 2 misidentified inquiry and authentic assessment during video-analysis, our preceding description about their microteaching indicated that they showed adequate skills within those criteria. For instance, this misidentification could be seen as pre-service science teacher number 2 asserted, "Inquiry can be seen as students work on their worksheet. Authentic assessment occurs as students generate research questions, invent hypotheses, and perform investigations." In her microteaching, although pre-service science teacher number 2 was still poor at contextualizing the material, she conducted an inquiry and authentic assessment well. Pre-service science teacher number

4 even had a good idea of authentic assessment by involving her students to do peer-assessment toward their friends' presentation. The evaluation and reflection conducted by the lecturer upon the video analysis provided great help in noticing correct scenes.

3.2. *What did they perceive?*

All pre-service teachers perceived that the instructional video helped them to identify and how to teach science contextually with the use of the scientific approach (Table 2), including each characteristics representing contextual teaching and stages of the scientific approach.

Table 2. Pre-service teachers' views about learning with instructional video

Response	Response was given (%)
The video helps me to:	
Identify seven essential characteristics of contextual teaching and learning	100
Learn how to teach contextual teaching and learning	100
Learn how to teach scientific approach	100
The video was easy to understand	90

In line with Table 2, pre-service science teacher number 4 also gave positive comments, "I love the idea of learning to teach contextually with the [instructional] video. It encourages me to apply this approach in my future classroom." pre-service science teacher number 7 added, "[This] video is very useful reference for teaching practice." pre-service science teacher number 1 suggested,

"It is very convenient to learn with the video because the caption helps me to identify specific scenes which are related to characteristics of contextual teaching. However, it would be nice if the video can show a clearer stage of authentic assessment."

In general, this study showed that pre-service teachers could learn how to teach science contextually along with a scientific approach to the instructional video that we had developed. They noticed the scenes in the instructional video as visual cues, that attaching mental images in their thinking system; this could help pre-service teachers to construct more concrete knowledge and build greater interests in learning than verbal description does [11]. Taking notes (on the worksheet) and discussing model teachers' teaching behaviour, as performed by pre-service teachers in this present study, also helps them to increase classroom awareness. Previous work reported that video lesson analysis improves pre-service teachers' ability to pay attention to noteworthy events of classroom interactions [14]. Higher scores on the video analysis task are also associated with better instructional quality [15]. Furthermore, pre-service teachers who write their own observations at video clips show better classroom awareness [16]. A recent study also indicated that peer dialogue during the use of video potentially heightens teacher's awareness about their own teaching practice [17].

The tendency of learning to teach contextually using instructional video was also affected by pre-service teachers' reflective behaviours. The video made them evaluate that model teacher should be more open to the students about authentic assessment and interact with proper classroom language. Teachers often evaluate model teacher's pedagogical approaches as viewed in the video, offering advice on what the teacher should have done differently [12]. For instance, pre-service teachers decided to apply peer-assessment during group presentation to strengthen authentic assessment and spoke grammatically corrected in Bahasa Indonesia.

We also find that these reflective behaviours may depend on the interaction between the facilitator and the pre-service teachers during the learning process. At the early microteaching session, when pre-service science teacher number 1 and pre-service science teacher number 2 taught with the poor contextual framework, the lecturer evaluated their techniques and strategies for teaching and asked the pre-service teachers to focus on how their material would be learned within real-world situations which were familiar to students. In the preceding description, we noticed that they used recent news on newspaper to contextualize their material and left the problem, method, and answers open within practical work to emphasize constructivism as well as scientific approach. Previous research also revealed that facilitator supports video-mediated teacher education by focusing issues to the learning goal, managing the noteworthy scene to be viewed and rewind, and explored understanding and interpretation upon viewing the video [12].

4. Conclusion

We concluded that pre-service teachers could learn to teach contextual teaching and to use the scientific approach in a science classroom with the help of model in the instructional video which has been developed. Pre-service teachers' skills in teaching showed that they are reflective about their own teaching practice and believed upon viewing the video and receiving an evaluation from the facilitator. However, the pre-service teachers may be weak at some criteria, such as utilizing teaching aids incorrectly, selecting irrelevant teaching aids, and associating one teaching ideas which mismatched with the real world situation. It would be unrealistic to expect that pre-service teachers could teach contextually with no failure or weakness after a session of learning with the video. Long periods of training are needed to sustain the way they learn to teach and improve their pedagogical content knowledge. We consider that facilitator takes important parts to help pre-service teachers focus on essential characteristics of targeted-performance and manage peer-dialogue during video analyses.

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